

US EPA ARCHIVE DOCUMENT

AP

OPP #

October 30, 1998

**MEMORANDUM:**

**SUBJECT:** ACEPHATE. HED Risk Assessment and Disciplinary Chapters for the Reregistration Eligibility Decision (RED ) Document. List A Reregistration Case 0042. Chemical No. 103301. DP Barcode: D245803..

**FROM:** Felecia A. Fort, Chemist  
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**BACKGROUND**

Attached is HED's risk assessment, disciplinary science chapters and other supporting documents for the Acephate Reregistration Eligibility Decision (RED) as follows:

HED Risk Assessment	Felecia Fort
Hazard Identification Assessment Review Committee Document	George Ghali
Toxicology Chapter of the HED RED	Krystna Locke
Product and Residue Chemistry Chapters for the HED RED	Felecia Fort
Occupational and Residential Exposure Assessment	Kathryn Boyle
Dietary Exposure and Risk Estimates for Reregistration	Felecia Fort

**EXECUTIVE SUMMARY**

Acephate (O,S-dimethyl acetylphosphoramidothioate) is a systemic/contact organophosphate insecticide used for control of insects on a variety of field, fruit, and vegetable crops. Products containing acephate are intended for both occupational and residential uses. The residential uses of acephate include both indoor and outdoor applications.

This is a highly unusual assessment because acephate metabolizes to methamidophos, which is also a registered pesticide. This assessment will take into account risk from acephate and methamidophos from application of acephate. For dietary purposes, acephate and methamidophos from acephate application only were each assessed separately. In addition, an aggregate dietary risk assessment was conducted based on exposure from methamidophos from the application of acephate and methamidophos exposure from the application of methamidophos. The occupational and residential risk assessment was conducted using acephate when assessing exposure to mixer/loaders (handlers). However, since acephate degrades to methamidophos, post application (reentry intervals) assessments were conducted for both acephate and methamidophos.

Toxicity endpoints were selected based on cholinesterase (ChE) inhibition of the red blood cell, brain and plasma. Based on the developmental and reproductive toxicity studies reviewed, there does not appear to be any special sensitivity for pre- or post-natal effects. Therefore the FQPA Safety Committee determined that for acephate the 10-fold safety factor for the protection of infants and children be removed.

## **RISK CHARACTERIZATION**

### **Dietary Risk - Food**

#### **Acephate**

A **chronic** dietary risk assessment was conducted using anticipated residues and BEAD percent crop treated information. The chronic risk is reported as a percentage of the reference dose (RfD) where %RfD greater than 100 is considered to be above HED's level of concern. The chronic analysis indicates that exposure for the U.S. population accounts for 11% of the RfD. For children (1 - 6 years), the subgroup with the highest exposure, 24% of the RfD is utilized. For non-nursing infants, 23% of the RfD is consumed. Therefore, chronic dietary risk considering consumption of acephate from food sources is below the level of concern.

To estimate **acute** dietary exposure, a high end exposure analysis assuming tolerance level residues and 100% of the crop treated was conducted. Acute dietary exposure estimates at the 95th percentile of exposure for the overall U.S. population, children (1 to 6 years), and non-nursing infants resulted in % aRfDs of 347%, 512%, and 394%, respectively. The results of the acute exposure analysis indicate there are concerns for all population subgroups for which an analysis was conducted. A probabilistic assessment of acute dietary exposure to acephate could further refine acute dietary risk but was not conducted by HED. It is recommended that the registrant(s) conduct a Monte Carlo analysis to address acute dietary concerns.

Acephate is classified as a Group C, possible human carcinogen. It was concluded that the RfD approach would be used in calculating carcinogenic exposure. The chronic dietary risk assessment with the RfD approach was conducted, and the results showed that the exposure from the uses recommended through reregistration does not exceed HED's level of concern for carcinogenic effects.

### **Methamidophos (Acephate application only)**

A **chronic** dietary risk assessment was conducted using anticipated residues and BEAD percent crop treated information. The chronic analysis indicates that exposure for the U.S. population accounts for 36% of the RfD. For children (1 - 6 years), the subgroup with the highest exposure, 45% of the RfD is utilized. For non-nursing infants, 33% of the RfD is consumed. Therefore, chronic dietary risk considering consumption of methamidophos from food sources is not of concern.

To estimate **acute** dietary exposure, a high end exposure analysis assuming tolerance level residues and 100% of the crop treated was conducted. Acute dietary exposure estimates at the 95th percentile of exposure for the overall U.S. population, children (1 to 6 years), and non-nursing infants resulted in % aRfDs of 300%, 482%, and 778%, respectively. The results of the acute exposure analysis indicate there are concerns for all population subgroups for which an analysis was conducted. A probabilistic assessment of acute dietary exposure to methamidophos could further refine acute dietary risk but was not conducted by HED.

Methamidophos is classified as a "not likely" human carcinogen. Therefore a carcinogenic risk assessment for methamidophos is not require.

### **Occupational Risks**

MOEs were calculated for mixer/loader (handler) applications for acephate. The calculations of short- and intermediate- term dermal risk indicate that even with all possible mitigation measures MOEs of greater than 100, the margin of exposure above which HED has no concern., could not be obtained for nine out of 25 scenarios. However, several issues must be considered when interpreting these results. These include (i) several handler assessments were completed using "low quality" PHED data due to the lack of a more acceptable data set; (ii) several generic protection factors were used to calculate handler exposures (the protection factors used are generally accepted by HED); and (iii)

factors used to calculate daily exposures to handlers are based on the best professional judgement of HED staff. The post-application occupational risk assessment indicate that post-application risks for both acephate and its degradation product methamidophos are of concern.

### **Non-occupational (residential) Risks**

HED has determined that residential and other non-occupational handlers are likely to be exposed as a result of applications of acephate at residential sites to control pests on turf, ornamentals, or fruit and vegetables. Post-application exposure to adults as well as children can occur as a result of applications to the same sites. The calculations of risks to handlers indicate that MOEs are less than 100 for four scenarios as follows: (i) mixing/loading/applying using low pressure handwand at all application rates; (ii) mixing/loading/applying using hose-end sprayer at all application rates; (iii) applying SP by hand/hand tool/shaker can; and (iv) applying by aerosol can. However, several issues must be considered when interpreting these results. These include (i) several handler assessments were completed using "low quality" PHED data due to the lack of a more acceptable data set; (ii) several generic protection factors were used to back-calculate hand exposures from gloved data (the protection factors used are generally accepted by HED); and (iii) factors used to calculate daily exposures to handlers are based on the best professional judgement of HED staff. For residential post-application exposure, HED has determined the risk associated with residents entering treated lawns. It should be noted that post-application exposures may also occur from contact (i.e., pruning, cutting, weeding) with treated ornamentals, flowers, trees, and shrubs. However, these exposures are expected to be lower than for turf exposures due to the lower contact rates, and were not evaluated. The results indicate that HED has concerns for residential exposure to acephate and its degradation product methamidophos when considering dermal exposure to turf and hand-to-mouth exposure from turf applications.

### **Aggregate Exposure/Risk (risks from methamidophos resulting from both acephate and methamidophos applications):**

For **chronic aggregate risk (food)**, chronic exposures to methamidophos from application of acephate and application of methamidophos were combined and compared to the methamidophos reference dose. This assessment was conducted using anticipated residues and BEAD % crop treated information. Results of the chronic exposure analysis show that 65% and 50% of the RfD is consumed for the U.S. population and non-nursing infants,

respectively. The most significantly exposed subpopulation, children (1 to 6 years ) occupied 106% of the RfD. The results indicate that for the children, HED's level of concern is exceeded.

An **acute aggregate risk (food)** which considers methamidophos from application of acephate and methamidophos was not conducted since HED already has concerns for methamidophos from application of acephate alone. It is recommended that the registrant (s) conduct a Monte Carlo analysis to address acute dietary concerns.

No **aggregate cancer risk** assessment is required because methamidophos is not a carcinogen.

An **aggregate exposure assessment which quantifies risk from food, water, and residential sources** was not conducted because HED has concern regarding risks from residential exposure alone.

### **Additional Data Requirements**

Additional data requirements have been identified in the science chapters. These requirements are indicated below.

#### **Toxicology**

A rat metabolism study (85-1) is required. The existing metabolism studies (MRIDs 00014994 and 00014219) provide information on the metabolism of Acephate by the rat, but are 25 years old and do not satisfy (even partially) the guideline requirements for the metabolism studies.

#### **Product Chemistry**

Most pertinent data requirements are satisfied for the Micro-Flo and Valent 97% Ts, except for the following physical chemical properties: OPPTS 830.6304, 830.6314, 830.6316, 830.6317, 830.6320, 830.7050, 830.7370, and 830.7550 for the Micro-Flo 97% T; and OPPTS 830.6320 and 830.7050 for the Valent 97% T. Data for all product-specific product chemistry requirements are outstanding for the Valent 75% FI. The registrants must submit the data required, and either certify that the suppliers of beginning materials and the manufacturing processes for the acephate MPs have not changed since the last comprehensive product chemistry review or submit complete updated product chemistry data packages.

## Residue Chemistry

Additional field trial data are required before the established tolerances for residues of acephate *per se* in/on soybeans may be reassessed.

## Occupational and Residential Exposure

No Pesticide Handlers Exposure Database (PHED) data were available for the following scenarios; therefore, both dermal (GLN 875.2400) and inhalation (GLN 875.2500) data are required:

applying in transplanting water  
applying in treatment hopper box  
applying in seed treatment hopper box  
applying in a seed treatment in a slurry tank  
loading /applying using aerosol generator  
loading/applying with Pest Control Operators (PCO) injector  
loading/applying tree injections

## **SCIENCE ASSESSMENT**

### **Summary of Registered Uses**

Acephate is a systemic/contact organophosphate insecticide manufactured in the United States by Valent U.S.A. Corporation under the trade name Orthene®. Products containing acephate are intended for both occupational and residential uses. Acephate is currently registered for food/feed uses on a variety of field, fruit, and vegetable crops as well as on food-handling establishments for the control of insect pests. The granular (G) and soluble concentrate (SC) are the acephate formulation classes registered for use on these sites. These formulations are typically applied to food/feed crops as foliar, soil, and/or seed treatments using ground or aerial equipment and at food-handling establishments as spot or crack-and crevice treatments. Occupational uses include terrestrial food and feed crops, indoor food uses, terrestrial non-food crops, commercial/industrial, and golf course turf. There are residential uses of acephate which include both indoor and outdoor uses. An Acephate Use Closure Memo dated December 23, 1997 was written which clarified acephate food uses that were used in this risk assessment. This memo lists the following maximum application rates for food crops treated with acephate:

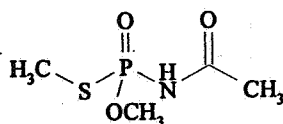
Beans (snap, dry, lima)	2 lb ai per acre per crop cycle
Brussels sprouts	2 lb ai per acre per crop cycle
Cauliflower	2 lb ai per acre per crop cycle

Celery	2 lb ai per acre per crop cycle
Cotton	6 lb ai per acre per crop cycle
Cranberries	1 lb ai per acre per crop cycle
Head Lettuce	2 lb ai per acre per crop cycle
Peanut	4 lb ai per acre per crop cycle
Pepper (non-bell)	1 lb ai per acre per crop cycle
Pepper (bell)	2 lb ai per acre per crop cycle
Peppermint/Spearmint	2 lb ai per acre per crop cycle
Soybean	1.5 lb ai per acre per crop cycle
Tobacco	4 lb ai per acre per crop cycle

## Physical and Chemical Properties Assessment

### Identification of Active Ingredient

Acephate is a colorless to white solid with a melting point of 81-91 C. Acephate is highly soluble in water (79.0 g/100 mL), acetone (151 g/100 mL), and ethanol (>100 g/100 mL), and is soluble in methanol (57.5 g/100 mL), ethyl acetate (35.0 G/100 mL), benzene (16.0 G/100 mL), and hexane (<0.1 g/100 mL) at 25 C.



Empirical Formula: C<sub>4</sub>H<sub>10</sub>NO<sub>3</sub>PS  
Molecular Weight: 183.16  
CAS Registry No.: 30560-19-1  
Shaughnessy No.: 103301

### Manufacturing-Use Products

A search of the Reference Files System (REFS) conducted 1/29/97 identified four acephate manufacturing-use products (MPs) registered under PC Code 103301: the Micro-Flo Company 97% T (EPA Reg. No. 51036-246); Valent USA Corporation 97% T (EPA Reg. No. 59639-41) and Orthene MFG (EPA Reg. No. 59639-42); Only these products are subject to a reregistration eligibility decision.



## Hazard Assessment

The toxicological database for acephate is adequate to support reregistration. Although the rat metabolism studies submitted were found to be inadequate; these studies are summarized in this hazard assessment. A new rat metabolism study is required.

### Acute toxicity

Acephate has low acute dermal and inhalation toxicity. It is non-irritating to skin, minimally irritating to the eyes and is not a skin sensitizer. It is classified under Category II for acute oral toxicity (see Table 1.)

Table 1. Acute Toxicity Data for Acephate

Test	Results	Category
Acute Oral LD <sub>50</sub> (rat) MRID 00014675	945 mg/kg ♂ 866 mg/kg ♀	2
Acute Dermal LD50 (rabbit) MRID 00055602	>10 g/kg ♂	4
Acute Inhalation LC <sub>50</sub> (rat) MRID 00015307	>61.7mg/L	4
Primary Eye Irritation (Rabbit) MRID 00014686	Mild irritant	3
Primary Dermal Irritation (Rabbit) MRID 00015305	PIS = 0.1 (Intact and abraded skin)	4
Dermal Sensitization (Guinea pig) MRID 00119085	Negative	-

### Special Subchronic Toxicity Study (Cholinesterase Inhibition)

In a special cholinesterase (ChE) inhibition study (MRID 40504819), SD rats received acephate in the diet for 13-weeks at concentrations ranging from 2 - 150 ppm. Acephate showed no effect on body weights, and no toxic signs were observed. Tissue abnormalities were not observed at necropsy and there was no mortality at the doses given (2 - 150 ppm). Brain cholinesterase was significantly inhibited at later weeks (9 - 13 weeks) in the 2 ppm group and at all times in the 5

though 150 ppm groups in both males and females. Erythrocyte ChE activity and plasma ChE were inhibited at the highest dose.

**Based on the inhibitions of ChE activities, the NOELs and LOELs for male and female rats are as follows: Brain, < 2 ppm (mg/kg/day: 0.12 ♂ and 0.15 ♀) and 2 ppm (LDT), respectively; RBC, 10 ppm (mg/kg/day: 0.58 ♂ and 0.76 ♀) and 150 ppm (mg/kg/day: 8.90 ♂ and 11.48 ♀), respectively; and Plasma, 10 ppm and 150 ppm, respectively.**

### **Subchronic Toxicity Studies**

In a subchronic toxicity study (4-week inhalation), CrIBr rats (MRID 40504818) exhibited tremors, polypnea, miosis, decreased body weight and weight gain and histopathological findings. Brain ChE was significantly decreased in all treated animals at all time points except for low dose males. Erythrocyte and plasma ChE activities were significantly inhibited for mid- and high- dose groups for males and females during the treatment phase.

**Based on the results of this study (tremors, miosis, decreased body weight and weight gain, and histopathological findings), the systemic LOEL is 93.6 mg/m<sup>3</sup> (0.0936 mg/L) and the systemic NOEL is 10.8 mg/m<sup>3</sup> (0.0108 mg/L). The LOEL for the inhibition of plasma cholinesterase (ChE) activity is 10.8 mg/m<sup>3</sup> (0.0108 mg/L), with a NOEL of 1.05 mg/m<sup>3</sup> (0.00105 mg/L). The LOEL for the inhibition of erythrocyte and brain ChE activities was 1.05 mg/m<sup>3</sup> (0.00105 mg/L), with a NOEL less than 1.05 mg/m<sup>3</sup> (LDT).**

In another subchronic toxicity study (4- week inhalation) in Fischer 344 rats (MRID 40645903), there were no treatment-related changes in body weight, food consumption, clinical chemistry or hematology parameters, plasma, erythrocyte or brain ChE activities, or histopathology findings.

**Based on the results of this study (lack of treatment-related effects), the systemic LOEL is >0.507 mg/m<sup>3</sup> (0.0005 mg/L; HDT) and the systemic NOEL is 0.507 mg/m<sup>3</sup>. The LOEL for the inhibition cholinesterase activities in plasma, erythrocytes and brain is also >0.507 mg/m<sup>3</sup>, with a NOEL of 0.507 mg/m<sup>3</sup>.**

### **Chronic Toxicity Studies**

A chronic feeding toxicity study (MRID 00084017 [main study] and 00101623 [additional data]), conducted on SD rats demonstrated that Acephate at 35 mg/kg/day (HDT) induced hyperactivity in some of the males; increased incidence of aggressive behavior, decreased body weight gain; and significant decreases in food efficiency. Inhibition of cholinesterase activities

in plasma, erythrocytes and brain were also observed.

**Based on the neurotoxic signs, decreased body weight gain and food efficiency, the systemic LOEL and NOEL for the male rats are 700 ppm (35 mg/kg/day) and 50 ppm (2.5 mg/kg/day), respectively. The systemic NOEL for the female rats is > 700 ppm. The LOEL and NOEL for the inhibition of plasma, RBC and brain ChE activities in males and females are 50 ppm (2.5 mg/kg/day) and 5 ppm (0.25 mg/kg/day; borderline value), respectively.**

In a chronic feeding study in Beagle dogs (MRID 41812001) Decreased hematological parameters, increases in thromboplastin time, increases in absolute liver weight and histological changes in the liver were observed.

**Based on decreases in hematological parameters (RBC, hemoglobin and hematocrit), increase in thromboplastin time, increase in absolute liver weight and histological changes in the liver (perivascular infiltration and pigment in reticuloendothelial cells), the LOEL and NOEL for systemic effects are 20.16 mg/kg/day (800 ppm; HDT) and 3.11 mg/kg/day (120 ppm), respectively (both sexes). The LOELs for cholinesterase (ChE) inhibition are as follows: Brain: 0.27 mg/kg/day (10 ppm), LDT, (males) and 3.11 mg/kg/day (females); RBC: 3.11 mg/kg/day (both sexes); and Plasma: >20.16 mg/kg/day (both sexes). The NOELs for ChE inhibition are as follows: Brain: <0.27 mg/kg/day (males) and 0.27 mg/kg/day (females); RBC: 0.27 mg/kg/day (both sexes); and Plasma: 20.16 mg/kg/day (both sexes).**

### **Carcinogenicity Studies**

In a carcinogenicity study (MRID 00084017 [main study] and 00101623 [additional data]), in SD rats, there was a higher incidence of adrenal medullary tumors (pheochromocytomas) in the treated male rats than in the control males. However, the reported incidence was dose-unrelated and within the historical control range. All of the tumors but two (one in the mid-dose and one in the high-dose group) in the current study were benign.

**Based on these findings (the incidence of adrenal medullary tumors was dose-unrelated and within the historical incidence), it was concluded (by the Health Effects Division pathologist and the independent pathologist who re-evaluated all male adrenal gland histopathological sections) that Technical RE-12420 (Acephate) was not carcinogenic in this study.**

In a carcinogenicity study (MRIDs: 00105197 [main study]; and 00077209, 00105198 and

00129156 [additional data]) in CD1 mice, female mice (high dose) had higher incidence of hepatocellular carcinomas (HC) and hyperplastic nodules (HN) than did the concurrent controls. Other treatment-related findings were: Liver and lung lesions, significantly decreased body weight gains; and significant changes in organ weights.

**Based on decreased body weight gains, decreased (in males) or increased (in females) weights of livers, decreased weights of kidneys, and non-neoplastic lesions in liver and lungs, the systemic LOEL is 250 ppm (mg/kg/day: 36 ♂ and 42 ♀) and the systemic NOEL is 50 ppm (mg/kg/day: 7 ♂ and 8 ♀). Based on the increased incidence of hepatocellular carcinomas in the 1000 ppm (167 mg/kg/day; HDT) females, Orthene Technical (Acephate) was carcinogenic to female mice in this study.**

### **Developmental Studies**

In a developmental (teratology) study in rats (MRID 41081602), decreased body weights and body weight gains and decreased food consumption and food efficiency were observed in the high- and mid- dose groups (75 and 20 mg/kg, respectively). There was also a statistically significant increase in the number of rats with tremors and decreased motor activity in the high dose group. Developmental toxicity was noted in the high-dose group as slight decreases in the mean number of ossified caudal vertebrae, sternal centers, metacarpals, and the forelimb and hindlimb phalanges.

**Based on reduced body weights, body weight gains, food consumption and food efficiency, the maternal toxicity LOEL is 20 mg/kg/day and the NOEL is 5 mg/kg/day. Based on decreases in mean numbers of ossification centers per litter, the developmental toxicity LOEL is 75 mg/kg/day and the NOEL is 20 mg/kg/day.**

In another developmental toxicity study on rabbits (MRID 00069684), two rabbits aborted and were sacrificed and discarded without examination. No other effects on the maternal and developmental parameters examined were seen.

**The LOAEL for maternal toxicity is 10 mg/kg/day based on an increase in the incidence of abortion; NOAEL, 3 mg/kg/day. The NOAEL for developmental toxicity is > 10 mg/kg/day (HDT).**

### **Reproduction Studies**

In a 3-generation reproduction study in rats (MRIDs: 40323401 [main study] and 40605701 [corrections]), treatment related effects were observed only in the high dose group, 25 mg/kg/day, and included decreased body weights and/or weight gains for adult males, adult females, and pups in the 2nd and 3rd generations; increases in food consumption for males and

females during the pre-mating period and decreases in food consumption for females during the gestation and lactation periods; clinical signs in males (increased incidence of alopecia in the first generation and increased incidence of soft or liquid stools in the second and third generations); decreases in mating performance for the F<sub>2b</sub> generation; decreases in mean litter size) for the F<sub>1b</sub>, F<sub>2a</sub>, F<sub>2b</sub> and F<sub>3a</sub> generations; and significant decreases in pup survival to day 4 for the F<sub>1a</sub> (3.2%) and the F<sub>2a</sub> (6.3%) generations.

**Based on decreased body weights and/or weight gains for adult males (each generation), and for adult females and pups (some generations), decreased food consumption during gestation and lactation periods, and decreases in litter size (some generations), the parental LOEL and NOEL are 500 ppm (25 mg/kg/day) and 50 ppm (2.5 mg/kg/day), respectively. Based on decreases in viability index (two generations) and in mating performance (one generation), the reproductive LOEL and NOEL are also 500 ppm (25 mg/kg/day) and 50 ppm (2.5 mg/kg/day), respectively.**

### **Mutagenicity Studies**

Fourteen acceptable mutagenicity studies were submitted. The results from the *in vitro* studies indicated that acephate was mutagenic in bacteria, yeast and cultured mammalian cells. Acephate also caused recombination and gene conversion in yeast, SCE in a cultured mammalian cell line and UDS in human fibroblasts. In general, genotoxicity was limited to high concentrations and exogenous metabolic activation (S9 microsomal fraction) was not required to uncover the positive responses. Attempts to characterize the mutagenic component(s) of Acephate by investigating a series of Acephate samples of varying purities in the Ames test failed; mutagenicity in these studies did not decrease with increasing purity levels of the test material. Nevertheless, the data from the *in vivo* assays with Acephate clearly showed that the genotoxic activity of Acephate was not expressed in whole animals. Confidence in the negative findings, particularly for the mouse somatic cell and the dominant lethal assays, is high because of the response induced in the target organ. The Science Assessment Review Committee (SARC) concluded, therefore, that the negative findings from the *in vivo* studies lessen the concern for a potential mutagenic hazard.

### **Metabolism Studies**

Two metabolism studies submitted were found to be inadequate although information was provided to discern the metabolism of Acephate by the rat. The results show that acephate is rapidly and completely absorbed from the stomach and rapidly excreted in urine. About 87% and 95% of the administered radioactivity (<sup>14</sup>C) was excreted, respectively, during the first 6 and 12 hours after dosing. Most of the remaining <sup>14</sup>C was found in the exhaled air (probably CO<sub>2</sub>; 1-4.5%), feces (1%) and tissues (0.4%). The <sup>14</sup>C found in urine was unchanged Acephate (O,S-

dimethyl acetylphosphoramidothioate; 73-77%), DMPT (O,S-dimethyl phosphorothioate; 3-6%) and S-Methyl acetylphosphoramidothioate; 3-4%). Methamidophos (O,S-dimethyl phosphoramidothioate; ORTHO 9006) was not detected in urine, and the author concluded that Methamidophos was only a plant and soil metabolite of Acephate. Of the 0.4% <sup>14</sup>C recovered in tissues, most (0.13-0.26%) was in the liver and least (0.001-0.004%) in the brain. Male and female rats had the same excretion pattern.

In another rat metabolism study (MRID 00014219) the purpose was to investigate whether Methamidophos (ORTHO 9006) was formed from Orthene (Acephate) in rats. Results indicated that Acephate was rapidly absorbed and rapidly eliminated by the rats. The carcasses contained only 12-48% and the gastrointestinal tracts 3-14% of the final dose at 3 hours after dosing. The excreta (chiefly urine) contained 54-56% of the final dose at 6 hours after dosing. There was no tendency for Acephate to concentrate in blood, liver, muscle, fat, heart and brain.

The rat converted a portion of Acephate to Methamidophos. Evidence was presented that the conversion took place in the small intestine and, to a lesser extent, in the stomach, and was apparently effected by the microorganisms. Transformed Methamidophos was then absorbed from the stomach and intestines, and distributed throughout the body. At 3 hours after the last dose, the carcass contained 0.6-1.6% and the excreta (chiefly urine) 1.1-1.5% of the final dose of Acephate as Methamidophos. There was no tendency for Methamidophos to accumulate in blood, liver, muscle, fat and heart.

### Neurotoxicity Studies

In an acute delayed neurotoxicity study (MRID 00154884), leghorn hens were dosed (by gavage) with acephate (785 mg/kg) and TOPC (600 mg/kg) (tri-o-tolyl phosphate; positive control). Toxic signs observed in the Acephate-treated group were: (1) Mortality (9/16 or 56% hens died, due to cholinergic effects, during days 3-7 after dosing); (2) Weight losses after initial dosing and redosing; (3) Diarrhea, lethargy, weakness in lower limbs, loss of coordination, wing droop and reduced reaction to sound and movement - each sign occurring at about 3 hours after dosing and redosing, and persisting through day 10); (4) Ataxia (during the first 7 days after each dosing and decreasing in severity thereafter); and (5) Swelling (minimal) of axis cylinder of the sciatic nerve in one hen only. In the TOPC-treated group, the typical delayed neurotoxicity was seen (loss of coordination, weakness in lower limbs, ataxia and staggering gait). Histological findings were lesions in the sciatic nerve characterized by lymphocytic foci, swollen and fragmented axons, nerve fiber and myelin degeneration, and Schwann cell hyperplasia.

**Based on the cholinergic and neurotoxic effects occurring shortly after dosing and disappearing within some 10 days and on the absence of lesions in the sciatic nerve (except for a slight swelling in one hen), Acephate Technical was negative for acute delayed neurotoxicity at 785 mg/kg (only dose tested) in comparison to findings of TOCP treated hens.**

In the acute neurotoxicity study in SD rats (MRID 44203303), the following treatment-related findings were observed in the 500 mg/kg and 100 mg/kg male and female groups: (1) Whole body and/or limb tremors; ataxia, weakness in hindlimbs and repetitive movement of mouth and jaws; alterations in posture, gait and mobility; low arousal and no approach and touch responses; decreased rearing and motor activities, rotarod performance, and body temperature; increased righting reflex and time to first step; and lacrimation, salivation and soiled fur; (2) Decreased body weight gains in males only (41-45% and 15% in the high-dose and mid-dose groups, respectively); and (3) Inhibition of cholinesterase activities in plasma (86-88%), RBC (53-55%) and brain (the six regions tested: 83-88%). Findings observed only in the 500 mg/kg male and female groups were: Increased catalepsy time and clonic convulsions; absence of the pinch, startle, pupil and olfactory responses; decreased hindlimb footsplay and forelimb and hindlimb grip strength; chromodacryorrhea; and clear or colored (tan, red, brown and/or yellow) staining/matting material on various body surfaces.

The following treatment-related findings were observed in the 10 mg/kg male and female groups: Whole body tremors (single occurrences) in one male and one female; inhibition of ChE activities in plasma (31-34%), RBC (18-19%) and brain regions (37-48%); and decreased rotarod performance in males on day 0 (when compared with that of the controls).

Toxic signs occurred within 0.5-2.5 hours after dosing and persisted for 4-8 hours or longer, but were not observed during the next day (study day 1). Plasma and RBC ChE activities were inhibited significantly ( $p < 0.01$ ) only during the dosing day. Brain ChE activities were inhibited ( $p < 0.01$ ) during the dosing day (all regions), day 7 after dosing (all regions but olfactory) and day 14 (midbrain only). Other parameters examined in this study were not affected by ORTHENE® Technical.

**Based on the above findings, the LOEL and NOEL for neurotoxicity, for both sexes, are 10 mg/kg (LDT) and <10 mg/kg, respectively. The LOELs and NOELs for the inhibition of plasma, RBC and brain cholinesterase activities are also 10 mg/kg and <10 mg/kg, respectively.**

In a subchronic neurotoxicity study in SD rats (MRID 44203304), the only effects seen at the low dose (5 ppm) were inhibition of brain cholinesterase. At the mid dose (50 ppm) there was significant inhibition of brain, and plasma cholinesterase. Erythrocyte cholinesterase was not significantly inhibited, but was decreased by 26% in females at week 3. Other effects seen at the mid dose level included a slight increase in clinical signs, specifically hair loss. At the high dose (700 ppm), brain and plasma cholinesterase were significantly inhibited in both sexes at all time points. Erythrocyte cholinesterase was significantly inhibited in both sexes at all time points except for week 13 females (25% inhibition). Additional effects seen at the high dose included decreased body weight (males) and body weight gain (males and females); increased food consumption (when measured as g/kg/day); increased grooming, increased rearing, and decreased rotarod time in males; and decreased motor activity in females.

**Based on the effects seen in this study, the LOEL for systemic effects (increases in clinical signs) was 50 ppm (3.31 or 3.95 mg/kg/day for males or females, respectively), with a NOEL of 5 ppm (0.33 or 0.41 mg/kg/day for males and females, respectively). The LOEL for neurotoxicity (FOB findings and decreased motor activity) was 700 ppm (48.63 or 58.27 mg/kg/day for males or females, respectively), with a NOEL of 50 ppm (3.31 or 3.95 mg/kg/day for males or females, respectively). The LOEL for erythrocyte cholinesterase inhibition was 700 ppm (48.63 or 58.27 mg/kg/day for males or females, respectively), with a NOEL of 50 ppm (3.31 or 3.95 mg/kg/day for males or females, respectively). The LOEL for plasma cholinesterase inhibition was 50 ppm (3.31 or 3.95 mg/kg/day for males or females, respectively), with a NOEL of 5 ppm (0.33 or 0.41 mg/kg/day for males and females, respectively). The LOEL for brain cholinesterase inhibition was 5 ppm (0.33 or 0.41 mg/kg/day for males and females, respectively), with the NOEL less than 5 ppm (the lowest dose tested).**

### **Toxicity Endpoint Selection**

Based on the evaluation of the above summarized studies, the Hazard Identification Assessment Review Committee identified the toxicity endpoints and the dose levels for use in risk assessments (HIARC document of 1/14/98). These endpoints are summarized in Table 2.



Table 2. Acephate Endpoints Used For Risk Assessment

Exposure Scenario	NOEL for use in Risk Assessment	Uncertainty Factor	Endpoint
Acute Dietary aRfD = 0.005 mg/kg/day	0.5 mg/kg/day (acute neurotoxicity range finding study)	100	Brain ChE inhibition
Chronic Dietary RfD = 0.0012 mg/kg/day	0.12 mg/kg/day (90-day feeding study)	100	Brain ChE inhibition
Short-Term (1-7 days)	12 mg/kg/day (21-day dermal toxicity study)	100	Brain ChE inhibition
Intermediate-Term Exposure (1 week to several months)	12 mg/kg/day (21-day dermal toxicity study)	100	Brain ChE inhibition
Long-Term Exposure (several months to lifetime)	12 mg/kg/day (21-day dermal toxicity)	100	Brain ChE inhibition
Inhalation Exposure (any duration)	0.14 mg/kg/day (4 week Inhalation Toxicity Study)  The inhalation NOEL of 0.0005 mg/L was converted to 0.14 mg/kg/day using the following equation: $(0.0005) (1)(47)(6)(1)$ where: (1) is 100 percent inhalation absorption which is implicitly in these estimations (47) is the conversion factor for Fischer 344 rats which is based on respiratory volume and body weights (6) is the duration of daily exposure in hours (1) is the default activity factor for animals	100	plasma, brain and erythrocyte ChE inhibition
Carcinogenic	Acephate has been classified as a Group C, possible human carcinogen. The RfD approach will be used.	N/A	N/A
Aggregate Assessment	The dermal and inhalation MOES may be combined to obtain a total MOE since a common toxicological endpoint (cholinesterase inhibition) was observed.	N/A	N/A
FQPA Considerations	For acephate the 10-fold uncertainty factor to account for the protection of infants and children has been removed. An uncertainty factor of 100 to account for interspecies extrapolation and intraspecies variability will be used. Thus, for all scenarios, MOEs equal to or greater than 100 are of no concern.	N/A	N/A

NOEL - No Observable Effect Level, ChE = Cholinesterase, MOE = Margins of Exposure, N/A = not applicable  
 Note that only short- and intermediate- term exposure/risk assessments are evaluated in this document. Since the exposures that would result from the uses of acephate were determined to be of an intermittent nature (i.e., the frequency and duration of these exposures do not exhibit a chronic exposure pattern), neither a long-term assessment nor a carcinogenic (RfD approach) assessment are appropriate.

## **Dietary Exposure Assessment**

The chemistry database is essentially complete. Based on the available plant and animal metabolism data, the acephate residues of concern in plant commodities are those that are currently regulated, acephate and its cholinesterase-inhibiting metabolite, methamidophos. Since methamidophos is itself a registered pesticide, the Agency will initiate a change in the residue definition of acephate tolerances for plant commodities in order to eliminate redundancy. The Agency is now recommending that all acephate tolerances be expressed in terms of only acephate *per se* under 40 CFR §180.108. Residues of methamidophos resulting from the metabolism of acephate are more appropriately placed under the tolerance regulations for methamidophos as a pesticide [40 CFR §180.315.(c)]. A statement which informs the reader of these changes should be placed under both 40 CFR §180.108 and 40 CFR §180.315. Additionally, the registrant is advised to add a statement to the label which states that no methamidophos products should be applied after application of acephate since this may result in illegal residues.

Adequate methods are available for data collection and tolerance enforcement for plant and animal commodities. Pending label amendments for some crops, adequate field trial data are available to reassess the established tolerances for residues of acephate *per se* in/on the following plant and animal commodities, as defined: beans (succulent and dry form); Brussels sprouts; cauliflower; celery; cottonseed; cranberries; lettuce (head); peanuts; peppers; and poultry. The available data suggest that the tolerance level for cottonseed can be lowered. Detailed tolerance reassessment information is provided in Table 3.

Additional field trial data and/or information are required before the established tolerance for residues for acephate *per se* in/on soybeans may be reassessed. Existing tolerance for these commodities have been used for dietary exposure estimates.

The available ruminant feeding data suggest that the established tolerances for residue of acephate *per se* in milk and the fat, meat, and meat byproducts of cattle, goats, hogs, horses are adequate. However, actual reassessment of tolerances will be made when the requested residue data for all major livestock feed items have been submitted and following recalculation of maximum dietary burden.

Table 3. Tolerance Reassessment Summary for Acephate.

Commodity	Acephate		Reassessed Tolerance <sup>2</sup>	Methamidophos		Comment [Correct Commodity Definition]
	Tolerance <sup>1</sup> Listed Under 40 CFR §180.108	Tolerance <sup>3</sup> Listed Under 40 CFR §180.315		Reassessed Tolerance <sup>3</sup>		
<b>Tolerances Listed Under 40 CFR §180.108 (a)</b>						
Beans (succulent and dry form)	3 (1)	--	3.0	--	1.0	[Beans, dry and succulent]
Brussels sprouts	3.0 (0.5)	1.0	3.0	1.0	1.0	
Cattle, fat	0.1	--	0.1	--	--	
Cattle, meat	0.1	--	0.1	--	--	
Cattle, mbyp	0.1	--	0.1	--	--	
Goats, fat	0.1	--	0.1	--	--	
Goats, meat	0.1	--	0.1	--	--	
Goats, mbyp	0.1	--	0.1	--	--	
Hogs, fat	0.1	--	0.1	--	--	
Hogs, meat	0.1	--	0.1	--	--	
Hogs, mbyp	0.1	--	0.1	--	--	
Horses, fat	0.1	--	0.1	--	--	
Horses, meat	0.1	--	0.1	--	--	
Horses, mbyp	0.1	--	0.1	--	--	
Milk	0.1	--	0.1	--	--	
Sheep, fat	0.1	--	0.1	--	--	
Sheep, meat	0.1	--	0.1	--	--	
Sheep, mbyp	0.1	--	0.1	--	--	
Cauliflower	2.0 (0.5)	1.0	2.0	1.0	1.0	

Commodity	Acephate		Reassessed Tolerance <sup>2</sup>	Methamidophos		Comment [Correct Commodity Definition]
	Tolerance <sup>1</sup> Listed Under 40 CFR §180.108	Tolerance <sup>3</sup> Listed Under 40 CFR §180.315		Reassessed Tolerance <sup>3</sup>		
Celery	10 (1)	10.0	10.0	1.0	1.0	
Cottonseed	2	0.5	0.5	0.1 (N)	0.1	[Cotton, undelimited seed]
Cranberries	0.5 (0.1)	0.5	0.5	--	0.1	
Eggs	0.1	0.1	0.1			
Grass (pasture & range)	15	Revoke	Revoke	--	--	This use is not supported by the registrant.
Grass hay	15	Revoke	Revoke	--	--	
Lettuce (head)	10 (1)	10.0	10.0	1.0 <sup>5</sup>	1.0	[Lettuce, head]
Mint hay	15.0 (1)	27	27	1	2	[Mint, tops (leaves and stem)] Tolerance may be lowered following receipt of additional information pertaining to residues exceeding tolerance in/on samples from trials conducted before the Update.
Peanuts	0.2	0.2	0.2	--	--	
Peanut hulls	5.0	Revoke	Revoke	--	--	Peanut hulls are no longer considered a significant livestock feed item (Table 1, OPPTS GLN 860.1000).
Peppers	4.0 (1)	4.0	4.0	1.0	1.0	
Poultry, fat	0.1	0.1	0.1	--	--	
Poultry, meat	0.1	0.1	0.1	--	--	
Poultry, mbyyp	0.1	0.1	0.1	--	--	

(continued; footnotes follow)

Commodity	Acephate		Methamidophos		Comment <i>[Correct Commodity Definition]</i>
	Tolerance <sup>1</sup> Listed Under 40 CFR §180.108	Reassessed Tolerance <sup>2</sup>	Tolerance <sup>3</sup> Listed Under 40 CFR §180.315	Reassessed Tolerance <sup>3</sup>	
Soybeans	1	TBD	--	--	Additional data are required to support use of acephate on soybeans under a Section 24(c) registration. Should SLN MS820023 be canceled, the established tolerance may be revoked.
<b>Tolerance To Be Proposed Under 40 CFR §180.108 (a)</b>					
Cotton, gin byproducts	None	TBD	--	--	Data for cotton gin byproducts are now required as a result of changes in Table 1 (GLN 860.1000).
<b>Tolerances Listed Under 40 CFR §180.108 (b)</b>					
Macadamia nuts	0.05	0.05	--	--	
<b>Tolerances Listed Under 40 CFR §185.100</b>					
Food items in food-handling establishments as a result of spot and/or crack and crevice treatments	0.02	0.02	--	--	
<b>Tolerances Listed Under 40 CFR §186.100</b>					
Cottonseed hulls	4	10	--	--	
Cottonseed meal	8	10	--	--	

Commodity	Acephate		Methamidophos		Comment [Correct Commodity Definition]
	Tolerance <sup>1</sup> Listed Under 40 CFR §180.108	Reassessed Tolerance <sup>2</sup>	Tolerance <sup>3</sup> Listed Under 40 CFR §180.315	Reassessed Tolerance <sup>3</sup>	
Soybean meal	4	TBD	--	--	The appropriate tolerance level for soybean meal, if needed, will be determined following resolution of data deficiencies for soybeans.

- 1 Expressed in terms of the combined residues of acephate and methamidophos. If specified, limits of methamidophos are given parenthetically.
- 2 Expressed in terms of acephate *per se*.
- 3 Expressed in terms of methamidophos *per se*.
- 4 TBD = To be determined. Reassessment of tolerance(s) cannot be made at this time because additional data are required.
- 5 The methamidophos tolerance covers all types of lettuce (head and leaf).

## **Dietary Exposure (food source)**

Dietary exposure assessments were conducted using the DEEM® (Dietary Exposure Evaluation Model) program and was based on the listing of tolerances eligible for reregistration as stated in the Use Closure Memo described in this document. Dietary exposure assessments were conducted for both acephate and its degradate, methamidophos. The dietary exposure assessment for methamidophos was conducted for exposure to methamidophos from application of acephate only. A dietary exposure assessment which includes exposure to methamidophos from application of methamidophos and application of acephate is discussed in the aggregate exposure assessment section of this document.

## **Chronic Dietary Exposure**

To assess chronic dietary risk the DEEM® program calculates exposure based on average food consumption estimates (from the USDA 1989-1992 Nationwide Food Consumption Survey (NFCS)) and on tolerances and/or appropriate anticipated residue estimates. Chronic dietary risk is expressed as a percent of the chronic Reference Dose (RfD) and is estimated by the DEEM system from the general U.S. population and 22 subpopulations including infants and children (which typically demonstrate the highest exposure). The toxicological endpoint selected for the chronic dietary assessment is the RfD, 0.0012 mg/kg/day. The chronic dietary assessment for acephate includes use of percent crop treated data (BEAD memo by Al Halvorsen ) and anticipated residues (HED memo by F.Fort, 5/5/98). Where percent crop treated estimates indicated no acephate use, a default minimum assumption of 1% crop treated was applied. A percent RfD less than 100 is considered to be below HED's level of concern.

Using the lower tolerance level for cottonseed and the higher tolerance level recommended for mint result in an Anticipated Residue Contribution (ARC) for acephate for the general population and non-nursing infants which occupies 11% and 23% of the RfD (Table 4). The most exposed subgroup, children (1-6 years) occupies 24% of the RfD. Based on these results, the chronic dietary risk from the uses recommended through reregistration, does not exceed HED's level of concern.

For methamidophos, the toxicological endpoint selected for the chronic dietary assessment is the adjusted RfD, 0.0001 mg/kg/day which includes an extra FQPA uncertainty factor of 3. Results of the chronic analysis indicated that 36%, 45% and 33% of the adjusted RfD is occupied for the general population, children (1- 6 years), and non-nursing infants, respectively (Table 4).

Table 4. Summary of Dietary Risk for Acephate

Population Subgroup	Chronic Dietary Risk		Acute Dietary Risk	
	Exposure (mg/kg/day)	% chronic RfD <sup>ab</sup>	Exposure (mg/kg/day)	% acute RfD <sup>ac</sup>
<b>Acephate</b>				
U.S. Population	0.000232	11	0.0173	346
Children (1 - 6 years)	0.000539	24	0.0256	512
Non-nursing Infants (<1 year)	0.000527	23	0.0197	394
<b>Methamidophos from acephate application</b>				
U.S. Population	0.000048	48	0.0030	300
Children (1 - 6 years)	0.000071	71	0.0048	482
Infants (<1 year)	0.000058	58	0.0078	778

a. A % RfD or %aRfD that is less than 100% is not considered as exceeding HEDs level of concern.

b. Rfd (acephate) = 0.0012 mg/kg/day; RfD(methamidophos) = 0.0001 mg/kg/day

c. aRfd (acephate) = 0.005 mg/kg/day; aRfD (methamidophos) = 0.001 mg/kg/day

### Acute Exposure

To assess acute dietary risk, the DEEM program calculated total, one day exposure based on the reported consumption of foods and uses a high end residue estimate (in this case tolerance level residues and 100% crop treated). The high end of the resultant exposure distribution is then compared to the acute Reference Dose. The acute RfD that was used in this assessment is 0.005 mg/kg/day. Acute dietary exposure estimates at the 95<sup>th</sup> percentile of exposure for the general population, children (1 to 6 years), and non-nursing infants resulted in an % aRfD of 347%, 512% and 394%, respectively (Table 4). These results exceed HED's level of concern regarding acute dietary exposure. A probabilistic assessment of acute dietary exposure to acephate could further refine acute dietary risk but was not conducted by HED. It is recommended that the registrant (s) conduct a Monte Carlo analysis to address acute dietary concerns.

For methamidophos, the acute RfD was determined to be 0.001mg/kg/day which included an additional FQPA uncertainty factor of 3. To estimate acute dietary exposure, a high end analysis assuming tolerance level residues and 100% crop treated was also conducted for methamidophos. The results indicate that there are concerns for all population subgroups. At the 95<sup>th</sup> percentile of exposure for the general population, children (1 to 6), and non-nursing infants, the %aRfD was 300, 482 and 778%, respectively. A probabilistic (Monte Carlo) assessment could further refine acute dietary risk.



## Carcinogenic Exposure

Acephate is classified as a Group C, possible human carcinogen. It was concluded that the RfD approach would be used in calculating carcinogenic exposure. This means that a quantitative risk assessment using a cancer endpoint will not be conducted. Rather, the chronic dietary risk assessment will be adequately protective for cancer risk as well as other chronic effects. Therefore, based on the chronic risk assessment, risks from the uses recommended through reregistration does not exceed HEDs level of concern.

Methamidophos is classified as a "not likely" human carcinogen. Therefore, a carcinogenic risk assessment for methamidophos is not required.

## **Non-Dietary Exposure**

### **Occupational and Residential Exposure**

Products containing acephate are intended for both occupational and residential (homeowner) uses. Occupational uses include terrestrial food and feed crops, indoor food crops, terrestrial non-food crops, commercial/industrial, and golf course turf. There are residential uses of acephate which include both indoor and outdoor uses.

Since acephate has been found to degrade to methamidophos, post-application risk assessments for methamidophos will be conducted. In the absence of chemical specific data, 2 percent of the estimated dislodgeable acephate residues will be assumed to be methamidophos. This two percent is based on a study performed by the Medical University of South Carolina as part of an interagency agreement between the Environmental Protection Agency and the Department of Labor, which is titled: Assessment of Dermal and Respiratory Exposure of Adult and Juvenile Tobacco Harvesters to Acephate, Duplin County, North Carolina (April 27, 1984).

### **Occupational Exposure**

Occupational exposure to acephate residues can occur to mixers, loaders, applicators, and other handlers during usual use patterns associated with acephate. Occupational workers are potentially exposed via dermal and inhalation routes. The exposure duration may be short-term (1 to 7 days) and intermediate-term (1 week to several months). A long term exposure duration is not expected for either applicators or post-application workers because the exposures that would result from the uses of acephate were determined to be of an intermittent nature i.e., the frequency and duration of these exposures do not exhibit a chronic exposure pattern.

## Occupational Handler Exposure and Risk

HED has identified 25 major exposure scenarios for which there are potential for occupational handler exposure during mixing, loading, and applying products containing acephate. These occupational scenarios reflect a broad range of application equipment and use sites, and were classified as either short-term or intermediate-term based primarily on the frequency of exposure. The estimated exposures considered baseline protection ( long pants, long-sleeved shirt, no gloves, and an open cab or tractor), additional personal protective equipment (PPE), which included a double layer of clothing and gloves), and engineering controls (closed application and mixing systems, and water soluble bags).

Chemical specific occupational handler exposure data are available for applications by Pest Control Operators (PCO) only. Therefore, for all other scenarios where appropriate data are available, an exposure assessment was developed using the Pesticide Handlers Exposure Database (PHED) Version 1.1, using the Surrogate Exposure Table (May 1997). Caveats, assumptions, and factors used to complete this exposure assessment are described in detail in Table 5 and in the Occupational and Residential Exposure Assessment attached. Handler exposure assessments are completed by EPA using a baseline exposure scenario and, if required, increasing levels of risk mitigation (PPE and engineering controls) to achieve an appropriate Margin of Exposure (MOE). The baseline scenario represents a handler wearing long pants, a long-sleeved shirt, and no gloves. The calculation of baseline exposures (both dermal and inhalation) are presented in Table 6. These baseline exposures are then used to complete the short- and intermediate-term risk assessment, considering exposures at baseline which are presented in Table 7. Tables 8 and 9 present in an analogous manner exposure and risks with PPE. Tables 10 and 11 present in an analogous manner exposure and risk with engineering controls.

The calculations of short- and intermediate- term dermal risk indicate that even with all possible mitigation measures MOE's of greater than 100 could not be obtained for the following scenarios:

- (1a) Mixing/loading soluble powder for aerial application with application rates of 1.0 lb a.i. per acre and 5.0 lb a.i. per acre for 350 acres.
- (1b) Mixing/loading soluble powder for chemigation application at all application rates
- (1c) Mixing/loading soluble powder for ground boom application with an application rate of 5.0 lb a.i. per acre for 80 acres
- (3a) Mixing/loading liquids for aerial application with an application rate of 0.75 lb a.i. per acre for 800 acres
- (5) Applying spray with a fixed wing aircraft with an application rate of 5.0 lb a.i. per acre for 350 acres
- (14a) Mixing/loading/applying soluble powder using low pressure hand wand for PCO, and for treatment of wasps, and for 1 lb ai/100 gal
- (15) Mixing/loading/applying using back pack sprayer for PCO

- (16) Mixing/loading/applying using high pressure sprayer
- (24) Loading/applying granular by hand for 1000 pots and for trees, shrubs, and ornamental

Several issues must be considered when interpreting the occupational exposure risk assessment. These include: (i) several handler assessments were completed using "low quality" PHED data due to the lack of a more acceptable data set; (ii) several generic protection factors were used to calculate handler exposures (the protection factors used are generally accepted by HED); and (iii) factors used to calculate daily exposures to handlers are based on the best professional judgement of HED staff.

#### Occupational Post-application Exposure and Risk

HED has determined that there are potential post-application occupational exposures to individuals entering treated areas for the purpose of (i) harvesting low growing fruits and vegetables and non-food field crops; (ii) scouting, weeding, hoeing, and other non-harvesting activities associated with low-growing field crops (crops with PHIs greater than 14 days); (iii) harvesting turf from sod farms; (iv) mowing turf on golf courses; and (v) transplanting, harvesting, and pruning ornamentals.

Based on these activities, four representative scenarios, that should bracket the reentry exposure levels anticipated from use on all crops, were evaluated. They are described in detail in the Occupational and Residential Exposure Assessment attached. Two approaches were used in estimating post-application exposure. The surrogate assessments presented in Tables 12A and 13 are the approach used by HED (see Residential SOPs) when no chemical specific data exists. For acephate, chemical specific data are available for only one crop, cauliflower (which will represent a low growing field crop). Tables 12B and 12C use the data from the cauliflower post-application study with some uncertainty because a review of these data (MRIDs 40504821 and 41023501, reviewed by P. Perreault, memo July 26, 1990) indicated that the cauliflower studies were unacceptable. The irrigation data presented in the addendum to the cauliflower Dislodgeable Foliar Residue (DFR) study indicate that irrigation practices during the study, specifically the use of sprinkler irrigation may have increased foliar residue dissipation significantly thus preventing the accumulation of foliar dislodgeable residues from one application to the next. Additionally, the study was conducted using 6 applications each at a rate of 1 lb ai, seven days apart. But, as a result of recent discussions with the registrant, on cauliflower the maximum application rate is now 2 lb ai/acre/crop cycle. Thus, data from the cauliflower DFR study after application 1 could be used to estimate the 1 lb ai rate, the data after application 2 could be used to estimate the 2 lb ai rate.

Since there is no decline curve for methamidophos, no chemical specific assessment to generate REIs (Restricted-Entry Intervals) was performed. However, point estimates were estimated for Day 0.

HED considers MOEs equal to or greater than 100 for acephate or methamidophos to be above

the level of concern for occupational workers. The resulting surrogate occupational post-application assessment for acephate and its degradate methamidophos indicates that:

#### Using Surrogate Data (Tables 12A and 13)

- Acephate MOEs are equal to or greater than 100 for non-harvesting activities associated with turf grass on Day 16 following application at a rate of 5.0 pounds active ingredient per acre. Methamidophos MOEs equal or exceed 100 on Day 36 postapplication for this scenario.
- Acephate MOEs equal or exceed 100 for harvesting activities associated with turf grass on Day 45 following application at a rate of 5.0 pound a. i. per acre. Methamidophos MOEs equal or exceed 100 on Day 66 for this scenario.
- Acephate MOEs equal or exceed 100 for non-harvesting activities associated with low growing field crops on Day 11 following application at a rate of 1.0 pound active ingredient per acre. Methamidophos MOEs equal or exceed 100 on Day 31 for this scenario.
- Acephate MOEs equal or exceed 100 for harvesting activities associated with low growing field crops on Day 20 following application at a rate of 1.0 pound active ingredient per acre. Methamidophos MOEs equal or exceed 100 on Day 39 for this scenario.

#### Using Chemical-Specific Data (Tables 12B and 12C)

- Acephate MOEs are greater than 100 for non-harvesting activities associated with low growing field crops on Day 0 of the second application of acephate (each application was at a rate of 1.0 pound a. i. per acre). The methamidophos MOE was equal to 13 on Day 0.

$$\text{Methamidophos MOE} = 0.03 / [ (0.0104)(0.001)(1000)(8) / 70 ] = 25$$

- Acephate MOEs are greater than 100 for harvesting activities associated with low growing field crops on Day 4 of the second application of acephate (each application was at a rate of 1.0 pound a. i. per acre). The methamidophos MOE was equal to 3 on Day 0.

$$\text{Methamidophos MOE} = 0.03 / [ (0.02)(0.001)(4000)(8) / 70 ] = 3$$

- Acephate MOEs are greater than 100 for non-harvesting activities associated with low growing field crops on Day 0 following application at a rate of 2.0 pounds a.i. per acre.

The methamidophos MOE was equal to 25 on Day 0.

$$\text{Methamidophos MOE} = 0.03 / [ (0.0104)(0.001)(1000)(8) / 70 ] = 25$$

- Acephate MOEs are greater than 100 for harvesting activities associated with low growing field crops on Day 20 following application at a rate of 2.0 pounds a.i. per acre. The methamidophos MOE was equal to 6 on Day 0

$$\text{Methamidophos MOE} = 0.03 / [ (0.0104)(0.001)(4000)(8) / 70 ] = 6$$

- Acephate MOEs are greater than 100 for non-harvesting activities associated with turf on Day 0 following application at a rate of 5.0 pounds a.i. per acre. The methamidophos MOE was equal to 10 on Day 0.

$$\text{Methamidophos MOE} = 0.03 / [ (0.0260)(0.001)(1000)(8) / 70 ] = 10$$

- Acephate MOEs are greater than 100 for harvesting activities associated with turf on Day 21 following application at a rate of 5.0 pounds a.i. per acre. The methamidophos MOE was equal to 1 on Day 0.

$$\text{Methamidophos MOE} = 0.03 / [ (0.0260)(0.001)(4000)(8) / 70 ] = 2.5$$

Based on the findings of the surrogate agricultural assessment, occupational postapplication risks for both acephate and its degradation product methamidophos are of concern.

### **Residential Handler Exposure**

HED has determined that residential and other non-occupational handlers are likely to be exposed during acephate use. Residential exposure can occur to both children and adults as a result of applications of acephate at residential sites to control pests on turf, ornamentals, or fruit and vegetables. Adults or older child handlers can be exposed during applications to ornamental at residences, parks, and recreational areas, including shade trees, evergreen, and roses; turf at residences, parks, and recreational areas, spot-treatment in residential or public areas, including residences, restaurants, stores, hospitals, hotels, manufacturing plants, and ships.

Post-application exposure to adults and children can occur as a result of applications to the same sites.

Seven major exposure scenarios based on the types of equipment that potentially can be used were identified (See Table 14). These scenarios include:

- (1) mixing/loading/applying with a low pressure hand wand;
- (2) mixing/loading/applying with a backpack sprayer;
- (3) mixing/loading/applying using hose-end sprayer;
- (4) mixing/loading/applying with a sprinkling can;
- (5) loading/applying SP by hand/handtool/shaker can;
- (6) loading/applying granules by shaker can;
- (7) applying with an aerosol can.

Handler exposure assessment are completed by HED using a residential exposure scenario to achieve an appropriate margins of exposure. The residential scenario generally represents a handler wearing short pants, a short-sleeved shirt and no gloves. The calculation of residential exposures are presented in Table 15. These daily exposures are used to complete the risk assessment. Table 16 presents the residential risks.

### **Residential Handler Scenarios with Risk Concerns**

The calculations of dermal and inhalation risks indicate that MOEs are more than 100 (see Table 16) for the following scenarios:

- (2) Mixing/loading/applying using backpack sprayer at all application rates  
(low confidence all data - 90% Protection Factors (PF) used for hands)
- (4) Mixing/loading/applying using sprinkling can at all application rates  
(low confidence all data - no PFs used)
- (6) Loading/applying granules by shaker can  
(medium confidence all data - no PFs used)

Several issues must be considered when interpreting the residential exposure/risk assessment. These include:

- Several handler assessments were completed using "low quality" PHED data due to the lack of a more acceptable data set.
- A generic protection factor (90% PF for hands) was used to back-calculate hand exposures from gloved data. This protection factor is generally accepted by HED.
- Factors used to calculate daily exposures to handlers (e.g., areas treated per day and gallons of liquid applied) are based on the best professional judgement of HED staff.

## Residential Post-application Exposures, Assumptions and Risk

HED has determined that there are potential post-application exposures to residents entering treated lawns. It should be noted that postapplication exposures may also occur from contact (i.e., pruning, cutting, weeding) with treated ornamentals, flowers, trees, and shrubs. However, these exposures are expected to be lower than for turf exposures due to the lower contact rates, and are not evaluated here. Turf exposures are calculated assuming that a one-half acre lawn is treated. It is further assumed that 50 gallons of sprayed hose-end product are used to calculate an application rate in units of lbs ai/acre based on label rates in units of lbs ai/gallon. The scenarios likely to result in post-application exposures are listed in Tables 17 (acephate) and 18 (methamidophos from acephate application) and are as follows:

- Dermal exposure from residue on turf (adult and child);
- Incidental nondietary ingestion of residue on lawn from hand-to-mouth transfer (child);
- Ingestion of treated turfgrass (child); and
- Incidental ingestion of soil from treated areas (child).

The equations and assumptions used for each of the scenarios were taken from the Draft Standard Operating Procedures (SOPs) for Residential Exposure Assessments Guidance Document (December 1997)<sup>5</sup>. To the extent possible the chemical specific data from the cauliflower post-application study was translated to turf (using the previously discussed equation) for adult and child residential postapplication to residues of acephate on turf.

MOEs were calculated as follows, using the NOELs for acephate and methamidophos, as previously described in this document.

$$\text{MOE} = \frac{\text{NOEL}}{\text{ADD}}$$

where MOE is the Margin of Exposure; NOEL is the No Observable Effect Level; and ADD is the average daily dose.

The resulting surrogate residential postapplication assessment indicates that:

- The MOEs for dermal exposure to turf are less than 100 for acephate and less than 300 for methamidophos.

- The MOEs for hand-to-mouth exposure from turf applications are less than 100 for acephate and less than 300 for methamidophos.
- The MOEs for turf grass ingestion are greater than 100 for acephate, and less than 300 for methamidophos.
- The MOEs for soil ingestion are greater than 100 for acephate and greater than 300 for methamidophos.

Thus, HED has concerns for residential exposure to acephate and its degradation product methamidophos when considering dermal exposure to turf and hand-to-mouth exposure from turf applications.

When using the cauliflower postapplication chemical specific data and extending to turf, the acephate MOE for an adult is equal to or greater than 100 on Day 34, and the acephate MOE for a child is equal to or greater than 100 on Day 29.

## **FQPA CONSIDERATIONS**

### **Aggregate Exposure**

In examining aggregate exposure, FQPA directs EPA to take into account available information concerning exposures from pesticide residues in food and other exposures for which there is reliable information. These other exposures include drinking water and non-occupational exposures, e.g., to pesticides used in and around the home. Risk assessments for aggregate exposure consider both short-, intermediate- and long-term (chronic) exposure scenarios considering the toxic effects which would likely be seen for each exposure duration.

Acephate is a food use chemical. Currently, HED has no information to quantitate risk from drinking water; however, Drinking Water Levels of Comparison (DWLOC) have been calculated for Acephate and its degradate Methamidophos. There are residential (non-occupational) uses of acephate; therefore, the considerations for aggregate exposure are those from food and residential exposure.

For **chronic aggregate risk (food)**, chronic exposures to methamidophos from application of acephate and application of methamidophos were combined and compared to the methamidophos reference dose. This assessment was conducted using anticipated residues and BEAD % crop treated information. Results of the chronic exposure analysis show that 65% and 50% of the RfD is consumed for the U.S. population and non-nursing infants, respectively. The most significantly exposed subpopulation, children (1 to 6 years ) occupied 106 % of the RfD. The results indicate that for the children, HED's level of concern is exceeded.



An **acute aggregate risk (food)** which considers methamidophos from application of acephate and methamidophos was not conducted since HED already has concerns for methamidophos from application of acephate alone. It is recommended that the registrant (s) conduct a Monte Carlo analysis which includes an aggregate assessment which take into account methamidophos from application of acephate and methamidophos to address acute dietary concerns.

No **aggregate cancer risk** assessment is required because methamidophos is not a carcinogen.

An **aggregate exposure assessment which quantifies risk from food, water, and residential sources** was not conducted because HED has residential exposure concerns.

### **Drinking Water**

In the absence of monitoring data for a pesticide and as a first tier approach, HED compares the models' estimates for both surface and ground water to calculated drinking water levels of comparison (DWLOCs) for surface and ground water. The DWLOC is the concentration of a chemical in drinking water that would be acceptable as an upper limit in light of *total* aggregate exposure to that chemical from food, water, and non-occupational (residential) sources. Since HED has residential exposure concerns for acephate, there is no allowable exposure to the pesticide through drinking water.

### **Cumulative Exposure To Substances with Common Mechanism of Toxicity.**

Section 408(b)(2)(D)(v) of the Food Quality Protection Act requires that, when considering whether to establish, modify, or revoke a tolerance, the Agency consider "available information" concerning the cumulative effects of a particular pesticide's residues and "other substances that have a common mechanism of toxicity." The Agency believes that "available information" in this context might include not only toxicity, chemistry, and exposure data, but also scientific policies and methodologies for understanding common mechanisms of toxicity and conducting cumulative risk assessments. For most pesticides, although the Agency has some information in its files that may turn out to be helpful in eventually determining whether a pesticide shares a common mechanism of toxicity with any other substances, EPA does not at this time have the methodologies to resolve the complex scientific issues concerning common mechanism of toxicity in a meaningful way. EPA has begun a pilot process to study this issue further through the examination of particular classes of pesticides. The Agency hopes that the results of this pilot process will increase the Agency's scientific understanding of this question such that EPA will be able to develop and apply scientific principles for better determining which chemicals have a common mechanism of toxicity

and evaluating the cumulative effects of such chemicals. The Agency anticipates, however, that even as its understanding of the science of common mechanisms increases, decisions on specific classes of chemicals will be heavily dependent on chemical specific data, much of which may not be presently available.

Although at present the Agency does not know how to apply the information in its files concerning common mechanism issues to most risk assessments, there are pesticides as to which the common mechanism issues can be resolved. These pesticides include pesticides that are toxicologically dissimilar to existing chemical substances (in which case the Agency can conclude that it is unlikely that a pesticide shares a common mechanism of activity with other substances) and pesticides that produce a common toxic metabolite (in which case common mechanism of activity will be assumed).

EPA does not have, at this time, available data to determine whether acephate has a common mechanism of toxicity with other substances or how to include this pesticide in a cumulative risk assessment. For the purposes of this tolerance action, therefore, EPA has not assumed that acephate has a common mechanism of toxicity with other substances.

However, the Agency has determined that acephate has a metabolite which is a registered pesticide, methamidophos. Therefore, methamidophos residues resulting from applications of both acephate and methamidophos will be considered in a cumulative risk assessment and compared to appropriate toxicological endpoints for methamidophos. This is described to some extent in the aggregate exposure section of this risk assessment document.

### **Endocrine Disruption**

EPA is required to develop a screening program to determine whether certain substances (including all pesticides and inerts) "may have an effect in humans that is similar to an effect produced by a naturally occurring estrogen, or such other endocrine effect...". The Agency is currently working with interested stakeholders, including other government agencies, public interest groups, industry and research scientists in developing a screening and testing program and a priority setting scheme to implement this program. Congress has allowed 3 years from the passage of FQPA (August 3, 1999) to implement this program. At that time, EPA may require further testing of this active ingredient and end use products for endocrine disrupter effects.

### **Determination of Safety for Infants and Children**

FFDCA section 408 provides that EPA shall apply an additional tenfold margin of safety for infants and children in the case of threshold effects to account for pre-and post-natal toxicity

and the completeness of the database unless EPA determines that a different margin of safety will be safe for infants and children. Margins of safety are incorporated into EPA risk assessments either directly through use of a MOE analysis or through using uncertainty (safety) factors in calculating a dose level that poses no appreciable risk to humans. EPA believes that reliable data support using the standard MOE and uncertainty factor (usually 100 for combined inter- and intra-species variability)) and not the additional tenfold MOE/uncertainty factor when EPA has a complete data base under existing guidelines and when the severity of the effect in infants or children or the potency or unusual toxic properties of a compound do not raise concerns regarding the adequacy of the standard MOE/safety factor.

**Adequacy of data:** The toxicology data base included an acceptable two-generation reproduction study in rats and prenatal developmental toxicity studies in rats and rabbits, meeting the basic data requirements, as defined for a food-use chemical by 40 CFR Part 158. In addition, a somatic cell assay provided information on effects in mice following prenatal exposure to acephate. There are no data gaps for the assessment of the effects of acephate following in utero and/or early postnatal exposure.

**Susceptibility issues:** There was no indication of increased sensitivity of the offspring of rats, mice, or rabbits to pre- and or postnatal exposure to acephate. In all studies examined, maternal or parental NOELs were less than or equivalent to offspring NOELs.

**Uncertainty factor:** The Agency determined that for acephate the 10-fold uncertainty factor for the protection of infants and children would be removed. This conclusion was based upon the following:

- (a) In prenatal developmental toxicity studies following *in utero* exposure in rats and rabbits, there was no evidence of effects being produced in fetuses at lower doses as compared to maternal animals nor was there evidence of an increase in severity of effects at or below maternally toxic doses.
- (b) In the pre/post natal two-generation reproduction study in rats, there was no evidence of enhanced susceptibility in pups when compared to adults (i.e., effects noted in offspring occurred at maternally toxic doses or higher).
- (c) There was no evidence of abnormalities in the development of the fetal nervous system in the pre/post natal studies.
- (d) There was no convincing evidence for requiring a developmental neurotoxicity study in rats.
- (e) The toxicology data base is complete and there are no data gaps according to Subdivision F Guideline requirements including meeting any of the triggers for requiring a developmental neurotoxicity study in rats.

Table 5: Occupational Exposure Scenario Descriptions for the Use of Acephate

Exposure Scenario (Number)	Data Source	Standard Assumptions (8-hr work day)	Comments*
<b>MIXER/LOADER DESCRIPTORS</b>			
Mixing/Loading Soluble Powder (1s/1b/1c/1d/1e/1f/1g/1h)	PHED V1.1	350 acres for aerial application/ chemigation; 80 acres for groundboom on agricultural, 40 acres on golf courses, 40 acres for airblast application (1,000 gallons used for trees&shrubs and outdoor floral), 13 gallons/acre and 6 acres for fire ant control, 1,000 gallons and 5 acres for hydraulic sprayer, 200,000 pounds of seed for slurry seed treatment, 20 acres for transplanting on a tobacco farm and 80 acres for hopper box application	<p>Baseline: Hand and dermal data are ABC grades, and inhalation data are ABC grades. Hand = 7 replicates; dermal = 22 to 45 replicates; and inhalation = 44 replicates. Low confidence in hand data due to the low number of hand replicates. Medium confidence in dermal and inhalation data. No protection factor was needed to define the unit exposure value.</p> <p>PPE: The same dermal data are used as for baseline. Hand data are AB grade with 24 replicates and a high confidence level. The same inhalation data are used as for baseline with an 80% protection factor to simulate the use of a dust/mist respirator.</p> <p>Engineering Controls: Hands and Dermal = ABC grades; Inhalation = ABC grades. Hands = 5 replicates; Dermal = 6 to 15 replicates; Inhalation = 12 replicates; Low confidence all data. No protection factor was needed to define the unit exposure value. Engineering controls are based on water soluble packets.</p>
Mixing/ Loading Dry Flowable (2)	PHED V1.1	200,000 pounds of seed	<p>Baseline: Hand and dermal data are AB grades, and inhalation data are AB grades. Hand = 7 replicates; dermal = 16 to 26 replicates and inhalation = 23 replicates. Low confidence in hand data due to the low number of hand replicates. High confidence in dermal and inhalation data. No protection factor was needed to define the unit exposure value.</p> <p>PPE: The same dermal data are used as for baseline. Hand data are ABC grade with 34 replicates and a medium confidence level. The same inhalation data are used as for baseline with an 80% protection factor to simulate the use of a dust/mist respirator.</p> <p>Engineering Controls: Hands and Dermal = ABC grades; inhalation = ABC grades. Hands = 5 replicates; Dermal = 6 to 15 replicates; Inhalation = 12 replicates; Low confidence all data. No protection factor was needed to define the unit exposure value. Engineering controls are based on water soluble packets.</p>
Mixing/Loading Liquids (3)	PHED V1.1	350 acres, for agricultural settings, 800 acres used for forest application; 200,000 pounds of cotton seed.	<p>Baseline: Hand and dermal are AB grades, and inhalation are AB grades. Hand replicates = 53 replicates; Dermal = 71 to 121 replicates; and inhalation = 85 replicates. High confidence in hand/dermal and inhalation data. No protection factor was needed to define the unit exposure.</p> <p>PPE :The same dermal data are used as for baseline. Hands = AB grades, replicates = 59. The same inhalation data are used as for the baseline with an 80% protection factor to simulate the use of a dust/mist respirator.</p> <p>Engineering Controls : Hand and dermal unit exposure are ABC grades. Hand = 31 replicates; and dermal=30 to 36 replicates. Medium confidence in dermal and hand data. Inhalation are AB grades; replicates = 27. High confidence in inhalation data. Gloves are worn during the use of engineering controls. No protection factor was needed to define the unit exposure value.</p>

Exposure Scenario (Number)	Data Source	Standard Assumptions* (8-hr work day)	Comments*
Mixing/Loading Granular (4)	PHED V1.1	80 acres	<p>Baseline: Hand data are all grades, dermal are ABC grades, and inhalation are AB grades. Hand = 10 replicates; dermal = 33 to 78 replicates; and inhalation = 58 replicates. Low confidence in hand data, medium confidence in dermal data, and high confidence in inhalation data. No protection factor was needed to define the unit exposure value.</p> <p>PPE: The same inhalation data are used as for baseline coupled with an 80% protection factor to simulate the use of a dust/mist respirator. Hand data are AB grades with 45 replicates, and high confidence level.</p> <p>Engineering Controls: The same data are used as for baseline with a 98% protection factor to simulate the use of a closed mixing system.</p>
<b>APPLICATOR DESCRIPTIONS</b>			
Applying Sprays with Fixed Wing Aircraft (5)	PHED V1.1	350 acres for crops; 800 acres for forest	<p>Baseline: No data.</p> <p>PPE: No data.</p> <p>Engineering Controls: Hands = AB grade, dermal and inhalation=ABC grade. Hands=34 replicates; dermal =24 to 48 replicates, and inhalation =23 replicates. Medium Confidence in dermal and inhalation data; high confidence in hand data. No Protection factor was needed to define the unit exposure value.</p>
Applying Sprays with Rotary Wing Aircraft (6)	PHED V1.1	350 acres for crops; 800 acres for forest	<p>Baseline: No data.</p> <p>PPE: No data.</p> <p>Engineering Controls: Hands and inhalation =A grade and dermal=C grade. Hands=2; replicates; dermal=3 replicates; and inhalation=3 replicates. Low confidence in dermal, hands and inhalation data. No protection factor was needed to define the unit exposure value.</p>
Applying with Ground Boom Sprayer (7)	PHED V1.1	80 acres (ag); 40 acres (golf course)	<p>Baseline: Hand, dermal, and inhalation data =AB grades. Hand = 29 replicates; dermal = 23 to 42 replicates; and inhalation = 22 replicates. High confidence in hand/dermal and inhalation data. No protection factor was needed to define the unit exposure value.</p> <p>PPE: The same dermal data are used as for baseline. The same inhalation data are used as for baseline with an 80% protection factor to simulate the use of a dust/mist respirator. Hand data are ABC grades, with 21 replicates, and medium confidence level.</p> <p>Engineering Controls: Hand and dermal data are ABC grades, and inhalation are AB grades. Hand = 16 replicates; dermal =20 to 31 replicates; inhalation = 16 replicates. Medium confidence in hand/dermal data, and high confidence in inhalation data.</p>

Exposure Scenario (Number)	Data Source	Standard Assumptions (8-in. work day)	Comments
Applying with Airblast Sprayer (8)	PHED V1.1	40 acres; 1,000 gallons	<p>Baseline: Hands = ABC grades; dermal and inhalation = AB grades. Hands = 31 replicates, dermal = 31 to 48 replicates; and inhalation = 47 replicates. High confidence in the dermal and inhalation data; medium confidence in hand data; No protection factor was needed to define the unit exposure.</p> <p>PPE: The same inhalation data are used as for the baseline coupled with an 80% protection factor to account for the use of a dust/mist respirator. Dermal = AB grades with 31 to 48 replicates and high confidence level. Hands = AB grades with 18 replicates, and high confidence level.</p> <p>Engineering Controls: Hands and Dermal = AB grade and inhalation = ABC grade. Hands = 20 replicates (no glove data back calculated from glove data assuming a 90% protection factor for gloves); dermal = 20-30 replicates and inhalation = 9 replicates. High confidence in hands and dermal data and low confidence in inhalation data.</p>
Applying Spray with Handgun Sprayer (9)	PHED V1.1	Fire Ants 13 gal/acre and 6 acres gallons; trees & shrubs 1,000 gal; turf 5 acres	<p>Baseline: Hand data are AB grades, dermal data are ABC grades, and inhalation data are A grades. Hand = 16 replicates; dermal = 4 to 20 replicates; and inhalation = 16 replicates. Low confidence in dermal data, and high confidence in hand and inhalation data. No protection factor was needed to define the unit exposure value.</p> <p>PPE: The same dermal data are used as for baseline. Hand data are AB grades with 4 replicates and low confidence level. The same inhalation data are used as for the baseline coupled with an 80% protection factor to simulate the use of a dust/mist respirator.</p> <p>Engineering Controls: Not feasible for this scenario.</p>
Applying in Transplanting Water (10)	PHED V1.1	20 acres	<p>No PHED data were available for this scenario; therefore, used the PHED data for groundboom, which may over-estimate transplant water application. See scenario (7)</p>
Applying in Seed Treatment Hopper Box (11)	No Data	No Data	NA
Applying as a Seed Treatment in a Slurry Tank (12)	No Data	No Data	NA
Applying Granular with Tractor Drawn Drop Type Spreader (13)	PHED V1.1	80 acres	<p>Baseline: Hand and dermal data are AB grade, and inhalation data are AB grade. Hand = 5 replicates; dermal = 1 to 5 replicates; and inhalation = 5 replicates. Low confidence in hand/dermal data, and low confidence in inhalation data. No protection factor was needed to define the unit exposure value.</p> <p>PPE: The same dermal data are used as for baseline. Hand data (gloved) are estimated from no gloves data using a 90% protection factor. The same inhalation data are used as for the baseline with an 80% protection factor to simulate the use of a dust/mist respirator.</p> <p>Engineering Controls: Hand, dermal, and inhalation are AB grades. Hand = 24 replicates; dermal = 2-30 replicates; and inhalation = 37 replicates. High confidence in hand, and inhalation data; low confidence in dermal data.</p>

Exposure Scenario (Number)	Data Source	Standard Assumptions* (8-hr work day)	Comments*
<b>MIXER/LOADER/ APPLICATOR</b>			
Mixing/Loading/Applying Soluble Powders Using Low Pressure Hand Wand (14a)	PHED V1.1	40 gallons; for floral crops; 5 gallons for Wasps and Fire ants	<p>Baseline: Hand data are AB grades, dermal are ABC grades, and inhalation data are ABC grades. Hand = 15 replicates, back calculated from glove data assuming a 90% protection factor from gloves; dermal = 16 replicates; and inhalation = 16 replicates. Medium confidence in hand, dermal and inhalation data.</p> <p>PPE: The same dermal, hand, and inhalation data are used as for baseline with an 80% protection factor for inhalation unit exposure to simulate the use of a dust/mist respirator.</p> <p>Engineering Controls: Not feasible for this scenario.</p>
Mixing/Loading/Applying Wettable Powders Using Low Pressure Hand Wand (14b)	MRID 40504823	crack and crevice treatment at residential sites: 1 qt finished product/house; range of 1 to 20 houses/day commercial sites: range of 1 to 20 gallons finished product per day	<p>9 replicates for residential sites</p> <p>9 replicates for commercial sites</p>
Mixing/Loading/Applying Using Backpack Sprayer (15)	PHED V1.1	40 gallons; for floral crops; 5 gallons for Wasps and Fire ants	<p>Baseline: Hand data are ABC grade, dermal are AB grades, and inhalation data are A grades. Hand = 11 replicates (back calculated from glove data assuming a 90% protection factor for gloves); dermal = 9 to 11 replicates; and inhalation = 11 replicates. Low confidence in hand/dermal and inhalation data.</p> <p>PPE: The same dermal, hand, and inhalation data are used as for the baseline coupled with an 80% protection factor to account for the use of a dust/mist respirator.</p> <p>Engineering Controls: Not feasible for this scenario.</p>
Mixing/Loading/Applying using High Pressure Sprayer (16)	PHED V1.1	1,000 gallons	<p>Baseline: Hands = ABC grade; dermal = AB grades; and inhalation = A grades. Hands = 13 replicates, back calculated from glove data using a 90% protection factor; dermal = 7 to 13 replicates; and inhalation = 13 replicates. Low confidence in hands, dermal and inhalation data.</p> <p>PPE: The same dermal data are used as for baseline couple with a 80% protection factor to account for the use of a dust/mist respirator.</p> <p>Engineering Controls: Not feasible for this scenario.</p>
Loading/Applying Using Aerosol Generator (17)	No Data	--	NA
Loading/Applying with PCO injector (18)	No Data	--	See scenario 14(b) for similar scenario for crack and crevice treatment
Loading/Applying SP by Hand/Handtool/Shaker Can (19)	PHED V1.1	10 mounds /acre; 1 acre	No PHED data were available for this scenario. Therefore, used the PHED data for the granular bait dispersed by hand scenario. See scenario (24).

Exposure Scenario (Number)	Data Source	Standard Assumptions* (8-hr work day)	Comments
Mixing/Loading /Applying Soluble Powder using Sprinkler Can (20)	No Data	1 gal/mound; 10 mound/acre; 1 acre	No PHED data were available for this scenario. Therefore, used the PHED data for the garden hose-end sprayer.  Baseline: Dermal and inhalation = ABC grade, hands = E grade; dermal = 8 replicates, hands = 8 replicates, inhalation = 8 replicates; A 50% protection factor was used to simulate long pants and long sleeve shirts.
Loading/Applying Tree Injections (21)	No Data	No Data	NA
Loading/ Applying Granular with Belly Grinder (22)	PHED V1.1	2 acres	Baseline: Hand and dermal data are ABC grades, and inhalation data are AB grades. Hand = 23 replicates; dermal = 29 to 45 replicates; and inhalation = 40 replicates. Medium confidence in hand/dermal data, and high confidence in inhalation data. No protection factor was needed to define the unit exposure value.  PPE: The same dermal data are used as for baseline. Hand data are ABC grade with 15 replicates and medium confidence level. The same inhalation data are used as for the baseline coupled with an 80% protection factor to account for the use of a dust/mist respirator.  Engineering Controls: Not feasible for this scenario.
Loading/Applying/ Granular with Shaker Can (23)	PHED V1.1	10,000 sq. ft	No PHED data were available for this scenario; therefore, used the PHED data for the granular bait dispersed by hand scenario. See scenario (24)
Loading/Applying Granular by Hand (24)	PHED V1.1	1000 pots	Baseline: Hand, dermal and inhalation data are ABC grades. Hands = 15 replicates, back calculated from glove data assuming a 90% protection factor; dermal = 16 replicates and inhalation = 16 replicates. Medium confidence in hand, dermal and inhalation data.  PPE: The same dermal, hands, and inhalation data are used as for baseline with a 80% protection factor for inhalation unit exposure value to simulate the use of a dust/mist respirator  Engineering Controls: There is the possibility of mechanical application; however, for this scenario extrapolation is not appropriate.
<b>FLAGGER DESCRIPTORS</b>			
Flagging Aerial Applications (25)	PHED V1.1	350 acres agricultural; 800 acres forest	Baseline: Hands, dermal and inhalation AB grades. Dermal = 18 to 28 replicates; Hands = 30 replicates; and inhalation = 28 replicates. High confidence in dermal, hands, and inhalation data.  PPE: The same dermal data are used as for baseline. Hand data are AB grades with 6 replicates and low confidence. The same inhalation data are used as for baseline coupled with a 80% protection factor to simulate the use of a dust/mist respirator.  Engineering Controls: The same data are used as for baseline with a 90% protection factor to simulate a closed cab.

\* Standard Assumptions based on an 8-hour work day as estimated by HED. BEAD data were not available.



b These grades are based on Quality Assurance/Quality Control data provided as part of the exposure studies. A replicate refers to data acquired during one complete work cycle. All handler exposure assessments in this document are based on the "Best Available" data as defined by HED SOP for meeting Subdivision U Guidelines (i.e., completing exposure assessments.) Best available grades are assigned as follows: matrices with grades A and B data (which is defined as acceptable grade data) and a minimum of 15 replicates; if not available, then grades A, B, and C data and a minimum of 15 replicates; if not available, then all data (all grades) regardless of the quality and number of replicates. High quality data with a protection factor take precedence over low quality data with no protection.

Data confidence as reported in the Table refers to both the quality and the quantity (number of replicates) of data for each PHED run. Each study in PHED has been graded from A to E. A high confidence run is grades A and B data and 15 or more replicates per body part. Any combination of A and B grade data are listed as acceptable grades data in the tables. A medium confidence run is grades A, B, and C data and 15 or more replicates per body part. Any combination of A, B, and C grade data are listed as ABC grade data in the tables. A low confidence run is all grades (any run that includes D or E grade data) or has less than 15 replicates per body part.

Table 6. Occupational Inhalation and Short-term and Intermediate-term Dermal Exposures to Acephate at Baseline

Exposure Scenario (See 7)	Baseline Dermal Unit Exposure (mg/lb al) <sup>b</sup>	Baseline Inhalation Unit Exposure (ug/lb al) <sup>b</sup>	Application Rate (al)	Amount Handled per Day <sup>a</sup>	Baseline Daily Dermal Exposure (mg/day) <sup>a</sup>	Baseline Daily Inhalation Exposure (mg/day) <sup>a</sup>		
<b>MIXER/LOADER EXPOSURE</b>								
Mixing/Loading Soluble Powder for Aerial Application (1a)	3.7	43	Ag. 0.5 lb/acre	350 acres	650	7.5		
			Ag 1.0 lb/acre					
			Turf 5.0 lb/acre					
			Pasture 0.125 lb/acre					
Mixing/Loading Soluble Powder for Chemigation Application (1b)	3.7	43	Cranberries 1.0 lb/acre	350 acres	1,300	15		
			Ag. 0.5 lb/acre					
Mixing/Loading Soluble Powder for Ground boom Application (1c)	3.7	43	Ag 1.0 lb/acre	80 acres	300	3.4		
			Pasture 0.125 lb/acre					
			Turf 5.0 lb/acre					
			80 acres (sod)				1,500	17
Mixing/Loading Soluble Powder for Airblast Application (1d)	3.7	43	40 acres (golf)	40 acres	740	8.6		
			Non-bearing Citrus 0.5 lb/acre				74	0.86
			Trees&Shrubs 1.0 lb/100 gal				1,000 gal	37
Mixing/Loading Soluble Powder for Handgun (Hydraulic Sprayer) Application (1e)	3.7	43	Outdoor Floral 0.5 lb/100 gal	1,000 gal	19	0.22		
			Tobacco (fire ant) 1.0 lb/80 gal				13 gal/acre; 6 acres	3.6
			Trees, Shrubs, Outdoor floral crops 1.0 lb/100 gal	1,000 gal	37	0.43		

Table 6. Occupational Inhalation and Short-term and Intermediate-term Dermal Exposures to Acephate at Baseline Continued

Exposure Scenario (Scen. #)	Baseline Dermal Unit Exposure (mg/lb ai)*	Baseline Inhalation Unit Exposure (µg/lb ai)	Application Rate (ai)	Amount Handled per Day <sup>4</sup>	Baseline Daily Dermal Exposure (mg/day) <sup>5</sup>	Baseline Daily Inhalation Exposure (mg/day) <sup>6</sup>
			Trees, Shrubs, Outdoor floral crops		19	0.22
			Turf	5 acres	93	1.1
Mixing/Loading Soluble Powder for Transplanting Water Application (1f)	3.7	43	0.75 lb/acres	20 acres	55.5	0.65
Mixing/Loading Soluble Powder for Slurry Seed Treatment (1g)	3.7	43	0.04 lb/100 lb seed	200,000 lbs of seed	296	3.4
Loading Soluble Powder for Hopper Box Application(1h)	3.7	43	0.1875 lb/acre	80 acres	56	0.65
Mixing/Loading Dry Flowable for Slurry Seed Treatment (2)	0.066	0.77	0.04 lbs/100 lb seed	200,000 lbs of seed	5.3	0.062
Mixing/Loading Liquids for Aerial Application (3a)	2.9	1.2	0.75 lb/acre	350 acres	760	0.32
			Forest	800 acres	1,700	0.72
Mixing/Loading Liquids for Slurry Seed Treatment (3b)	2.9	1.2	0.04 lb/ 100 lb seed	200,000 lbs of seed	230	0.096
Loading Granular in Drop-Type Tractor-Drawn Spreader (4)	0.0084	1.7	1.0 lb/acre	80 acres	0.67	0.14
<b>APPLICATOR EXPOSURE</b>						
Applying Sprays with Fixed Wing Aircraft (5)	See Engineering Controls	See Engineering Controls	Ag.	350 acres	See Engineering Controls	See Engineering Controls
			Ag.			
			Turf			
			Pasture			
			Forest			
				350 acres		
				800		

**Table 6. Occupational Inhalation and Short-term and Intermediate-term Dermal Exposures to Acephate at Baseline Continued**

Exposure Scenario (Scan #)	Baseline Dermal Unit Exposure (mg/lb ai) <sup>a</sup>	Baseline Inhalation Unit Exposure (µg/lb ai) <sup>b</sup>	Application Rate (ai) <sup>c</sup>	Amount Handled per Day <sup>d</sup>	Baseline Daily Dermal Exposure (mg/day) <sup>e</sup>	Baseline Daily Inhalation Exposure (mg/day) <sup>f</sup>
Applying Spray With Rotary Wing Aircraft (6)	See Engineering Controls	See Engineering Controls	Ag. 0.5 lb/acre	350 acres	See Engineering Controls	See Engineering Controls
			Ag. 1.0 lb/acre			
			Turf 5.0 lb/acre			
			Pasture 0.125 lb/acre			
			Forest 0.75 lb/acre			
				350 acres		
				800 acres		
Applying Spray with a Groundboom Sprayer (7)	0.014	0.74	Ag. 0.5 lb/acre	80 acres	0.56	0.030
			Ag. 1.0 lb/acre			
			Pasture 0.125 lb/acre			
			Turf 5.0 lb/acre			
				80 acres (sod)	5.6	0.30
				40 acres (golf)	2.8	0.15
Applying Spray with Airblast Sprayer (8)	0.36	4.5	Non-bearing Citrus 0.5 lb/acre	40 acres	7.2	0.090
			Trees&Shrubs 1.0 lb/100 gal			
			Outdoor Floral 0.5 lb/100 gal			
			Tobacco (fire ant) 1.0 lb/80 gal			
				1,000 gal	3.6	0.045
Applying Spray with Handgun Sprayer (9)	1.3	3.9	Outdoor Floral 0.5 lb/100 gal	1,000 gal	1.8	0.023
			Tobacco (fire ant) 1.0 lb/80 gal			
			Trees, Shrubs, Outdoor floral crops 1.0 lb/100 gal			
			Trees, Shrubs, Outdoor floral crops 0.5 lb/100 gal			
			Turf 5 lb/acre			
				13 gal/acre; 6 acres	1.3	0.0038
				1,000 gal	13	0.039
					6.5	0.020
				5 acres	33	0.098
Applying in Transplanting Water (10)	0.014	0.74	Tobacco 0.75 lb/acre	20 acres	0.21	0.011

Table 6. Occupational Inhalation and Short-term and Intermediate-term Dermal Exposures to Acephate at Baseline Continued

Exposure Scenario (See #)	Baseline Dermal Unit Exposure (mg/lb ai)*	Baseline Inhalation Unit Exposure (µg/lb ai)*	Application Rate (ai)*	Amount Handled per Day <sup>4</sup>	Baseline Daily Dermal Exposure (mg/day)*	Baseline Daily Inhalation Exposure (mg/day) <sup>5</sup>
Applying as a Seed Treatment in a Hopper Box (11)	No Data	No Data	0.1875 lb/acre	80 acres	No Data	No Data
Applying as a Seed Treatment in a Slurry Tank (12)	No Data	No Data	0.04 lb/100 lb seed	200,000 lbs of seed	No Data	No Data
Applying Granular with Tractor-Drawn Drop-Type Spreader (13)	0.0099	1.2	1.0 lb/acre	80 acres	0.79	0.096
<b>MIXER/LOADER/APPLICATOR EXPOSURE</b>						
Mixing/Loading/Applying Soluble Powders Using Low Pressure Hand Wand (14a)	29	1,100	Trees, Shrubs, Roses, Ground Cover, Floral Crops: 0.5 lb/100 gal	40 gal	5.8	0.22
			Trees, Shrubs, Roses, Ground Cover, Floral Crops: 1.0 lb/100 gal		12	0.44
			Wasps 0.075 lb/1 gal	5 gal	11	0.41
			Fire Ant (non-crop) 0.047 lb/5 gal	5 gal	1.4	0.052
			PCO 0.088 lb/gal	40 gal	100	3.9
Mixing/Loading/Applying Wettable Powders Using Low Pressure Hand Wand (14b)	160	2800	0.08745	0.25 gal.	3.4	0.06
			0.08745	4 gal.	56	0.98
			0.08745	1 gal.	15	0.24
	170	2800	0.08745	40 gal.	600	9.8
Mixing/Loading/Applying Using Backpack Sprayer(15)	2.5	30	Trees, Shrubs, Roses, Ground Cover, Floral Crops: 0.5 lb/100 gal	40 gal	0.5	0.0060
			Trees, Shrubs, Roses, Ground Cover, Floral Crops: 1.0 lb/100 gal		1	0.012
			Wasps 0.075 lb/1 gal	5 gal	0.94	0.011
			Fire Ant (non-crop) 0.047 lb/5 gal	5 gal	0.12	0.0014
			PCO 0.088 lb/gal	40 gal	8.8	0.11

Table 6. Occupational Inhalation and Short-term and Intermediate-term Dermal Exposures to Acephate at Baseline Continued

Exposure Scenario (See. 7)	Baseline Dermal Unit Exposure (mg/lb ai) <sup>a</sup>	Baseline Inhalation Unit Exposure (µg/lb ai) <sup>b</sup>	Application Rate (ai) <sup>c</sup>	Amount Handled per Day <sup>d</sup>	Baseline Daily Dermal Exposure (mg/day) <sup>e</sup>	Baseline Daily Inhalation Exposure (mg/day) <sup>f</sup>
Mixing/Loading/Applying Using High Pressure Sprayer(16)	3.5	120	Trees, Shrubs, Roses, Ground Cover, Floral Crops: 0.5 lb/100 gal 1.0 lb/100 gal	1,000 gal	18	0.60
Loading/Applying Using Aerosol Generator (17)	No Data	No Data	Indoor ornamentals, flowers, trees, shrubs, roses: 10 seconds per 100 sq ft if 2 ft plants	No Data	No Data	No Data
			Outdoor ornamentals, flowers, trees, shrubs, roses: 1 second per row-foot; spray both sides of row	No Data	No Data	No Data
Loading/Applying with PCO injector (18)	No Data	No Data	PCO crack&revice: 1% spray; 1 second of spray per spot; 1 spot per linear foot	No Data	No Data	No Data
Loading/Applying Soluble Powder by Hand/ Handtool/Shaker Can (19) (label 00239-02406)	100	470	Fire Ants 2 tsp/mound (0.00694 lb/mound)	10 mounds/acre; 1 acre	6.94	0.0326
Mixing/Loading/Applying Soluble Powder Using Sprinkling Can (20)	31	9	Fire Ants 0.047 oz/5 gal (0.0029 lb/5 gal)	1 gal/mound; 10 mounds/acre; 1 acre	0.182	0.000053
Loading/Applying Tree Injections (21)	No Data	No Data	1.5 gm/injection	Dependent on tree size	No Data	No Data
Loading/Applying Granules with Belly Grinder (22)	10	62	Trees, shrubs, ornamentals 0.1125 lb/1,000 sq ft	87,000 sq. ft.	97.9	0.606
Loading/Applying Granules with Shaker Can (23)	100	470	Trees, shrubs, ornamentals 0.1125 lb/1,000 sq ft	10,000 sq. ft.	112.5	0.53
Loading/Applying Granules by Hand (24) (label 59639-87)	100	470	0.00099 lb per pot up to 12" diameter	1000 pots	99	0.4653

**Table 6. Occupational Inhalation and Short-term and Intermediate-term Dermal Exposures to Acephate at Baseline Continued**

Exposure Scenario (See, f)	Baseline Dermal Unit Exposure (mg/lb ai) <sup>a</sup>	Baseline Inhalation Exposure (µg/lb ai) <sup>b</sup>	Application Rate (ai) <sup>c</sup>	Amount Handled per Day <sup>d</sup>	Baseline Daily Dermal Exposure (mg/day) <sup>e</sup>	Baseline Daily Inhalation Exposure (mg/day) <sup>f</sup>
			Fire ants: 2 tsp/mound (0.008 lb/mound)	1 acre; 10 mounds per acre	8	0.0376
			Trees, shrubs, ornamentals 0.1125 lb/1,000 sq ft	1,000 sq ft	11.25	0.0529
<b>FLAGGER EXPOSURE</b>						
Flagging Aerial Spray Applications (25)	0.011	0.35	Ag. 0.5 lb/acre	350 acres	1.9	0.061
			Ag. 1.0 lb/acre		3.9	0.12
			Turf 5.0 lb/acre		19	0.61
			Pasture 0.125 lb/acre		0.48	0.015
			Forest 0.75 lb/acre		2.9	0.092
				800 acres	6.6	0.21

**Footnotes:**

- a Baseline dermal unit exposure represents long pants, long sleeved shirt, no gloves, open mixing/loading, open cab tractor.
- b Baseline inhalation represents no respirator.
- c Application rates are values found in acephate labels.
- d Daily amount handled values are from the HED estimates of amount that could be handled in a single day for each exposure scenario of concern.
- e Daily dermal exposure (mg/day) = Unit exposure (mg/lb ai) \* Appl. rate (lb ai/acre) or (lbs ai/gallon) \* Amount treated (acre/day or gallons/day).
- f Daily inhalation exposure (mg/day) = Unit exposure (mg/lb ai) \* (1mg/1000µg) Conversion Factor \* Appl. rate (lb ai/acre) \* Amount treated (acre/day or gallons/day).

Table 7. Occupational Inhalation and Short-term and Intermediate-term Dermal Risks to Acephate at Baseline

Exposure Scenario (See 4)	Baseline Daily Dermal Dose <sup>a</sup> (mg/kg/day)	Baseline Dermal MOE <sup>b</sup>	Baseline Daily Inhalation Dose <sup>c</sup> (mg/kg/day)	Baseline Inhalation MOE <sup>d</sup>	Baseline Combined Dermal & Inhalation MOE <sup>e</sup>
<b>MIXER/LOADER</b>					
Mixing/Loading Soluble Powder for Aerial Application (1a)	9.3	1.3	0.11	1.3	<1
	19	0.63	0.21	0.67	<1
	93	0.13	1.1	0.13	<1
	2.3	5.2	0.027	5.2	3
Mixing/Loading Soluble Powder for Chemigation Application (1b)	19	0.63	0.21	0.67	<1
Mixing/Loading Soluble Powder for Groundboom Application (1c)	2.1	5.7	0.024	5.8	3
	4.3	2.8	0.049	2.9	1
	0.53	23	0.0061	23	12
	21	0.57	0.24	0.58	<1
	11	1.1	0.12	1.2	<1
Mixing/Loading Soluble Powder for Airblast Application (1d)	1.1	11	0.012	12	6
	0.53	23	0.0061	23	12
	0.27	44	0.0031	45	22
Mixing/Loading Soluble Powder for Handgun Sprayer Application (1e)	0.051	240	0.00060	230	120
	0.53	23	0.0061	23	12
	0.27	44	0.0031	45	22
	1.3	9.2	0.016	8.8	5
Mixing/Loading Soluble Powder for Transplanting Water Application (1f)	0.79	15	0.0093	15	8
Mixing/Loading Soluble Powder for Slurry Seed Treatment (1g)	4.3	2.8	0.049	2.9	1
Loading Soluble Powder for Hopper Box application(1h)	0.80	15	0.0093	15	8
Mixing/Loading Dry Flowable for Slurry Seed Treatment (2)	0.076	160	0.00089	160	80

Table 7. Occupational Inhalation and Short-term and Intermediate-term Dermal Risks to Acephate at Baseline (Continued)

Exposure Scenario (Scen. #)	Baseline Daily Dermal Dose <sup>a</sup> (mg/kg/day)	Baseline Dermal MOE <sup>b</sup>	Baseline Daily Inhalation Dose <sup>c</sup> (mg/kg/day)	Baseline Inhalation MOE <sup>d</sup>	Baseline Combined Dermal & Inhalation MOE <sup>e</sup>
Mixing/Loading Liquids for Aerial Application (3a)	11	1.1	0.0046	30	1
	24	0.50	0.010	14	<1
Mixing/Loading Liquids for Slurry Seed Treatment (3b)	3.3	3.6	0.0014	100	4
Loading Granular in Drop-Type Tractor-Drawn Spreader (4)	0.0096	1,300	0.0020	70	66
<b>APPLICATOR</b>					
Applying Sprays with Fixed Wing Aircraft (5)	See Engineering Controls	See Engineering Controls	See Engineering Controls	See Engineering Controls	See Engineering Controls
Applying Spray With Rotary Wing Aircraft (6)	See Engineering Controls	See Engineering Controls	See Engineering Controls	See Engineering Controls	See Engineering Controls
Applying Spray with a Groundboom Sprayer (7)	0.0080	1,500	0.00043	330	270
	0.016	750	0.00084	170	140
	0.0020	6,000	0.00011	1,300	1,100
	0.080	150	0.0043	33	27
	0.040	300	0.0021	67	55
Applying Spray with Airblast Sprayer (8)	0.10	120	0.0013	110	57
	0.051	240	0.00064	220	110
	0.026	460	0.00033	420	220
Applying Spray with Handgun Sprayer (9)	0.019	630	0.000054	2,600	510
	0.19	63	0.00056	250	50
	0.093	130	0.00029	480	100
	0.47	26	0.0014	100	21
Applying in Transplanting Water (10)	0.003	4000	0.00016	880	740
Applying as a Seed Treatment in a Hopper Box (11)	No Data	No Data	No Data	No Data	No Data
Applying as a Seed Treatment in a Slurry Tank (12)	No Data	No Data	No Data	No Data	No Data



Table 7. Occupational Inhalation and Short-term and Intermediate-term Dermal Risks to Acephate at Baseline (Continued)

Exposure Scenario (Scen. #)	Baseline Daily Dermal Dose <sup>a</sup> (mg/kg/day)	Baseline Dermal MOE <sup>b</sup>	Baseline Daily Inhalation Dose <sup>c</sup> (mg/kg/day)	Baseline Inhalation MOE <sup>d</sup>	Baseline Combined Dermal & Inhalation MOE <sup>e</sup>
Applying Granular with Tractor-Drawn Drop-Type Spreader (13)	0.011	1,100	0.0014	100	92
<b>MIXER/ LOADER/APPLICATOR</b>					
Mixing/Loading/Applying Soluble Powders Using Low Pressure Hand Wand (14a)	0.083	140	0.0031	45	34
	0.17	71	0.0063	22	17
	0.16	75	0.0059	24	18
	0.020	600	0.00074	190	140
	1.4	8.6	0.056	2.5	2
Mixing/Loading/Applying Wettable Powders Using Low Pressure Hand Wand (14b)	0.049	250	0.00086	160	71
	0.8	15	0.014	10	66
	0.214	56	0.214	0.653	< 1
	8.57	1.4	0.14	1	< 1
Mixing/Loading/Applying Using Backpack Sprayer(15)	0.00714	1700	0.000086	1,600	820
	0.0143	840	0.00017	820	415
	0.0134	890	0.00016	880	440
	0.0017	7000	0.000020	7,000	3500
	0.1257	95	0.0016	88	47
Mixing/Loading/Applying Using High Pressure Sprayer(16)	0.26	46	0.0086	16	12
	0.50	24	0.017	8.2	6
Loading/Applying Using Aerosol Generator (17)	No Data	No Data	No Data	No Data	No Data
Loading/Applying with PCO injector (18)	No Data	No Data	No Data	No Data	No Data
Loading/Applying Soluble Powder (dry) by Hand/Handtool/Shaker Can (19)	0.099	120	0.0046	30	26
Mixing/Loading/Applying Soluble Powder Using Sprinkling Can (20)	0.0026	4600	.0000007	190,000	4400

Table 7. Occupational Inhalation and Short-term and Intermediate-term Dermal Risks to Acephate at Baseline (Continued)

Exposure Scenario (Scen. #)	Baseline Daily Dermal Dose <sup>a</sup> (mg/kg/day)	Baseline Dermal MOE <sup>b</sup>	Baseline Daily Inhalation Dose <sup>c</sup> (mg/kg/day)	Baseline Inhalation MOE <sup>d</sup>	Baseline Combined Dermal & Inhalation MOE <sup>e</sup>
Loading/Applying Tree Injections (21)	No Data	No Data	No Data	No Data	No Data
Loading/Applying Granules with Belly Grinder (22)	1.4	9	0.0087	16	6
Loading/Applying Granules with Shaker Can (23)	1.6	8	0.0075	19	6
Loading/Applying Granules by Hand (24)	1.4	8	0.0066	21	6
	0.11	105	0.00054	260	71
	0.16	75	0.00076	185	67
<b>FLAGGER</b>					
Flagging Aerial Spray Applications (25)	0.027	440	0.00087	160	120
	0.056	210	0.0017	82	59
	0.27	44	0.0087	16	12
	0.0069	1,700	0.00021	670	480
	0.041	290	0.0013	110	80
	0.094	130	0.003	47	35

**Footnotes:**

- a Baseline Daily Dermal Dose (mg/kg/day) = Baseline Daily Dermal Exposure (mg/day) from Table 4 / Body weight (70 kg).
- b Baseline Dermal MOE = Short- and Intermediate-term NOEL (12 mg/kg/day) / Baseline Daily Dermal Dose (mg/kg/day).
- c Baseline Daily Inhalation Dose (mg/kg/day) = Baseline Daily Inhalation Exposure (mg/day) from Table 4 / Body weight (70 kg).
- d Baseline Inhalation MOE = Inhalation NOEL (0.14 mg/kg/day) / Baseline Daily Inhalation Dose (mg/kg/day).

<sup>e</sup> Total MOE: 
$$\frac{1}{\frac{1}{MOE_{Inhalation}} + \frac{1}{MOE_{Dermal}}}$$

Table 8. Occupational Inhalation and Short-term and Intermediate-term Dermal Exposures to Acephate With PPE

Exposure Scenario (Scen. #)	PPE Dermal Unit Exposure (mg/lb ai) <sup>a</sup>	PPE Inhalation Unit Exposure ( $\mu$ g/lb ai) <sup>b</sup>	Application Rate (ai) <sup>c</sup>	Amount Handled per Day <sup>d</sup>	PPE Daily Dermal Exposure (mg/day) <sup>e</sup>	PPE Daily Inhalation Exposure (mg/day) <sup>f</sup>
<b>MIXER/LOADER EXPOSURE</b>						
Mixing/Loading Soluble Powder for Aerial Application (1a)	0.17	8.6	0.5 lb/acre	350 acres	30	1.5
			1.0 lb/acre		60	3.0
			5.0 lb/acre		300	15
			0.125 lb/acre		7.4	0.38
Mixing/Loading Soluble Powder for Chemigation Application (1b)	0.17	8.6	1.0 lb/acre	350 acres	60	3.0
			Cranberries			
Mixing/Loading Soluble Powder for Ground boom Application (1c)	0.17	8.6	0.5 lb/acre	80 acres	6.8	0.34
			1.0 lb/acre		14	0.69
			0.125 lb/acre		1.7	0.086
			5.0 lb/acre	80 acres (sod)	68	3.4
Mixing/Loading Soluble Powder for Airblast Application (1d)	0.17	8.6		40 acres (golf)	34	1.7
			0.5 lb/acre	40 acres	3.4	0.17
			1.0 lb/ 100 gal	1,000 gal	1.7	0.086
			0.5 lb/ 100 gal	1,000 gal	0.85	0.043
Mixing/Loading Soluble Powder for Handgun Sprayer Application (1e)	0.17	8.6	1.0 lb/80 gal	13 gal/acre; 6 acres	0.17	0.0084
			1.0 lb/ 100 gal	1,000 gal	1.7	0.086
			0.5 lb/ 100 gal		0.85	0.043
			5.0 lb/acre	5 acres	4.3	0.22
Mixing/Loading Soluble Powder for Transplanting Water Application (1f)	0.17	8.6	0.75 lb/acre	20 acres	2.55	0.129
			Tobacco			

Table 8. Occupational Inhalation and Short-term and Intermediate-term Dermal Exposures to Acephate with PPE (Continued)

Exposure Scenario (See #)	PPE Dermal Unit Exposure (mg/lb ai) <sup>a</sup>	PPE Inhalation Unit Exposure (μg/lb ai) <sup>b</sup>	Application Rate (ai) <sup>c</sup>	Amount Handled per Day <sup>d</sup>	PPE Daily Dermal Exposure (mg/day) <sup>e</sup>	PPE Daily Inhalation Exposure (mg/day) <sup>f</sup>
Mixing/Loading Soluble Powder for Slurry Seed Treatment (1g)	0.17	8.6	0.04 lb/100 lb seed	200,000 lbs of seed	14	0.69
Loading Soluble Powder for Hopper Box Application(1h)	0.17	8.6	0.1875 lb/acre	80 acres	2.6	0.13
Mixing/Loading Dry Flowable for Slurry Seed Treatment (2)	0.066	0.15	0.04 lbs/100 lb seed	200,000 lbs of seed	5.3	0.012
Mixing/Loading Liquids for Aerial Application (3a)	0.023	0.24	0.75 lb/acre	350 acres	6.0	0.063
				800 acres	14	0.14
Mixing/Loading Liquids for Slurry Seed Treatment (3b)	0.023	0.24	0.04 lb/ 100 lb seed	200,000 lbs of seed	1.8	0.019
Loading Granular in Drop-Type Tractor-Drawn Spreader (4)	0.0069	0.34	1.0 lb/acre	80 acres	0.55	0.027
<b>APPLICATOR EXPOSURE</b>						
Applying Sprays with Fixed Wing Aircraft (5)	No Data See Engineering Controls	No Data See Engineering Controls	0.5 lb/acre	350 acres	See Engineering Controls	See Engineering Controls
			1.0 lb/acre			
			5.0 lb/acre			
			0.125 lb/acre			
			0.75 lb/acre	350 acres		
			800 acres			

Table 8. Occupational Inhalation and Short-term and Intermediate-term Dermal Exposures to Acephate with PPE (Continued)

Exposure Scenario (Scen. #)	PPE Dermal Unit Exposure (mg/lb ai)	PPE Inhalation Unit Exposure ( $\mu$ g/lb ai)	Application Rate (ai)	Amount Handled per Day	PPE Daily Dermal Exposure (mg/day)	PPE Daily Inhalation Exposure (mg/day)
Applying Spray With Rotary Wing Aircraft (6)	See Engineering Controls	See Engineering Controls	Ag. 0.5 lb/acre	350 acres	See Engineering Controls	See Engineering Controls
			Ag. 1.0 lb/acre			
			Turf 5.0 lb/acre			
			Pasture 0.125 lb/acre			
			Forest 0.75 lb/acre	350 acres		
				800 acres		
Applying Spray with a Groundboom Sprayer (7)	0.014	0.15	Ag. 0.5 lb/acre	80 acres	0.56	0.0060
			Ag. 1.0 lb/acre		1.1	0.012
			Pasture 0.125 lb/acre		0.14	0.0015
			Turf 5.0 lb/acre	80 acres (sod)	5.6	0.060
				40 acres (golf)	2.8	0.030
Applying Spray with Airblast Sprayer (8)	0.24	0.90	Non-bearing Citrus 0.5 lb/acre	40 acres	4.8	0.018
			Trees&Shrubs 1.0 lb/ 100 gal	1,000 gal	2.4	0.0090
			Outdoor Floral 0.5 lb/ 100 gal	1,000 gal	1.2	0.0045
			Tobacco (fire ant) 1.0 lb/80 gal	13 gal/acre; 6 acres	0.38	0.00076
Applying Spray with Handgun Sprayer (9)	0.39	0.78	Trees, Shrubs, Outdoor floral crops 1.0 lb/ 100 gal	1,000 gal	3.9	0.0078
			Trees, Shrubs, Outdoor floral crops 0.5 lb/ 100 gal		2.0	0.0039
			Turf 5 lb/acre	5 acres	9.8	0.0020
			Tobacco 0.75 lb/acre	20 acres	0.21	0.00225
Applying in Transplanting Water (10)	0.014	0.15				

Table 3. Occupational Inhalation and Short-term and Intermediate-term Dermal Exposures to Acephate with PPE (Continued)

Exposure Scenario (See: #)	PPE Dermal Unit Exposure (mg/lb a) <sup>b</sup>	PPE Inhalation Unit Exposure (µg/lb a) <sup>b</sup>	Application Rate (a) <sup>c</sup>	Amount Handled per Day <sup>d</sup>	PPE Daily Dermal Exposure (mg/day) <sup>e</sup>	PPE Daily Inhalation Exposure (mg/day) <sup>f</sup>
Applying as a Seed Treatment in a Hopper Box (11)	No Data	No Data	0.1875 lb /acres	80 acres	No Data	No Data
Applying as a Seed Treatment in a Slurry Tank (12)	No Data	No Data	0.04 lb/ 100 lb seed	200,000 lbs of seed	No Data	No Data
Applying Granular with Tractor-Drawn Drop-Type Spreader (13)	0.0072	0.24	1.0 lb /acres	80 acres	0.58	0.019
<b>MIXER/ LOADER/APPLICATOR EXPOSURE</b>						
Mixing/Loading/Applying Soluble Powder Using Low Pressure Hand Wand (14a)	8.6	220	Trees, Shrubs, Roses, Ground Cover, Floral Crops: 0.5 lb/ 100 gal	40 gal	1.7	0.044
			Trees, Shrubs, Roses, Ground Cover, Floral Crops: 1.0 lb/100 gal		3.4	0.088
			Wasps 0.075 lb/1 gal	5 gal	3.2	0.083
			Fire Ant (non-crop) 0.047 lb/5 gal	5 gal	0.40	0.010
			PCO 0.088 lb/gal	40 gal	30	0.77
Mixing/Loading/Applying Wettable Powders Using Low Pressure Hand Wand (14b)	cannot apply PPE to registrant data	cannot apply PPE to registrant data				
Mixing/Loading/Applying Using Backpack Sprayer(15)	2.5	6.0	Trees, Shrubs, Roses, Ground Cover, Floral Crops: 0.5 lb/ 100 gal	40 gal	0.50	0.0012
			Trees, Shrubs, Roses, Ground Cover, Floral Crops: 1.0 lb/100 gal		1.0	0.0024
			Wasps 0.075 lb/1 gal	5 gal	0.94	0.0023
			Fire Ant (non-crop) 0.047 lb/5 gal	5 gal	0.12	0.00028
			PCO 0.088 lb/gal	40 gal	8.8	0.021
Mixing/Loading/Applying Using High Pressure Sprayer(16)	2.5	24	Trees, Shrubs, Roses, Ground Cover, Floral Crops: 0.5 lb/ 100 gal	1,000 gal	13	0.12

Table 8. Occupational Inhalation and Short-term and Intermediate-term Dermal Exposures to Acephate with PPE (Continued)

Exposure Scenario (See n)	PPE Dermal Unit Exposure (mg/lb ai)*	PPE Inhalation Unit Exposure (µg/lb ai)*	Application Rate (ai)*	Amount Handled per Day <sup>1</sup>	PPE Daily Dermal Exposure (mg/dsy)*	PPE Daily Inhalation Exposure (mg/day)*
			1.0 lb/100 gal		25	0.24
Loading/Applying Using Aerosol Generator (17)	No Data	No Data	Indoor ornamentals, flowers, trees, shrubs, roses: 10 seconds per 100 sq ft if 2 ft plants	No Data	No Data	No Data
Loading/Applying with PCO injector (18) (See scenario 14(b) for a similar scenario for crack and crevice treatment)	No Data	No Data	Outdoor ornamentals, flowers, trees, shrubs, roses: 1 second per row-foot; spray both sides of row	No Data	No Data	No Data
Loading/Applying Soluble Powder (dry) by Hand/ Handtool/Shaker Can (19)	71	94	Fire Ants 2 tsp/mound (0.00694 lb/mound)	10 mounds/acre; 1 acre	4.9	0.0065
Mixing/Loading/Applying Soluble Powder Using Sprinkling Can (20)	No Data	No Data	Fire Ants 0.047 oz/5 gal	1 gal/mound; 13 mounds/acre; 1 acre	No Data	No Data
Loading/Applying Tree Injections (21)	No Data	No Data	1.5 gm/injection	Dependent on tree size	No Data	No Data
Loading/Applying Gramules with Belly Grinder (22)	20	12	Trees, shrubs, ornamentals 0.1125 lb/1,000 sq ft	87,000 sq. ft.	196	0.117
Loading/Applying Gramules with Shaker Can (23)	71	94	Trees, shrubs, ornamentals 0.1125 lb/1,000 sq ft	10,000 sq. ft.	80	0.105
Loading/Applying Gramules by Hand (24)	71	94	0.00099 lb per pot up to 12" diameter Fire ants: 0.008 lb/mound	1000 pots 10 mounds/acre; 1 acre	70.3 5.68	0.09 0.0075

**Table 8. Occupational Inhalation and Short-term and Intermediate-term Dermal Exposures to Acephate with PPE (Continued)**

Exposure Scenario (Scen. #)	PPE Dermal Unit Exposure (mg/lb ai) <sup>a</sup>	PPE Inhalation Unit Exposure (µg/lb ai) <sup>b</sup>	Application Rate (ai) <sup>c</sup>	Amount Handled per Day <sup>d</sup>	PPE Daily Dermal Exposure (mg/day) <sup>e</sup>	PPE Daily Inhalation Exposure (mg/day) <sup>f</sup>	
			Trees, shrubs, ornamentals	1,000 sq ft	8.0	0.0105	
<b>FLAGGER EXPOSURE</b>							
Flagging Aerial Spray Applications (25)	0.010	0.070	Ag.	0.5 lb/acre	1.8	0.012	
			Ag.	1.0 lb/acre	350 acres	3.5	0.025
			Turf	5.0 lb/acre	18	0.12	
			Pasture	0.125 lb/acre	0.44	0.0031	
			Forest	0.75 lb/acre	2.6	0.018	
				350 acres	6.0	0.042	

**Footnotes:**  
 a PPE Dermal Unit Exposure represents long pants, long sleeved shirt, gloves, open mixing/loading, open cab tractor.  
 b PPE Inhalation assumes a dust mask (80 percent protection factor applied).  
 c Application rates are values found in acephate labels.  
 d Daily amount handled values are from the HED estimates of amount that could be handled in a single day for each exposure scenario of concern.  
 e Daily dermal exposure (mg/day) = Unit exposure (mg/lb ai) \* Appl. rate (lb ai/acre or lbs ai/gallon) \* Amount treated (acre/day or gallons/day).  
 f Daily inhalation exposure (mg/day) = Unit exposure (mg/lb ai) \* (1mg/1000µg) Conversion Factor \* Appl. rate (lb ai/acre) \* Amount treated (acre/day or gallons/day).



Table 9. Occupational Inhalation and Short-term and Intermediate-term Dermal Risks to Acephate with PPE

Exposure Scenario (Scen. #)	PPE Daily Dermal Dose <sup>c</sup> (mg/kg/day)	PPE Dermal MOE <sup>b</sup>	PPE Daily Inhalation Dose <sup>c</sup> (mg/kg/day)	PPE Inhalation MOE <sup>a</sup>	PPE Combined Dermal & Inhalation MOE <sup>e</sup>
<b>MIXER/LOADER</b>					
Mixing/Loading Soluble Powder for Aerial Application (1a)	0.43	28	0.021	6.7	5
	0.86	14	0.043	3.3	3
	4.3	2.8	0.21	0.67	<1
Mixing/Loading Soluble Powder for Chemigation Application (1b)	0.11	110	0.0054	26	21
	0.86	14	0.043	3.3	3
	0.097	120	0.0049	29	23
Mixing/Loading Soluble Powder for Groundboom Application (1c)	0.20	60	0.0099	14	11
	0.024	500	0.0012	120	97
	0.97	12	0.049	2.9	2
Mixing/Loading Soluble Powder for Airblast Application (1d)	0.49	24	0.024	5.8	5
	0.049	240	0.0024	58	47
	0.024	500	0.0012	120	97
Mixing/Loading Soluble Powder for Handgun Sprayer Application (1e)	0.012	1,000	0.00061	230	190
	NA	NA	NA	NA	NA
	0.024	500	0.0012	120	97
Mixing/Loading Soluble Powder for Transplanting Water Application (1f)	0.012	1,000	0.00061	230	190
	0.061	200	0.0031	45	37
	0.0364	330	0.0018	76	63
Mixing/Loading Soluble Powder for Slurry Seed Treatment (1g)	0.20	60	0.0099	14	9
	0.037	320	0.0019	74	60
Mixing/Loading Dry Flowable for Slurry Seed Treatment (2)	0.076	160	0.00017	820	130

Table 9. Occupational Inhalation and Short-term and Intermediate-term Dermal Risks to Acephate with PPE (Continued)

Exposure Scenario (Scen. #)	PPE Daily Dermal Dose <sup>a</sup> (mg/kg/day)	PPE Dermal MOE <sup>b</sup>	PPE Daily Inhalation Dose <sup>c</sup> (mg/kg/day)	PPE Inhalation MOE <sup>d</sup>	PPE Combined Dermal & Inhalation MOE <sup>e</sup>
Mixing/Loading Liquids for Aerial Application (3a)	0.086	140	0.00090	160	75
	0.20	60	0.0020	70	32
Mixing/Loading Liquids for Slurry Seed Treatment (3b)	0.026	460	0.00027	520	240
Loading Granular in Drop-Type Tractor-Drawn Spreader (4)	0.0079	1,500	0.00039	360	290
<b>APPLICATOR</b>					
Applying Sprays with Fixed Wing Aircraft (5)	See Engineering Controls	See Engineering Controls	See Engineering Controls	See Engineering Controls	See Engineering Controls
Applying Spray With Rotary Wing Aircraft (6)	See Engineering Controls	See Engineering Controls	See Engineering Controls	See Engineering Controls	See Engineering Controls
Applying Spray with a Groundboom Sprayer (7)	NA	NA	NA	NA	NA
	NA	NA	NA	NA	NA
	NA	NA	NA	NA	NA
	0.080	150	0.00086	160	77
	0.040	300	0.00043	330	160
Applying Spray with Airblast Sprayer (8)	0.069	170	0.00026	540	130
	NA	NA	NA	NA	NA
	NA	NA	NA	NA	NA
	NA	NA	NA	NA	NA
Applying Spray with Handgun Sprayer (9)	NA	NA	NA	NA	NA
	0.056	210	0.00011	1,300	180
	NA	NA	NA	NA	NA
	0.14	86	0.00029	480	73
Applying in Transplanting Water (10)	NA	NA	NA	NA	NA
Applying as a Seed Treatment in a Hopper Box (11)	No Data	No Data	No Data	No Data	No Data
Applying as a Seed Treatment in a Slurry Tank (12)	No Data	No Data	No Data	No Data	No Data
Applying Granular with Tractor-Drawn Drop-Type Spreader (13)	0.0083	1,400	0.00027	520	380

Table 9. Occupational Inhalation and Short-term and Intermediate-term Dermal Risks to Acepate with PPE (Continued)

Exposure Scenario (Scen. #)	PPE Daily Dermal Dose <sup>a</sup> (mg/kg/day)	PPE Dermal MOE <sup>b</sup>	PPE Daily Inhalation Dose <sup>c</sup> (mg/kg/day)	PPE Inhalation MOE <sup>d</sup>	PPE Combined Dermal & Inhalation MOE <sup>e</sup>
<b>MIXER/ LOADER/APPLICATOR</b>					
Mixing/Loading/Applying Soluble Powders Using Low Pressure Hand Wand (14a)	0.024	500	0.00063	220	150
	0.048	250	0.0013	110	76
	0.046	260	0.0012	120	82
	NA	NA	NA	NA	NA
	0.43	28	0.011	13	8.9
Mixing/Loading/Applying Wettable Powders Using Low Pressure Hand Wand (14b)	cannot apply PPE to registrant data	---	---	---	---
Mixing/Loading/Applying Using Backpack Sprayer(15)	NA	NA	NA	NA	NA
	NA	NA	NA	NA	NA
	NA	NA	NA	NA	NA
	NA	NA	NA	NA	NA
	0.13	92	0.00030	470	77
Mixing/Loading/Applying Using High Pressure Sprayer(16)	0.19	63	0.0017	82	37
	0.36	33	0.0034	41	18
Loading/Applying Using Aerosol Generator (17)	No Data	No Data	No Data	No Data	No Data
Loading/Applying with PCO injector (18)	No Data	No Data	No Data	No Data	No Data
Loading/Applying Soluble Powder (dry) by Hand/Handtool/Shaker Can (19)	0.070	170	0.00009	1500	150
Mixing/Loading/Applying Soluble Powder Using Sprinkling Can (20)	NA	NA	NA	NA	NA
Loading/Applying Tree Injections (21)	No Data	No Data	No Data	No Data	No Data
Loading/Applying Granules with Belly Grinder (22)	2.8	4.3	0.0017	83	4
Loading/Applying Granules with Shaker Can (23)	1.14	10	0.0015	93	9

Table 9. Occupational Inhalation and Short-term and Intermediate-term Dermal Risks to Acephate with PPE (Continued)

Exposure Scenario (Scen. #)	PPE Daily Dermal Dose <sup>a</sup> (mg/kg/day)	PPE Dermal MOE <sup>b</sup>	PPE Daily Inhalation Dose <sup>c</sup> (mg/kg/day)	PPE Inhalation MOE <sup>d</sup>	PPE Combined Dermal & Inhalation MOE <sup>e</sup>
Loading/Applying Granules by Hand (24)	1	12	0.0013	105	11
	0.08	150	0.0001	1303	140
	0.114	105	0.00015	926	95
FLAGGER					
Flagging Aerial Spray Applications (25)	NA	NA	NA	NA	NA
	0.050	240	0.00036	390	150
	0.25	48	0.0017	82	30
	NA	NA	NA	NA	NA
	0.038	320	0.00026	540	200
	0.086	140	0.00060	230	87

**Footnotes:**

- a PPE Daily Dermal Dose (mg/kg/day) = PPE Daily Dermal Exposure (mg/day) from Table 6 / Body weight (70 kg).
- b PPE Dermal MOE = Short- and Intermediate-term NOEL (12 mg/kg/day) / PPE Daily Dermal Dose (mg/kg/day).
- c PPE Daily Inhalation Dose (mg/kg/day) = PPE Daily Inhalation Exposure (mg/day) from Table 6 / Body weight (70 kg).
- d PPE Inhalation MOE = Inhalation NOEL (0.14 mg/kg/day) / PPE Daily Inhalation Dose (mg/kg/day).

e Total MOE: 
$$\frac{1}{\frac{1}{MOE_{Inhalation}} + \frac{1}{MOE_{Dermal}}}$$

NA Not Applicable Not necessary to estimate the MOE since the MOE at baseline was equal to or greater than 100

Table 10. Occupational Inhalation and Short-term and Intermediate-term Dermal Exposures to Acephate With Engineering Controls

Exposure Scenario (Scen. #)	Engineering Controls Unit Exposure (mg/lb aD)	Engineering Controls Inhalation Unit Exposure ( $\mu\text{g}/\text{lb aI}$ )	Application Rate (aI)	Amount Handled per Day	Engineering Controls Dermal Exposure (mg/day)	Engineering Controls Daily Inhalation Exposure (mg/day)
<b>MIXER/LOADER EXPOSURE</b>						
Mixing/Loading Soluble Powder for Aerial Application (1a)	0.0098	0.24	Ag. 0.5 lb/acre	350 acres	1.7	0.042
			Ag 1.0 lb/acre			
			Turf 5.0 lb/acre			
			Pasture 0.125 lb/acre			
Mixing/Loading Soluble Powder for Chemigation Application (1b)	0.0098	0.24	Cranberries 1.0 lb/acre	350 acres	3.4	0.084
Mixing/Loading Soluble Powder for Ground boom Application (1c)	0.0098	0.24	Ag. 0.5 lb/acre	80 acres	0.39	0.0096
			Ag 1.0 lb/acre			
			Pasture 0.125 lb/acre			
			Turf 5.0 lb/acre			
Mixing/Loading Soluble Powder for Airblast Application (1d)	0.0098	0.24		80 acres (sod)	3.9	0.096
				40 acres (golf)	2.0	0.048
				40 acres	0.20	0.0048
				Trees&Shrubs 1.0 lb/100 gal	0.098	0.0024
				Outdoor Floral 0.5 lb/100 gal	0.049	0.0012
				Tobacco (fire ant) 1.0 lb/80 gal	0.0096	0.00023
Mixing/Loading Soluble Powder for Handgun Sprayer Application (1e)	0.0098	0.24		13 gal/acre; 6 acres	0.098	0.0024
				1,000 gal	0.049	0.0012
				5 acres	0.25	0.0060
				Tobacco 0.75 lb/acre	Need EPA Input	Need EPA Input

Table 10. Occupational Inhalation and Short-term and Intermediate-term Dermal Exposures to Acephate With Engineering Controls (Continued)

Exposure Scenario (Seen. #)	Engineering Controls Unit Exposure (mg/lb ai) <sup>a</sup>	Engineering Controls Inhalation Unit Exposure (µg/lb ai) <sup>b</sup>	Application Rate (ai) <sup>c</sup>	Amount Handled per Day <sup>d</sup>	Engineering Controls Dermal Exposure (mg/day) <sup>e</sup>	Engineering Controls Daily Inhalation Exposure (mg/day) <sup>f</sup>
Mixing/Loading Soluble Powder for Slurry Seed Treatment (1g)	0.0098	0.24	Cotton seed 0.04 lb/100 lb seed	200,000 lbs of seed	0.78	0.019
Loading Soluble Powder for Hopper Box Application(1h)	0.0098	0.24	Cotton seed 0.1875 lb/acre	80 acres	0.15	0.0036
Mixing/Loading Dry Flowable for Slurry Seed Treatment (2)	0.0098	0.24	Cotton seed 0.04 lbs/100 lb seed	200,000 lbs of seed	0.78	0.019
Mixing/Loading Liquids for Aerial Application (3a)	0.0086	0.083	Pasture/Forest 0.75 lb/acre	350 acres 800 acres	2.3 5.2	0.022 0.050
Mixing/Loading Liquids for Slurry Seed Treatment (3b)	0.0086	0.083	Cotton seed 0.04 lb/ 100 lb seed	200,000 lbs of seed	0.69	0.0066
Loading Granular in Drop-Type Tractor-Drawn Spreader (4)	0.00017 <sup>g</sup>	0.034 <sup>h</sup>	Cotton 1.0 lb/acre	80 acres	0.014	0.0027
<b>APPLICATOR EXPOSURE</b>						
Applying Sprays with Fixed Wing Aircraft (5)	0.005	0.068	Ag. 0.5 lb/acre	350 acres	0.88	0.012
			Ag. 1.0 lb/acre			
			Turf 5.0 lb/acre			
			Pasture 0.125 lb/acre			
			Forest 0.75 lb/acre			
			Ag. 0.5 lb/acre			
Applying Spray With Rotary Wing Aircraft (6)	0.0019	0.0018	Ag. 1.0 lb/acre	350 acres	0.33	0.00032
			Turf 5.0 lb/acre			
			Pasture 0.125 lb/acre			
			Forest 0.75 lb/acre			
			Ag. 0.5 lb/acre			
			Ag. 1.0 lb/acre			
0.005	0.068	0.0018	0.0019	0.0018	0.0019	0.0018
0.005	0.068	0.0018	0.0019	0.0018	0.0019	0.0018
0.005	0.068	0.0018	0.0019	0.0018	0.0019	0.0018
0.005	0.068	0.0018	0.0019	0.0018	0.0019	0.0018
0.005	0.068	0.0018	0.0019	0.0018	0.0019	0.0018
0.005	0.068	0.0018	0.0019	0.0018	0.0019	0.0018

Table 10. Occupational Inhalation and Short-term and Intermediate-term Dermal Exposures to Acephate With Engineering Controls (Continued)

Exposure Scenario (Scen. #)	Engineering Controls Dermal Unit Exposure (mg/lb ai)*	Engineering Controls Inhalation Unit Exposure (µg/lb ai)*	Application Rate (ai)	Amount Handled per Day <sup>†</sup>	Engineering Controls Dermal (mg/day) <sup>†</sup>	Engineering Controls Daily Inhalation Exposure (mg/day) <sup>†</sup>
Applying Spray with a Groundboom Sprayer (7)	0.005	0.043	Ag. 0.5 lb/acre	80 acres	0.20	0.0017
			Ag. 1.0 lb/acre			
			Pasture 0.125 lb/acre			
			Turf 5.0 lb/acre			
Applying Spray with Airblast Sprayer (8)	0.14	0.45	Non-bearing Citrus 0.5 lb/acre	40 acres	2.8	0.0090
			Trees&Shrubs 1.0 lb/ 100 gal	1,000 gal	1.4	0.0045
			Outdoor Floral 0.5 lb/ 100 gal	1,000 gal	0.7	0.0023
			Tobacco (fire ant) 1.0 lb/80 gal	13 gal/acre; 6 acres	NF	NF
Applying Spray with Handgun Sprayer (9)	NF	NF	Trees, Shrubs, Outdoor floral crops 1.0 lb/ 100 gal	1,000 gal	NF	NF
			Trees, Shrubs, Outdoor floral crops 0.5 lb/ 100 gal		NF	NF
			Turf 5 lb/acre	5 acres	NF	NF
			Tobacco 0.75 lb/acre	20 acres	0.075	0.000645
Applying in Transplanting Water (10)	0.005	0.043	Cotton 0.1875 lb /acre	80 acres	No Data	No Data
Applying as a Seed Treatment in a Hopper Box (11)	No Data	No Data	Cotton Seed 0.04 lb/ 100 lb seed	200,000 lbs of seed	No Data	No Data
Applying as a Seed Treatment in a Slurry Tank (12)	No Data	No Data	Cotton 1.0 lb /acre	80 acres	0.17	0.018
Applying Granular with Tractor-Drawn Drop-Type Spreader (13)	0.0021	0.22				

Table 10. Occupational Inhalation and Short-term and Intermediate-term Dermal Exposures to Acephate With Engineering Controls (Continued)

Exposure Scenario (Scen. #)	Engineering Controls Unit: Dermal Exposure (mg/lb ai) <sup>a</sup>	Engineering Controls Inhalation Unit Exposure (µg/lb ai) <sup>a</sup>	Application Rate (ai) <sup>b</sup>	Amount Handled per Day <sup>c</sup>	Engineering Controls Dermal Exposure (mg/day) <sup>d</sup>	Engineering Controls Daily Inhalation Exposure (mg/day) <sup>e</sup>
<b>MIXER/LOADER/APPLICATOR EXPOSURE</b>						
Mixing/Loading/Applying Using low Pressure Hand Wand (14a)	NF	NF	Trees, Shrubs, Roses, Ground Cover, Floral Crops: 0.5 lb/ 100 gal	40 gal	NF	NF
			Trees, Shrubs, Roses, Ground Cover, Floral Crops: 1.0 lb/100 gal			
			Wasps 0.075 lb/1 gal			
			Fire Ant (non-crop) 0.047 lb/5 gal			
			PCO 0.088 lb/gal			
Mixing/Loading/Applying Wettable Powders Using Low Pressure Hand Wand (14b)	NF	NF	---	---	NF	NF
			Trees, Shrubs, Roses, Ground Cover, Floral Crops: 0.5 lb/ 100 gal			
			Trees, Shrubs, Roses, Ground Cover, Floral Crops: 1.0 lb/100 gal			
			Wasps 0.075 lb/1 gal			
			Fire Ant (non-crop) 0.047 lb/5 gal			
Mixing/Loading/Applying Using Backpack Sprayer(15)	NF	NF	Trees, Shrubs, Roses, Ground Cover, Floral Crops: 0.5 lb/100 gal	40 gal	NF	NF
			Trees, Shrubs, Roses, Ground Cover, Floral Crops: 1.0 lb/100 gal			
			Wasps 0.075 lb/1 gal			
			Fire Ant (non-crop) 0.047 lb/5 gal			
			PCO 0.088 lb/gal			
Mixing/Loading/Applying Using High Pressure Sprayer(16)	NF	NF	Trees, Shrubs, Roses, Ground Cover, Floral Crops: 0.5 lb/ 100 gal	1,000 gal	NF	NF
			Trees, Shrubs, Roses, Ground Cover, Floral Crops: 1.0 lb/100 gal			



Table 10. Occupational Inhalation and Short-term and Intermediate-term Dermal Exposures to Acephate With Engineering Controls (Continued)

Exposure Scenario (Scan. #)	Engineering Controls Unit: Exposure (mg/lb a) <sup>a</sup>	Engineering Controls Inhalation Unit Exposure (µg/lb a) <sup>a</sup>	Application Rate (a) <sup>b</sup>	Amount Handled per Day <sup>c</sup>	Engineering Controls Dermal Exposure (mg/day) <sup>d</sup>	Engineering Controls Daily Inhalation Exposure (mg/day) <sup>d</sup>
Loading/Applying Using Aerosol Generator (17)	NF	NF	Indoor ornamentals, flowers, trees, shrubs, roses: 10 seconds per 100 sq ft if 2 ft plants	--	NF	NF
Loading/Applying with PCO injector (18) (See scenario 14(b) for a similar scenario for crack and crevice treatment)	NF	NF	Outdoor ornamentals, flowers, trees, shrubs, roses: 1 second per row-foot; spray both sides of row	--	NF	NF
Loading/Applying Soluble Powder (dry) by Hand/Handtool/Shaker Can (19)	NF	NF	PCO crack&crevice: 1% spray; 1 second of spray perspot; 1 spot per linear foot	--	NF	NF
Mixing/Loading/Applying Soluble Powder Using Sprinkling Can (20)	NF	NF	Fire Ants 2 tsp/mound	10 mounds/acre; 1 acre	NF	NF
Loading/Applying Tree Injections (21)	NF	NF	Fire Ants 0.047 oz/5 gal	1 gal/mound; 10 mounds/acre; 1 acre	NA	NA
Loading/Applying Granules with Belly Grinder (22)	NF	NF	1.5 gm/injection	Dependent on tree size	NF	NF
Loading/Applying Granules with Shaker Can (23)	NF	NF	Trees, shrubs, ornamentals 0.1125 lb/1,000 sq ft	87,000 sq. ft.	NF	NF
Loading/Applying Granules by Hand (24)	NF	NF	Trees, shrubs, ornamentals 0.06 lb/1,000 sq ft	10,000 sq. ft.	NF	NF
			0.0078 lb per pot up to 12" diameter	350 pots	NF	NF
			Fire ants: 0.008 lb mound	10 mounds/acre; 1 acre	NF	NF
			Trees, shrubs, ornamentals 0.1125 lb/1,000 sq ft	1,000 sq ft	NF	NF

Table 10. Occupational Inhalation and Short-term and Intermediate-term Dermal Exposures to Acephate With Engineering Controls (Continued)

Exposure Scenario (Scen. #)	Engineering Controls Dermal Unit Exposure (mg/lb ai) <sup>a</sup>	Engineering Controls Inhalation Unit Exposure (µg/lb ai) <sup>b</sup>	Application Rate (ai) <sup>c</sup>	Amount Handled per Day <sup>d</sup>	Engineering Controls Dermal (mg/day) <sup>e</sup>	Engineering Controls Daily Inhalation Exposure (mg/day) <sup>f</sup>
<b>FLAGGER EXPOSURE</b>						
Flagging Aerial Spray Applications (25)	0.0011	0.035	Ag. 0.5 lb/acre	350 acres	0.19	0.0061
			Ag. 1.0 lb/acre		0.39	0.012
			Turf 5.0 lb/acre	1.9	0.061	
			Pasture 0.125 lb/acre	0.048	0.0015	
			Forest 0.75 lb/acre	350 acres	0.29	0.092
			800 acres	0.66	0.021	

**Footnotes:**

- a Engineering control dermal unit exposure values assumes single layer clothing, gloves, and closed mixing for mixer loaders, and single layer, no gloves, enclosed cab/cockpit for applicators and flaggers.
- b Engineering control inhalation unit exposure values assumes closed mixing for mixer loaders and closed cab/cockpit for applicators.
- c Application rates are values found in Acephate labels.
- d Daily amount handled values are from the HED estimates of amount that could be handled in a single day for each exposure scenario of concern.
- e Daily dermal exposure (mg/day) = Unit exposure (mg/lb ai) \* Appl. rate (lb ai/acre) \* Acres treated (acre/day).
- f Daily inhalation exposure (mg/day) = Unit exposure (mg/lb ai) \* (1mg/1000µg) Conversion Factor \* Appl. rate (lb ai/acre) \* Acres treated (acre/day).
- g Lock 'n Load system assumed.

**NOTE:** NF = Not feasible; No engineering controls exist or HED does not consider engineering controls an effective approach for mitigating exposure during the use of certain types of equipment.

Table 11. Occupational Inhalation and Short-term and Intermediate-term Dermal Risks to Acephate with Engineering Controls

Exposure Scenario (Scen. #)	Eng. Controls Daily Dermal Dose* (mg/kg/day)	Eng. Controls Dermal MOE <sup>b</sup>	Eng. Controls Daily Inhalation Dose <sup>c</sup> (mg/kg/day)	Eng. Controls Inhalation MOE <sup>d</sup>	Eng. Controls Combined Dermal & Inhalation MOE <sup>e</sup>
<b>MIXER/LOADER</b>					
Mixing/Loading Soluble Powder for Aerial Application (1a)	0.025	480	0.00060	230	160
	0.049	240	0.0012	120	80
	0.25	48	0.0060	23	16
	0.0061	2,000	0.00016	880	610
Mixing/Loading Soluble Powder for Chemigation Application (1b)	0.049	240	0.0012	120	80
Mixing/Loading Soluble Powder for Ground boom Application (1c)	0.0056	2,100	0.00014	1,000	680
	0.011	1,100	0.00027	520	350
	0.0014	8,600	0.000034	4,100	2,800
	0.056	210	0.0014	100	68
	0.029	430	0.00069	200	140
Mixing/Loading Soluble Powder for Airblast Application (1d)	0.0029	4,300	0.000069	2,000	1,400
	0.0014	8,600	0.000034	4,100	2,800
	NA	NA	NA	NA	NA
Mixing/Loading Soluble Powder for Handgun Sprayer Application (1e)	NA	NA	NA	NA	NA
	0.0014	8,600	0.000034	4,100	2,800
	NA	NA	NA	NA	NA
	0.0035	3,400	0.000086	1,600	1,100
Mixing/Loading Soluble Powder for Transplanting Water Application (1f)	0.0021	5,700	0.000051	2,700	1,800
Mixing/Loading Soluble Powder for Slurry Seed Treatment (1g)	0.011	1,100	0.00027	520	350
Loading Soluble Powder for Hopper Box Application(1h)	0.0021	5,700	0.000051	2,700	1,800
Mixing/Loading Dry Flowable for Slurry Seed Treatment (2)	NA	NA	NA	NA	NA

Table 11. Occupational Inhalation and Short-term and Intermediate-term Dermal Risks to Acephate with Engineering Controls (Continued)

Exposure Scenario (Scen. #)	Eng. Controls Daily Dermal Dose* (mg/kg/day)	Eng. Controls Dermal MOE <sup>b</sup>	Eng. Controls Daily Inhalation Dose* (mg/kg/day)	Eng. Controls Inhalation MOE <sup>d</sup>	Eng. Controls Combined Dermal & Inhalation MOE <sup>e</sup>
Mixing/Loading Liquids for Aerial Application (3a)	0.032	380	0.00031	450	210
	0.074	160	0.00071	200	89
Mixing/Loading Liquids for Slurry Seed Treatment (3b)	NA	NA	NA	NA	NA
Loading Granular in Drop-Type Tractor-Drawn Spreader (4)	NA	NA	NA	NA	NA
<b>APPLICATOR</b>					
Applying Sprays with Fixed Wing Aircraft (5)	0.013	920	0.00017	820	430
	0.026	480	0.00034	410	220
	0.13	92	0.0017	82	43
	0.0031	3,900	0.000043	3,300	1,800
	0.019	630	0.00026	540	290
	0.043	280	0.00039	240	130
Applying Spray With Rotary Wing Aircraft (6)	0.0047	2,600	4.6E-6	30,000	2,400
	0.0096	1,300	9.0E-6	16,000	1,200
	0.047	260	0.000046	3,000	240
	0.0012	10,000	1.1E-6	130,000	9,300
	0.0071	1,700	6.7E-6	21,000	1,600
	0.016	750	0.000016	8,800	690
Applying Spray with a Groundboom Sprayer (7)	NA	NA	NA	NA	NA
	NA	NA	NA	NA	NA
	NA	NA	NA	NA	NA
	0.029	410	0.00024	580	240
	NA	NA	NA	NA	NA
Applying Spray with Airblast Sprayer (8)	NA	NA	NA	NA	NA

Table 11. Occupational Inhalation and Short-term and Intermediate-term Dermal Risks to Acephate with Engineering Controls (Continued)

Exposure Scenario (Scen. #)	Eng. Controls Daily Dermal Dose* (mg/kg/day)	Eng. Controls Dermal MOE*	Eng. Controls Daily Inhalation Dose* (mg/kg/day)	Eng. Controls Inhalation MOE*	Eng. Controls Combined Dermal & Inhalation MOE*
Applying Spray with Handgun Sprayer (9)	NF	NF	NF	NF	NF
Applying in Transplanting Water (10)	NA	NA	NA	NA	NA
Applying as a Seed Treatment in a Hopper Box (11)	No Data	No Data	No Data	No Data	No Data
Applying as a Seed Treatment in a Slurry Tank (12)	No Data	No Data	No Data	No Data	No Data
Applying Granular with Tractor-Drawn Drop-Type Spreader (13)	NA	NA	NA	NA	NA
<b>MIXER/LOADER/APPLICATOR</b>					
Mixing/Loading/Applying Using Low Pressure Hand Wand (14a)	NF	NF	NF	NF	NF
Mixing/Loading/Applying Wettable Powders Using Low Pressure Hand Wand (14b)	NF	NF	NF	NF	NF
Mixing/Loading/Applying Using Backpack Sprayer(15)	NF	NF	NF	NF	NF
Mixing/Loading/Applying Using High Pressure Sprayer(16)	NF	NF	NF	NF	NF
Loading/Applying Using Aerosol Generator (17)	NF	NF	NF	NF	NF
Loading/Applying with PCO injector (18)	NF	NF	NF	NF	NF
Loading/Applying Soluble Powder (dry) by Hand/Handtool/Shaker Can (19)	NF	NF	NF	NF	NF
Mixing/Loading/Applying Soluble Powder Using Sprinkling Can (20)	NF	NF	NF	NF	NF
Loading/Applying Tree Injections (21)	NF	NF	NF	NF	NF
Loading/Applying Granules with Belly Grinder (22)	NF	NF	NF	NF	NF
Loading/Applying Granules with Shaker Can (23)	NF	NF	NF	NF	NF
Loading/Applying Gramule by Hand (24)	NF	NF	NF	NF	NF

Table 11. Occupational Inhalation and Short-term and Intermediate-term Dermal Risks to Acephate with Engineering Controls (Continued)

Exposure Scenario (Sec. f)	Eng. Controls Daily Dermal Dose <sup>a</sup> (mg/kg/day)	Eng. Controls Dermal MOE <sup>b</sup>	Eng. Controls Daily Inhalation Dose <sup>c</sup> (mg/kg/day)	Eng. Controls Inhalation MOE <sup>d</sup>	Eng. Controls Combined Dermal & Inhalation MOE <sup>e</sup>
<b>FLAGGER</b>					
Flagging Aerial Spray Applications (25)	NA	NA	NA	NA	NA
	NA	NA	NA	NA	NA
	0.27	440	0.00874	160	120
	NA	NA	NA	NA	NA
	NA	NA	NA	NA	NA
	0.0094	1300	0.0003	470	340

**Footnotes:**

- a Eng. Controls Daily Dermal Dose (mg/kg/day) = Eng. Controls Daily Dermal Exposure (mg/day) from Table 8 / Body weight (70 kg).
- b Eng. Controls Dermal MOE = Short- and Intermediate-term NOEL (12 mg/kg/day) / Eng. Controls Daily Dermal Dose (mg/kg/day).
- c Eng. Controls Daily Inhalation Dose (mg/kg/day) = Eng. Controls Daily Inhalation Exposure (mg/day) from Table 8 / Body weight (70 kg).
- d Eng. Controls Inhalation MOE = Inhalation NOEL (0.14 mg/kg/day) / Eng. Controls Daily Inhalation Dose (mg/kg/day).

**Total MOE:**

$$\frac{1}{\frac{1}{MOE_{Inhalation}} + \frac{1}{MOE_{Dermal}}}$$

Note: NF = Not feasible; No engineering controls exist or HED does not consider engineering controls an effective approach for mitigating exposure during the use of certain types of equipment.  
 NA = Not applicable; Not necessary to estimate the MOE at baseline or with PPE was equal to or greater than 100

Table 12A: Acephate Postapplication Assessment (No Chemical Specific Data Used)

Low Growing Field Crops					Turf						
DAT <sup>a</sup>	DFR <sup>d</sup> ( $\mu\text{g}/\text{cm}^2$ ) <sup>b</sup>	Dermal Dose (mg/kg/day) <sup>b</sup>		MOE <sup>c</sup>	DAT <sup>a</sup>	DFR <sup>d</sup> ( $\mu\text{g}/\text{cm}^2$ ) <sup>b</sup>	Dermal Dose (mg/kg/day) <sup>b</sup>		MOE <sup>c</sup>		
		Non-Harvesting Tc = 1500	Harvesting Tc = 3500				Non-Harvesting Tc = 500	Sod Harvesting Tc = 10,000			
0	2.2	0.38	0.90	31	13	0	11	0.64	13	19	1
11	0.70	0.12	0.28	100	43	10	3.9	0.22	4.5	54	3
20	0.27	NA	0.11	NA	110	16	2.1	0.12	2.4	100	5
---	---	---	---	---	---	45	0.098	NA	0.11	NA	110

<sup>a</sup> DAT is "days after treatment."

<sup>b</sup> See text for explanation of equation

<sup>c</sup> MOE = NOEL (12 mg/kg/day) / Dermal Dose (mg/kg/day)

<sup>d</sup> DFR is "Dislodgeable Foliar Residue"

<sup>e</sup> Tc is "Transfer Coefficient"

Table 12B: Acephate Postapplication Assessment (Using Cauliflower DFR Data)

Cauliflower (max rate - 2 lb ai/acre)				Cauliflower (2 - 1 lb ai/acre applications separated by a week)			
DAT <sup>a</sup>	DFR <sup>d</sup> ( $\mu\text{g}/\text{cm}^2$ ) <sup>b</sup>	Dermal Dose (mg/kg/day) <sup>c</sup>		DFR ( $\mu\text{g}/\text{cm}^2$ ) <sup>b</sup>	Dermal Dose (mg/kg/day) <sup>c</sup>		MOE <sup>e</sup>
		Non-harvesting Tc = 1000	Harvesting Tc = 4000		Non-Harvesting Tc = 1000	Harvesting Tc = 4000	
0	0.560	0.064	0.256	0.368	0.042	0.168	71
4	0.387	---	0.177	0.255	---	0.116	100
8	0.268	---	0.122	---	---	---	---
9	0.244	---	0.112	---	---	---	---

a DAT is "days after treatment."

b See text for explanation of equation

c MOE = NOEL (12 mg/kg/day) / Dermal Dose (mg/kg/day)

d DFR is "Dislodgeable Foliar Residue"

e Tc is "Transfer Coefficient"



Table 12C: Acetate Postapplication Assessment (Using Cauliflower DFR Data)

Turf (max rate - 5 lb ai/acre)					
DAT <sup>a</sup>	DFR <sup>d</sup> ( $\mu\text{g}/\text{cm}^2$ ) <sup>b</sup>	Dermal Dose (mg/kg/day) <sup>b</sup>		MOE <sup>c</sup>	
		Non-harvesting Tc = 1000	Sod Harvesting Tc = 10000	Non-Harvesting	Harvesting
0	1.4	0.08	0.8	150	15
10	0.557	---	0.318	---	38
20	0.222	---	0.127	---	95
21	0.202	---	0.115	---	100

a DAT is "days after treatment."

b See text for explanation of equation

c MOE = NOEL (12 mg/kg/day) / Dermal Dose (mg/kg/day)

d DFR is "Dislodgeable Foliar Residue"

e Tc is "Transfer Coefficient"

Table 13. Methamidophos Postapplication Assessment (No Chemical Specific Data Used)

Low Growing Field Crops						Turf					
DAT <sup>a</sup>	DFR <sup>d</sup> ( $\mu\text{g}/\text{cm}^2$ ) <sup>b</sup>	Dermal Dose (mg/kg/day) <sup>b</sup>		MOE <sup>c</sup>		DFR ( $\mu\text{g}/\text{cm}^2$ ) <sup>b</sup>	Dermal Dose (mg/kg/day) <sup>b</sup>		MOE <sup>c</sup>		
		Non-harvesting Tc = 1500	Harvesting Tc = 3500	Non-harvesting	Harvesting		Non-harvesting Tc = 500	Sod Harvesting Tc = 10,000	Non-harvesting	Sod Harvesting	
0	0.045	0.0077	0.018	3.9	1.7	0.22	0.013	0.26	2	<1	
25	0.0032	0.00055	0.0013	54	23	0.016	0.00092	0.018	33	1	
31	0.0017	0.00029	0.00069	100	44	0.0050	0.00028	0.0063	106	5	
39	0.00074	0.00013	0.00030	236	101	0.00021	NA	0.00030	NA	101	

<sup>a</sup> DAT is "days after treatment."

<sup>b</sup> See text for explanation of equations (p 21)

<sup>c</sup> MOE = NOEL (0.03 mg/kg/day) / Dermal Dose (mg/kg/day)

<sup>d</sup> DFR is "Distodgeable Foliar Residue"

<sup>e</sup> Tc is "Transfer Coefficient"

Table 14: Residential Exposure Scenario Descriptions for the Use of Acephate

Exposure Scenario (Number)	Data Source	Standard Assumptions <sup>a</sup>	Comments <sup>b,c</sup>
Mixing/Loading /Applying Using Wettable Powder Low Pressure Hand Wand (1)	PHED VI.1	5 gallons	Residential: Hand data are grade A, dermal data are C grade, and inhalation data are C grade. Hand = 15 replicates; dermal = 16 replicates; and inhalation = 16 replicates. High confidence in hand data. Medium confidence in inhalation and dermal data. A 90% protection factor was needed to "back calculate" a no glove unit exposure value from all non-detects.
Mixing /Loading/Applying Using Backpack Sprayer(2)	PHED VI.1	5 gallons	Residential: Hand is grade C, dermal data are AB grades, and inhalation data are A grade. Hand = 11 replicates; dermal = 9-11 replicates and inhalation = 11 replicates. Low confidence in hand/dermal/inhalation data. A 90% protection factor was needed to "back calculate" a no glove unit exposure value from all non-detects.
Mixing/Loading/Applying Using Hose-End Sprayer(3a)	PHED VI.1	50 gallons of spray solution; 20,000 sq ft (0.5 acre) for turf	Residential: Dermal =C grade; Hands =E grade and inhalation =C grade. Hand = 8 replicates; Dermal = 8 replicates; and inhalation = 8 replicates. Low confidence in dermal, hand and inhalation data.
Mixing/Loading/Applying Using Hose-End Sprayer(3b)	MRID 40504827	50 gallons; 0.094 lb ai/8 gallons	5 replicates
Mixing/ Loading /Applying Using Sprinkler Can (4)	PHED VI.1	5 gallons	Residential: Dermal,=C grade; Hands =E grade and inhalation=C grade. Hand =8 replicates; Dermal = 8 replicates; and inhalation = 8 replicates. Low confidence in dermal, hand and inhalation data.
Loading/Applying Soluble Powder (dry) by Hand/ Hand Tool/Shaker Can (5)	PHED VI.1	7 mounds	No PHED data were available for this scenario; therefore, used the PHED data for the granular bait dispersed by hand scenario.
Loading/Applying Granules by Shaker Can (6)	PHED VI.1	100 sq ft, 20 roses	Residential: Dermal = ABC grades, Hand = ABC grades; dermal/hands = 16 replicates, Inhalation = ABC grades, inhalation = 16 replicates. Medium confidence in dermal and inhalation data.
Applying By Aerosol Can (7)	PHED VI.1	2 cans (32 oz.)	No PHED data were available for this scenario; therefore, used the PHED data for the granular bait dispersed by hand scenario. Residential: Dermal = ABC grades, Hand = ABC grades; dermal/hands = 16 replicates, Inhalation = ABC grades, inhalation = 16 replicates. Medium confidence in dermal and inhalation data. Residential: Hands=A grade, dermal/inhalation=ABC. Hand = 15 replicates; dermal/inhalation = 30 replicates. Medium confidence in dermal and inhalation data, high confidence in hand data.

a Some of the assumptions are from Standard Operating Procedures (SOPs) for Residential Exposure Assessment.

b These grades are based on Quality Assurance/Quality Control data provided as part of the exposure studies. A replicate refers to data acquired during one complete work cycle. All handler exposure assessments in this document are based on the "Best Available" data as defined by HED SOP for meeting Subdivision U Guidelines (i.e., completing exposure assessments.) Best available grades are assigned as follows: matrices with grades A and B data (which is defined as acceptable grade data) and a minimum of 15 replicates; if not available, then grades A, B, and C data and a minimum of 15 replicates; if not available, then all data (all grades) regardless of the quality and number of replicates. High quality data with a protection factor take precedence over low quality data with no protection.

Data confidence as reported in the Table refers to both the quality and the quantity (number of replicates) of data for each PHED run. Each study in PHED has been graded from A to E. A high confidence run is grades A and B data and 15 or more replicates per body part. Any combination of A and B grade data are listed as acceptable grades data in the tables. A medium confidence run is grades A, B, and C data and 15 or more replicates per body part. Any combination of A, B, and C grade data are listed as ABC grade data in the tables. A low confidence run is all grades (any run that includes D or E grade data) or has less than 15 replicates per body part.

c Clothing for residential scenarios is short pants, short-sleeved shirt, no gloves, open mixing/loading. Use of PPE is not considered appropriate as the Agency can only make recommendations to residential handlers.

Table 15. Inhalation and Intermediate-term Dermal Exposures to Acephate - Residential

Exposure Scenario (Scen. #)	Residential Dermal Unit Exposure (mg/lb ai)*	Residential Inhalation Unit Exposure (µg/lb ai)*	Application Rate (ai)*	Amount Handled per Day*	Residential Daily Dermal Exposure (mg/day)*	Residential Daily Inhalation Exposure (µg/day)*
<b>RESIDENTIAL</b>						
Mixing/Loading/Applying Wettable Powder Using Low Pressure Hand Wand (1)	250	1,100	Ornamentals, flowers, shrubs, trees, fire ants 0.023 lb/gal	5 gallons	29	0.13
			Turf 0.035 lb/gal	5 gallons	44	0.19
			Roses, flowers, shrubs, trees 0.0076 lb/gal (LUIS)	5 gallons	9.5	0.042
Mixing/Loading/Applying Using Backpack Sprayer (2)	5.1	30	Ornamentals, flowers, shrubs, trees, fire ants 0.023 lb (4.5 grams)/gal	5 gallons	0.59	0.0035
			Turf 0.035/gal	5 gallons	0.89	0.0053
			Roses, flowers, shrubs, trees 0.0076 lb/gal (LUIS)	5 gallons	0.19	0.0011
Mixing/Loading/Applying Using Hose-End Sprayer (3a)	30	9.5	Ornamentals, flowers, shrubs, trees 0.023 lb/gal	50 gallons	35	0.011
			Turf 0.035 lb/gal	50 gallons	53	0.017
			Roses, flowers, shrubs, trees 0.0076 lb/gal (LUIS)	50 gallons	11	0.0036
			Shade trees 0.013 lb/gal (LUIS)	50 gallons	20	0.0062
			Ornamentals and turf 0.058 lb/1,000 sq ft. (LUIS)	20,000 sq ft (1/2 A)	35	0.011
Mixing/Loading/Applying Using Hose-End Sprayer(3b)	480	150	shrubbery 0.01175 lb/gal	50 gallons	282	0.0881
Mixing/Loading/Applying Using Sprinkling Can (4)	30	9.5	Ornamentals, flowers, shrubs, trees, fire ants 0.023 lb/gal	5 gallons	3.5	0.0011
			Turf 0.035 lb/gal.	5 gallons	5.3	0.0017
			Roses, flowers, shrubs, trees 0.0076 lb/gal (LUIS)	5 gallons	1.1	0.00036
Loading/Applying Soluble Powder (dry) Concentrate by Hand/Handtool/Shaker Can (5)	430	470	Fire Ants 0.0069 lb/mound	7 mounds	21	0.022

Table 15. Inhalation and Intermediate-term Dermal Exposures to Acephate - Residential (continued)

Exposure Scenario (Scen. #)	Residential Dermal Exposure (mg/lb ai) <sup>a</sup>	Residential Inhalation Unit Exposure (µg/lb ai) <sup>b</sup>	Application Rate (ai) <sup>c</sup>	Amount Handled per Day <sup>d</sup>	Residential Daily Dermal Exposure (mg/day) <sup>e</sup>	Residential Daily Inhalation Exposure (µg/day) <sup>f</sup>
Loading/Applying Granules by Shaker Can (6) (Note that label 239-2472 specified 3 shaker cups of 1.5#/25 sq ft. Could not be converted to lbs — 0.1125 lb/1000 sq ft was used as a surrogate)	430	470	Ornamentals	100 sq ft	4.8	0.0053
			Roses	5 sq ft/rose; 20 roses		
Applying by Aerosol Can (7)	220	2,400	Crack & Crevice	2 cans (32 oz)	4.4	0.048
			Ornamentals	2 cans (32 oz)	13	0.14

Footnotes:

- a Dermal unit exposure represents short pants, short sleeved shirt, no gloves, open mixing/loading. Inhalation represents no respirator.
- b Application rates are values found in acephate labels.
- c Daily amount handled values are from the HED estimates of amount that could be handled in a single day for each exposure scenario of concern.
- d Daily dermal exposure (mg/day) = Unit exposure (mg/lb ai) \* Appl. rate (lb ai/acre) \* Acres treated (acre/day).
- e Daily inhalation exposure (mg/day) = Unit exposure (mg/lb ai) \* (1 mg/1000µg) Conversion Factor \* Acres treated (acre/day).
- f

Table 16. Inhalation and Dermal Risks to Acephate - Residential

Exposure Scenario (Scen. #)	Residential Dose Daily Dermal (mg/kg/day)	Residential Dermal MOE	Residential Daily Inhalation Dose (mg/kg/day)	Residential Inhalation MOE	Residential Combined Dermal & Inhalation MOE
<b>RESIDENTIAL</b>					
Mixing/Loading/Applying Wettable Powder Using Low Pressure Hand Wand (1)	0.41	29	0.0019	74	21
	0.63	19	0.0027	52	14
	0.14	86	0.00060	230	63
Mixing/Loading/Applying Using Backpack Sprayer (2)	0.0084	1,400	0.000050	2,800	930
	0.013	920	0.000076	1,800	610
	0.0027	4,400	0.000016	8,800	2,900
Mixing/Loading/Applying Using Hose-End Sprayer (3a)	0.50	24	0.00016	880	23
	0.76	16	0.00024	580	16
	0.16	75	0.000051	2,700	73
	0.29	41	0.000089	1,600	40
	0.5	24	0.00016	880	23
Mixing/Loading/Applying Using Hose-End Sprayer(3b)	4.02	2/98	0.00126	111	3
Mixing/Loading/Applying Using Sprinkling Can (4)	0.05	240	0.000016	8,800	230
	0.076	160	0.000024	5,800	160
	0.016	750	0.0000051	27,000	730
Loading/Applying Soluble Powder (dry) by Hand/Handtool/Shaker Can (5)	0.3	40	0.00031	3182	40
Loading/Applying Granules by Shaker Can (6)	0.068	175	0.0000757	1849	160

Table 16. Inhalation and Dermal Risks to Acephate - Residential (Continued)

Exposure Scenario (Scen. #)	Residential Daily Dermal (mg/kg/day)	Residential Dermal MOE	Residential Daily Inhalation Dose (mg/kg/day)	Residential Inhalation MOE	Residential Combined Dermal & Inhalation MOE
Applying by Aerosol Can (7)	0.0.63	190	0.00069	200	97
	0.19	63	0.002	70	33

**Footnotes:**

- a Residential Daily Dermal Dose (mg/kg/day) = Residential Daily Dermal Exposure (mg/day) from Table 13 / Body weight (70 kg).
- b Residential Dermal MOE = Short- and Intermediate-term NOEL (12 mg/kg/day) / Residential Daily Dermal Dose (mg/kg/day).
- c Residential Daily Inhalation Dose (mg/kg/day) = Residential Daily Inhalation Exposure (mg/day) from Table 13 / Body weight (70 kg).
- d Residential Inhalation MOE = Inhalation NOEL (0.14 mg/kg/day) / Residential Daily Inhalation Dose (mg/kg/day).

e Total MOE:

$$\frac{1}{\frac{1}{MOE_{Inhalation}} + \frac{1}{MOE_{Dermal}}}$$

Table 17. Residential Post-application Scenarios and Estimated Risks for Acephate Applied to Turf

Scenario	Exposed Individual	Application Rate Per Treatment (AR) (lbs ai/A) <sup>a</sup>	DFR (ug/cm <sup>2</sup> ) <sup>b</sup>	GRt (ug/cm <sup>2</sup> ) <sup>c</sup>	SRt (ug/g) <sup>d</sup>	Transfer Coefficient (Tc) (cm <sup>2</sup> /hr)	Exposure Time (ET) (hrs/day)	Dermal Abs. (%)	Surface Area (SA) (cm <sup>2</sup> /event)	Freq. (FQ) (events/hr)	IgR (cm <sup>2</sup> /day) or (mg/day) <sup>e</sup>	BW (kg)	ADD (mg/kg/day) <sup>f</sup>	MOE <sup>g</sup>
Dermal exposure	Adult	3.5	7.8	-	-	43,000	2	100	-	-	-	70	9.6	1.2
	Child					8,700						15	9.1	1.3
Hand-to-Mouth	Child	3.5	7.8	-	-	-	2	-	350	1.56	-	15	0.57	21
Turfgrass ingestion	Child	3.5	-	7.8	-	-	-	-	-	-	25	15	0.013	923
Incidental soil ingestion	Child	3.5	-	-	26	-	-	-	-	-	100	15	0.00018	67,000

a Application rate for turf estimated as follows: 0.035 lb ai/gallon (based on acephate labels) \* 50 gallons applied/0.5 acres for full lawn treatments (assumed) = 3.5 lb ai/acre.

b Dislodgeable foliar residue (ug/cm<sup>2</sup>) = [AR (lbs ai/A) \* fraction ai retained on foliage (20%) \* 4.54E+8 ug/lb \* 2.47E-8 A/cm<sup>2</sup>].

c Grass residue (ug/cm<sup>2</sup>) = [AR (lbs ai/A) \* fraction ai retained on foliage (20%) \* 4.54E+8 ug/lb \* 2.47E-8 A/cm<sup>2</sup>].

d Soil residue (ug/cm<sup>2</sup>) = [AR (lbs ai/A) \* 4.54E+8 ug/lb \* 2.47E-8 A/cm<sup>2</sup> \* 0.67 cm<sup>3</sup>/g soil].

e Ingestion rate: cm<sup>2</sup>/day for grass ingestion, and mg/day for incidental soil ingestion.

f Average daily dose (ADD) (mg/kg/day)

Dermal exposure:

Hand-to-mouth:

Turfgrass ingestion:

Incidental soil ingestion:

g MOE = NOEL (12 mg/kg/day) / ADD.

$$= [DFR (ug/cm^2) * Tc (cm^2/hr) * mg/1,000 ug * ET (hrs/day) * absorption factor (1.0)] / [BW (kg)];$$

$$= [DFR (ug/cm^2) * SA (cm^2/event) * FQ (events/hr) * mg/1,000 ug * ET (2 hrs/day)] / [BW (kg)];$$

$$= [GRt (ug/cm^2) * IgR (cm^2/day) * mg/1,000 ug] / [BW (kg)];$$

$$= [SRt (ug/g) * IgR (mg/day) * g/1,000,000 ug] / [BW (kg)].$$



Table 18. Residential Post-application Scenarios and Estimated Risks for Methamidophos from Acephate Applied to Turf

Scenario	Exposed Individual	Application Rate Per Treatment (AR) (lbs ai/A) <sup>a</sup>	DFR (ug/cm <sup>2</sup> ) <sup>b</sup>	GRT (ug/cm <sup>2</sup> )	SRT (ug/g) <sup>d</sup>	Transfer Coefficient (Tc) (cm <sup>2</sup> /hr)	Exposure Time (ET) (hrs/day)	Dermal Abs. (%)	Surface Area (SA) (cm <sup>2</sup> /event)	Freq. (FQ) (events/hr)	IgR (cm <sup>2</sup> /d ay) or (mg/d ay) <sup>e</sup>	BW (kg)	ADD (mg/kg/d ay) <sup>f</sup>	MOE <sup>g</sup>
Dermal exposure	Adult	0.07	0.16	-	-	43,000	2	100	-	-	-	70	0.20	0.15
	Child					8,700						15	0.19	0.16
Hand-to-Mouth	Child	0.07	0.16	-	-	-	2	-	350	1.56	-	15	0.011	2.7
Turfgrass ingestion	Child	0.07	-	0.16	-	-	-	-	-	-	25	15	0.00026	115
Incidental soil ingestion	Child	0.07	-	-	0.53	-	-	-	-	-	100	15	0.000003	8,600

a Application rate for turf estimated as follows: 0.035 lb ai/gallon (based on acephate labels) \* 50 gallons applied/0.5 acres for full lawn treatments (assumed) \* 0.02 (fraction of acephate that is methamidophos) = 0.07 lb ai/acre.

b Dislodgeable foliar residue (ug/cm<sup>2</sup>) = [AR (lbs ai/A) \* fraction ai retained on foliage (20%) \* 4.54E+8 ug/lb \* 2.47E-8 A/cm<sup>2</sup>].

c Grass residue (ug/cm<sup>2</sup>) = [AR (lbs ai/A) \* fraction ai retained on foliage (20%) \* 4.54E+8 ug/lb \* 2.47E-8 A/cm<sup>2</sup>].

d Soil residue (ug/cm<sup>2</sup>) = [AR (lbs ai/A) \* 4.54E+8 ug/lb \* 2.47E-8 A/cm<sup>2</sup> \* 0.67 cm<sup>3</sup>/g soil].

e Ingestion rate: cm<sup>2</sup>/day for grass ingestion, and mg/day for incidental soil ingestion.

f Average daily dose (ADD) (mg/kg/day)

Dermal exposure:

Hand-to-mouth:

Turfgrass ingestion

Incidental soil ingestion: = [SRT (ug/g) \* IgR (mg/day) \* g/1,000,000 ug] / [BW (kg)]

g MOE = NOEL (0.03 mg/kg/day) / ADD.

$$= [DFR (ug/cm^2) * Tc (cm^2/hr) * mg/1,000 ug * ET (hrs/day) * absorption factor (1.0)] / [BW (kg)];$$

$$= [DFR (ug/cm^2) * SA (cm^2/event) * FQ (events/hr) * mg/1,000 ug * ET (2 hrs/day)] / [BW (kg)];$$

$$= [GRT (ug/cm^2) * IgR (cm^2/day) * mg/1,000 ug] / [BW (kg)];$$

$$= [SRT (ug/g) * IgR (mg/day) * g/1,000,000 ug] / [BW (kg)].$$