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UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON, D.C. 20460

OFFICE OF
PREVENTION, PESTICIDES AND
TOXIC SUBSTANCES

October 14, 1999

MEMORANDUM:

SUBJECT: **Acephate.** Revised Human Health Risk Assessment. HED Chapter for the Reregistration Eligibility Decision (RED) Document. List A Reregistration Case 0042. Chemical No. 103301. DP Barcode D259663.

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Please find attached the revised Human Health Risk Assessment for the acephate Reregistration Eligibility Decision Document (RED). The HED chapter includes the Hazard Assessment from Nancy McCarroll, Toxicology Branch I (Attachment 1), Product and Residue Chemistry Assessments from Felecia Fort, Reregistration Branch 1 (Attachment 2), Dietary Exposure Analysis from Felecia Fort, Reregistration Branch 1 (Attachment 3), and the Occupational and Residential Exposure Assessment from Catherine Joseph, Reregistration Branch 1 (Attachment 4). Information was also drawn from the 01/15/98 HIARC memorandum (HED Doc. No. 012453), a draft of EFED's Water Resource Assessment, and the FQPA Safety Factor Committee memorandum. This risk assessment or its components have been evaluated within HED by the following peer review committees: HIARC, FQPA SFC, ChemSAC, ExpoSAC, and DE SAC.

ACEPHATE

HED'S HUMAN HEALTH RISK ASSESSMENT

1.0 EXECUTIVE SUMMARY

The Health Effects Division (HED) has conducted a human health risk assessment for the active ingredient **acephate** for the purpose of making a reregistration eligibility decision.

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.

HED evaluated the toxicology, residue chemistry, and occupational exposure databases for methamidophos and determined that the data are adequate to support a reregistration eligibility decision. This is an 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 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.

Acephate is an organophosphate. As with other chemicals in its class, cholinesterase inhibition is the major toxic effect of acephate; however, other toxic effects were also observed in the toxicology studies.

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 III for acute oral toxicity. Acephate is degraded to methamidophos in the environment.

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 in animals which were exposed to acephate *in utero* 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 reduced to 1X. The specific doses and endpoints selected by the HED Hazard Identification Assessment Review

Committee for risk assessment were:

- Acute dietary - NOAEL = 0.5 mg/kg/day based on plasma and brain cholinesterase inhibition in an acute neurotoxicity range finding study in rats at 2.5 mg/kg/day.
- Chronic dietary - NOAEL = 0.12 mg/kg/day based on brain cholinesterase inhibition at 0.21 mg/kg/day from a 13 week toxicity study on rats. Although there is slight inhibition at 0.12 mg/kg, the inhibition was considered minimal.
- Short-term and intermediate-term dermal - NOAEL = 12 mg/kg/day based on brain cholinesterase inhibition at 60 mg/kg/day from a 21-day dermal study.
- Short-term and intermediate-term inhalation - NOAEL = 0.0005 mg/L based on a plasma, brain and erythrocyte cholinesterase inhibition at >0.0005 mg/L from a 4 week inhalation study in rats.

All doses for risk assessment purposes were assessed uncertainty factors of 10x for interspecies extrapolation and 10x for intraspecies variability.

The acephate dietary risk assessments reflect highly refined exposure assessments; anticipated residues and percent crop treated information were incorporated. Refinements were conducted in anticipation of a cumulative risk assessment being conducted in the future and also to permit a more realistic comparison of Drinking Water Levels of Comparison (DWLOC) with estimates of potential drinking water concentrations provided by the Environmental Fate and Effects Division (EFED). Acute dietary assessments were conducted using an probabilistic/Monte Carlo method with an acute population adjusted dose (aPAD) of 0.005 and 0.001 mg/kg/day for acephate and methamidophos, respectively; acute risk from acephate and methamidophos from application of acephate only resulted in 22% and 61% of the acephate and methamidophos aPAD consumed for the general U.S. population. The most highly exposed subpopulation, children (1 to 6 years) consumed 33% of the acephate aPAD. For methamidophos, the most highly exposed subpopulation was infants where 80% of methamidophos aPAD was consumed. Chronic risks calculated using chronic PADs (cPAD) of 0.0012 mg/kg/day (acephate) and 0.0001 mg/kg/day (methamidophos) were low. Chronic dietary risk resulted in 7% and 17% of the cPAD consumed for the general U.S. population and children (1 to 6 years old, again the most highly exposed subgroup), respectively for acephate. Methamidophos risks were also low with 16% and 19% of the methamidophos cPAD consumed for the general U.S. population and children (1 to 6 years old, also the most highly exposed subgroup).

In examining aggregate exposure, EPA takes into account the available and reliable information concerning exposures from pesticide residues in food and other exposures include drinking water and non-occupational exposures, e.g., exposure 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.

There are residential uses of acephate; therefore, the considerations for aggregate exposure are those from food, water, and residential uses. Additionally, since methamidophos is a metabolite of acephate, aggregate risk assessments which determine the methamidophos risks from application of both acephate and methamidophos, and from applications of acephate alone were conducted.

For chronic aggregate risk (food only), 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 23% of the cPAD is consumed for the U.S. population. The most significantly exposed subpopulation, children (1 to 6 years) occupied 37% of the cPAD, respectively. The results indicate that HED has no concern for chronic aggregate exposure from food alone.

An acute aggregate dietary exposure analysis (food only) which considers methamidophos from application of acephate and of methamidophos was also conducted. For this analysis residue refinements including anticipated residues generated from field trial and monitoring data, adjustments for percent crop treated, washing and cooking factors, and a probabilistic/Monte Carlo acute analysis were utilized. Applying all of these refinements, the most highly exposed population subgroup was children 1-6 years with a %aPAD of 120%. For the general U.S. population, 79% of the aPAD was consumed. The results indicate that for children, 100% of the aPAD is exceeded.

With respect to the exposure in water, conservative Tier II (PRZM-EXAMS) modeling was provided by EFED and indicate that acephate concentrations in surface water are not likely to exceed 82 ppb for peak (acute) exposure and 15 ppb for mean (chronic) exposure. Surface water Estimate Exposure Concentrations (EECs) for drinking water exposure estimates for methamidophos were generated using GENEEC modeling (Tier I) assuming a 25% conversion efficiency. A Tier II assessment using PRZM-EXAMS was not conducted because of the high uncertainty surrounding any estimate of the decay rate for acephate and the transformation rate of acephate to methamidophos needed for the PRZM simulation. The EECs for methamidophos formed as a degradate from acephate used on cotton were 22 ppb for peak(acute) and 12 ppb for mean (chronic) exposure. Using the SCI-GROW model to estimate concentrations of methamidophos in ground water, yielded low EECs for both acute and chronic exposure of acephate and methamidophos at 0.02 and 0.005 ug/L, respectively.

Upon comparison of the chronic Drinking Water Levels of Comparison (DWLOCs) with the environmental concentrations of acephate, surface water concentrations exceed the DWLOCs for infants and children. Consequently, there appears to be a potential for acephate residues in surface water to occur at levels of concern for infants and children. For methamidophos, EECs for surface water are greater than the DWLOCs for all subpopulations; therefore, there may also be chronic dietary concern for methamidophos residues in drinking water.

Acute surface water concentrations exceed the acute DWLOCs for acephate (infants and

children) and for methamidophos (all subpopulations). Thus, there appears to be a potential for acephate and methamidophos residues in surface water to occur at levels of concern. Drinking water monitoring data would allow refinement of the estimated environmental concentrations (EECs).

There are no chronic or acute concerns for drinking water from groundwater sources.

An aggregate exposure assessment which considers risk from food (from application of acephate and application of methamidophos) and water was conducted for chronic exposure only since HED has concerns for acute aggregate exposure from food alone. Using the aggregate chronic food exposure (exposure which incorporates methamidophos residues from application of both methamidophos and acephate), DWLOCs were calculated. The results indicate that there may be concern for children(1 to 6 years) and infants.

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.

Occupational and residential exposure assessments were conducted for acephate. In addition to quantifying risk to acephate exposures, the occupational and residential assessment addressed methamidophos exposures and risks following the application of acephate products.

For occupational risk analysis, twenty-five exposure handler scenarios were identified for acephate. Only two chemical-specific exposure monitoring studies were submitted in support of the reregistration of acephate. The majority of analyses for both short- and intermediate-term exposures were performed using the Pesticide Handlers Exposure Database (PHED), Version 1.1 (August 1998).

The calculations of handler's combined dermal and inhalation risks indicate that at the highest level of mitigation available and/or feasible for a specific scenario, thirteen of the twenty-five scenarios do not exceed 100. There are also five scenarios for which no exposure data are available and four scenarios for which surrogate data from similar PHED scenarios were used. The range of combined dermal and inhalation MOEs for the handler/applicators' scenarios was 0.065 to 2800.

HED has determined that workers may be exposed to acephate and methamidophos upon entering occupational areas which have been previously treated with acephate to perform specific work activities in these areas (e.g., scouting, staking/tying, irrigating, harvesting). Due to the frequency and duration of post-application worker exposures coupled with the dissipation of acephate and methamidophos following acephate treatments, it was determined that occupational acephate uses result in potential intermediate-term dermal acephate and methamidophos post-application worker exposures. Potential inhalation exposures are not anticipated for post-application worker exposures, and HED currently has no policy/method for evaluating non-dietary ingestion by workers due to poor hygiene practices or smoking. As a result, only dermal

exposures were evaluated in the post-application worker assessment. Valent submitted four dislodgeable foliar residue studies (DFRs) and one turf transferable residue study (TTR) which address the dissipation of acephate and methamidophos in fields/greenhouses of succulent beans, cauliflower, greenhouse roses, tobacco, and turfgrass. These studies were used to evaluate potential post-application worker risks.

Re-entry intervals (REIs) were calculated for specific tasks. Calculated REIs for succulent beans while performing harvest by hand, stake/tie, scout, and irrigate were 5 days. Calculated REIs for cauliflower while performing scout, irrigate, and harvest by hand were 0 days. Calculated REIs for greenhouse roses while sorting and packing was 6 days and while pruning and harvesting by hand was 12 days. Calculated REIs for tobacco while performing stake/tie, scout and irrigate was 8 days and while harvesting by hand was 19 days. Calculated REIs for turfgrass while mowing with tractor or push-type mower was 0 days and while harvesting sod was 1 day. It should be noted that the default REI of 24 hours will still apply to cauliflower and turf under the Worker Protection Standard.

Residential acephate applications can be carried out by several methods which include aerosol can, shaker can, backpack sprayer, hand/handtool/shaker can, hose-end sprayer, low-pressure handwand, and sprinkler can. Due to the frequency and duration of acephate uses, it was determined that uses of acephate by residential pesticide/handlers applicators result in short-term exposures to these applicators. The calculated combined dermal and inhalation risks indicate that two exposure scenarios exceed 100 while six scenarios do not. There are also two scenarios for which surrogate data from similar PHED scenarios were used. The range of combined dermal and inhalation MOEs for the residential acephate applicators' scenarios was 2.9 to 7,100.

The public may be exposed to acephate and methamidophos upon entering residential areas which have been previously treated with acephate. The available data indicated that residential acephate uses result in potential short-term dermal and oral acephate and methamidophos post-application residential exposures to the public. However, inhalation exposures are not anticipated for post-application residential exposures.

It is anticipated that adults and children may primarily be exposed to acephate and methamidophos through their contact with turfgrass and soil. The analyses indicated that the following acephate post-application residential exposure scenarios may be of potential concern: dermal risks to adults and children (MOEs of 50 and 52, respectively), children's hand-to-mouth risks (MOE = 36), and children's turfgrass ingestion risks (MOE = 38). The calculated MOE for acephate children's incidental soil ingestion did not exceed HED's level of concern (MOE = 3,600), and none of the methamidophos post-application residential exposure scenarios exceed HED's level of concern (MOE range = 820 - 600,000). It should be noted that the residential SOPs specify that the residential exposure calculations are to be used as a screening basis,

The public may also be exposed to acephate and methamidophos upon entering recreational areas (golf courses) which have been previously treated with acephate. The possible post-application exposures are short-term dermal exposures and inhalation exposure is not expected. The

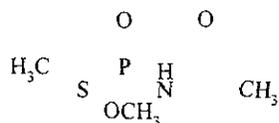
recreational areas addressed in this assessment are golf courses.

The results showed that MOEs for adult golfers' risks to acephate and methamidophos were 7,500 and 125,000, respectively while the calculated MOEs for 13+ year-old golfers' risks to acephate and methamidophos were 4,620 and 78,100, respectively.

Several areas of the risk assessment and characterization would improve with more data. Valent recently completed several DFR and TTR studies; data for applicator scenarios for which no data are currently available would allow more refined risk estimates to be made. Additionally, specific data on typical use, types of mixing and loading completed for application equipment, types of packaging available to individual and professional pesticide applicators, types of potential engineering controls, additional information on slit-placement techniques for turf applications of granules, and information on post-application techniques for all crops could be submitted.

2.0 PHYSICAL/CHEMICAL PROPERTIES CHARACTERIZATION

ACEPHATE



Empirical Formula: C₄H₁₀NO₃PS

Molecular Weight:183.16

CAS Registry No.:30560-19-1

Shaughnessy No.:103301

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.

A search of the Reference Files System (REFS) conducted 1/29/97 identified four acephate manufacturing-use products (MPs) registered under Shaughnessy No. 103301. The registered acephate MPs are listed in Table 1; only these products are subject to a reregistration eligibility decision.

Table 1. Registered Manufacturing-use Products of Acephate.

Formulation	EPA Reg. No.	Registrant
97% T	51036-246	Micro-Flo Company
97% T	59639-41	Valent U.S.A. Corporation
Orthene MFG	59639-42	

3.0 HAZARD CHARACTERIZATION

The toxicological database for acephate is adequate to support reregistration. In general the dominant toxic effects seen in various toxicity studies were the effects generally associated with cholinesterase inhibition. Although the rat metabolism studies submitted were found to be inadequate, these studies are summarized in this hazard assessment. While the lack of an adequate metabolism study will not affect the Reregistration Eligibility for acephate, a new confirmatory rat metabolism study is required. The available toxicology studies are summarized in this hazard assessment. Tables 2, 3a, and 3b present the acute toxicity profile for acephate and

the HIARC toxicity endpoints and doses for risk assessment, respectively.

Acephate has low acute dermal and inhalation toxicity (Tox. Category IV). It is non-irritating to skin and eyes and is not a skin sensitizer. It is classified under Category III for acute oral toxicity (see Table 2.)

Sufficient data are available to describe the subchronic toxicity of acephate. In a special oral cholinesterase inhibition study, acephate had no effect on body weights and no toxic signs were observed. Tissue abnormalities were not observed at necropsy and there was no mortality. There was inhibition of plasma, RBC, brain cholinesterase (ChE) down to 0.12 mg/kg BW/day. With dermal application, cholinesterase inhibition occurred in a dose-related manner, was significant, and was seen in the brain. Two inhalation studies were also submitted. In the high dose study, tremors, miosis, decreased body weight and weight gain, and histopathological findings as well as plasma, brain and erythrocyte ChE inhibition were seen. No treatment-related changes in body weight, food consumption, clinical chemistry or hematology parameters, plasma, erythrocyte or brain cholinesterase activity, or histopathology findings were seen in the other study conducted at lower dose rates.

Adequate data are available to assess the chronic toxicity and carcinogenic potential of acephate. The most consistent toxicological findings following chronic acephate exposure were decreased body weight gain (rats) and inhibition of plasma, erythrocyte and/or brain cholinesterase (rats and dogs). Other treatment related effects (decreased hematological parameters, increased thromboplastin time, increased absolute liver weight, and histological changes in the liver) were seen in the dog at the high dose (167 mg/kg/day). Acephate has been classified as a Group C, possible human carcinogen; however, it was concluded that no quantitative risk assessment is needed based on the occurrence of tumors, mainly carcinomas in only one sex of one species, and only at the highest dose; and the lack of mutagenicity seen in *in vivo* mutagenicity studies.

Two developmental toxicity studies (rat and rabbit) and one reproductive toxicity study in rats were available for review. These data are considered adequate to assess the developmental and reproductive toxicity potential of acephate, no significant developmental and reproductive toxic effects were found. There is no indication of an increased sensitivity of the offspring of rats or rabbits to pre-natal or postnatal exposure to acephate. In all studies examined, maternal or parental NOAELs are lower or equivalent to the offspring NOAELs.

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 cause 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*

in vivo assays with acephate clearly showed that the genotoxic activity of acephate was not expressed in whole animals. The Hazard Identification Assessment Review Committee (HIARC) concluded, therefore, that the negative findings from the *in vivo* studies lessen the concern for a potential mutagenic hazard.

Two metabolism studies submitted were found to be inadequate although some information was provided to gain some understanding of 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 (^{14}C) was excreted, respectively, during the first 6 and 12 hours after dosing. Most of the remaining ^{14}C was found in the exhaled air, feces and tissues. The ^{14}C found in urine was unchanged acephate (73-77%), DMPT (O,S-dimethyl phosphorothioate; 3-6%) and S-Methyl acetylphosphoramidothioate; (3-4%). Methamidophos was not detected in urine, and it was concluded that methamidophos was only a plant and soil metabolite of acephate. Of the 0.4% ^{14}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, the purpose was to investigate whether methamidophos was formed from acephate in rats. Results indicated that acephate was rapidly absorbed and eliminated by the rats. 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. Methamidophos was then absorbed from the stomach and intestines, and distributed throughout the body. There was also no indication for methamidophos to accumulate in blood, liver, muscle, fat and heart.

Acceptable acute and subchronic delayed neurotoxicity studies in hens and acute and subchronic neurotoxicity screening batteries in rats were available for review. There were no data gaps for the assessment of the neurotoxic potential of acephate. Data from the hen studies indicate that acephate produces toxic signs characteristic of ChE inhibition (acute and subchronic exposures), but no delayed neurotoxicity or histological changes in brain, spinal cord or peripheral nerves. In an acute neurotoxicity study in rats, neurotoxic effects were seen at the lowest dose tested (whole body tremors, decreased rotarod performance) as well as plasma, RBC, and brain cholinesterase inhibition. In a subchronic neurotoxicity study in the rat, the most prevalent effect was cholinesterase inhibition.

The toxicity of methamidophos, a metabolite of acephate is discussed in the HED chapter of the methamidophos Human Health Assessment. However, since the risk assessment for methamidophos resulting from applications of acephate is discussed in this document, methamidophos risk assessment endpoints and NOAELs are provided in Table 3b.

Table 2. Toxicity Profile of Acephate

Guideline No.	Study Type	MRID #	Results	Tox. Category	Study Classification
Acute Toxicity					
81-1	Acute Oral LD ₅₀ (rat)	00014675	945 mg/kg ♂ 866 mg/kg ♀		
81-1	Acute Oral LD ₅₀ (rat) Recalculation	00029686	1.4 g/kg ♂ 1.0 g/kg ♀	3	Acceptable
81-2	Acute Dermal LD50 (rabbit)	00055602	>10 g/kg ♂	4	Acceptable
81-3	Acute Inhalation LC ₅₀ (rat)	00015307	>61.7mg/L	4	Acceptable
81-4	Primary Eye Irritation (Rabbit)	00014686	Non-irritant	4	Acceptable
81-5	Primary Dermal Irritation (Rabbit)	00015305	PIS = 0.1 (Intact and abraded skin)	4	Acceptable
81-6	Dermal Sensitization (Guinea pig)	00119085	Negative	---	Acceptable
Guideline No.	Study Type	MRID #	Results		Core Grade
Subchronic Toxicity					
82-1(a) 870.3100	90-day feeding- rat (Special ChE inhibition study)	40504819	ChE NOAEL(plasma) = 0.76 mg/kg/day ♀, 0.58 mg/kg/day ♂ ChE LOAEL(plasma) = 11.48 mg/kg/day ♀, 8.9 mg/kg/day ♂ ChE NOAEL (brain) = <0.15 mg/kg/day ♀, <0.12 mg/kg/day ♂ ChE LOAEL (brain) = 0.15 mg/kg/day ♀ (LDT), 0.21 mg/kg/day ♂ ChE NOAEL (RBC) = 0.76 mg/kg/day ♀, 0.58 mg/kg/day ♂ ChE LOAEL (RBC) = 11.48 mg/kg/day ♀, 8.9 mg/kg/day ♂		Acceptable
82-2 870-3200	21-day dermal-rat	44541101	NOAEL = 12 mg/kg/day LOAEL = 60 mg/kg/day based on reduced brain ChE No dermal toxicity was seen.		Acceptable

Guideline No.	Study Type	MRID #	Results	Core Grade
82-3 870-3465	4-week inhalation- rat	40504818	<p>systemic NOAEL = 0.0108 mg/L systemic LOAEL = 0.0936 mg/L based on tremors, miosis, decreased body weight and weight gain, and histopathological changes in the nasal cavity.</p> <p>ChE NOAEL(plasma) = 0.00105 mg/L ChE LOAEL(plasma) = 0.0108 mg/L</p> <p>ChE NOAEL (brain and erythrocyte) = <0.00105 mg/L (LDT) ChE LOAEL (brain and erythrocyte) = 0.00105 mg/L.</p>	Acceptable
82-3 870-3465	4-week inhalation- rat	40645903	<p>systemic NOAEL = 0.0005 mg/L (HDT)</p> <p>ChE NOAEL (plasma, erythrocytes, and brain) = 0.0005 mg/L ChE LOAEL = >0.0005 mg/L (HDT)</p>	Acceptable
Chronic Toxicity				
83-1(a)	1-year chronic feeding/carcinogenicity study in rats	00084017 00101623	<p>systemic NOAEL = 2.5 mg/kg/day ♂ ; >35 mg/kg/day ♀ systemic LOAEL = 35 mg/kg/day based on neurotoxic signs, decreased body weight gain and food efficiency</p> <p>ChE (plasma, RBC, and brain) NOAEL = 0.25 mg/kg/day ChE (plasma, RBC, and brain) LOAEL = 2.5 mg/kg/day</p>	Acceptable

Guideline No.	Study Type	MRID #	Results	Core Grade
83-1(b) 870-4100	1-year chronic feeding - dog	41812001	<p>systemic NOAEL = 3.11 mg/kg/day systemic LOAEL = 20.16 mg/kg/day (HDT) based on decreases in hematological parameters, increase in thromboplastin time, increase in absolute liver weight and histological changes in the liver</p> <p>ChE NOAEL(plasma) = 20.16 mg/kg/day ChE LOAEL(plasma) = >20.16 mg/kg/day</p> <p>ChE NOAEL (brain) = <0.27 mg/kg/day ♀, 0.27 mg/kg/day ♂ ChE LOAEL (brain) = 0.27 mg/kg/day ♀(LDT), 3.11 mg/kg/day ♂ (LDT)</p> <p>ChE NOAEL (RBC) = 0.27 mg/kg/day ChE LOAEL(RBC) = 3.11 mg/kg/day</p>	Acceptable
83-5 870.4300	Chronic feeding/Carcinogenicity-rats	008417	No treatment related increases in tumor incidence	Acceptable
83-2(b)	Carcinogenicity-mouse	00105197, 00077209, 00105198, 00129156	<p>systemic NOAEL =7 mg/kg/day ♂, 8 mg/kg/day ♀ systemic LOAEL =36 mg/kg/day ♂, 42 mg/kg/day ♀ based on 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</p> <p>At 167 mg/kg/day (HDT) ♂, increased incidence of hepatocellular carcinomas in female mice was found</p>	Acceptable
Developmental/Reproductive Toxicity				
83-3(a)	Developmental toxicity study -rat	41081602	<p>Maternal Toxicity NOAEL = 5 mg/kg/day LOAEL =20 mg/kg/day based on reduced body weights, body weight gains, food consumption, and food efficiency</p> <p>Developmental Toxicity NOAEL = 20 mg/kg/day LOAEL = 75 mg/kg/day based on decreases in mean numbers of ossification centers per litter</p>	Acceptable

Guideline No.	Study Type	MRID #	Results	Core Grade
83-3(b)	Developmental toxicity study-rabbit	00069684 00069683	Maternal Toxicity NOAEL = 3 mg/kg/day LOAEL = 10 mg/kg/day (HDT) based on increased abortions Developmental Toxicity NOAEL = >10 mg/kg/day (HDT)	Acceptable
83-4	Multi-generation Reproduction study-rats	40323401 40605701	Parental Toxicity NOAEL = 2.5 mg/kg/day LOAEL = 25 mg/kg/day based on decreased body weights and/or weight gains Reproductive Toxicity NOAEL = 2.5 mg/kg/day LOAEL = 25 mg/kg/day based on decreased viability index (two generations and mating performance (one generation))	Acceptable
Neurotoxicity				
81-7	Acute delayed neurotoxicity in hens	00154884	No delayed neurotoxicity was found in the treated hens. However, cholinergic and neurotoxic effects occurred shortly after dosing and disappeared within 10 days. No lesions were observed in the sciatic nerve which included diarrhea, lethargy, limb weakness, and loss of coordination.	Acceptable
	Acute range finding neurotoxicity in rats	44203301	Systemic toxicity NOAEL = 5 mg/kg LOAEL = 25 mg/kg based on clinical signs such as lacrimation althered gait, and constricted pupils Plasma ChE NOAEL = 0.5 mg/kg ♂ and <5 mg/kg ♀ LOAEL = 2.5 mg/kg♂ and 5 mg/kg ♀ RBC ChE NOAEL = 2.5 mg/kg ♂ and <5 mg/kg ♀ LOAEL = 5 mg/kg (both sexes) Brain ChE NOAEL = 0.5 mg/kg ♂ and <5 mg/kg ♀ LOAEL = 2.5 mg/kg♂ and <5 mg/kg ♀	Acceptable

Guideline No.	Study Type	MRID #	Results	Core Grade
81-8	Acute neurotoxicity - rats	44203303	Neurotoxicity NOAEL = <10 mg/kg LOAEL = 10 mg/kg (LDT) based on whole body tremors, decreased rotarod performance ChE NOAEL = <10 mg/kg ChE LOAEL = 10 mg/kg based on plasma, RBC, and brain ChE inhibition	Acceptable
82-7	Subchronic neurotoxicity - rats	44203304	Systemic toxicity NOAEL = 0.33 mg/kg/day ♀ and 0.41 mg/kg/day ♂ LOAEL = 49 mg/kg/day ♀ and 58.27 mg/kg/day ♂ based on increases in clinical signs Neurotoxicity NOAEL = 3.95 mg/kg/day ♀ and 3.31 mg/kg/day ♂ LOAEL = 58.3 mg/kg/day ♀ and 48.6 mg/kg/day ♂ based on decreased rotarod time, and increased rearing. Erythrocyte ChE NOAEL = 3.31 mg/kg ♂ and 3.95 mg/kg ♀ ChE LOAEL = 48.6 mg/kg ♂ and 58.3 mg/kg ♀ Plasma ChE NOAEL = 0.41 mg/kg/day ♀ and 0.33 mg/kg/day ♂ ChE LOAEL = 3.31 mg/kg ♂ and 3.95 mg/kg ♀ Brain ChE NOAEL = <0.33 mg/kg ♂ and <0.41 mg/kg ♀ ChE LOAEL = 0.33 mg/kg ♂ and 0.41 mg/kg ♀	Acceptable
Mutagenicity				
84-2 870.5100 870.5375 870.5550	Mutagenicity studies	00119080, 00028625, 00132948, 00132947, 000132949, 00132950, 00137738, 40209101, 00132953, 00119081, 00132955, 00132949, 00132954, 00028625	Fourteen acceptable mutagenicity studies were submitted. The results from the <i>in vitro</i> 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 <i>in vivo</i> 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.	Acceptable

Guideline No.	Study Type	MRID #	Results	Core Grade
Metabolism				
85-1	Metabolism study- rats	00014994	Acephate is rapidly and completely absorbed from the stomach and rapidly excreted in urine. Methamidophos was not detected in urine, and the author concluded that Methamidophos was only a plant and soil metabolite of acephate.	Acceptable
85-1	Metabolism study-rats	00014219	Acephate was rapidly absorbed and rapidly eliminated by the rats. There was no tendency for acephate to concentrate in blood, liver, muscle, fat, heart and brain. Rats 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. There was no tendency for methamidophos to accumulate in blood, liver, muscle, fat and heart.	Acceptable

NOAEL = No Observable Adverse Effect Level

LOAEL = Lowest Observable Adverse Effect Level

LDT = Lowest Dose Tested; HDT = Highest Dose Tested

ChE = Cholinesterase

3.2 Dose Response Assessment

The strengths and weaknesses of the acephate toxicology database were considered during the process of toxicity endpoint and dose selection. In general, all the required guideline studies on acephate were available and provided reasonable confidence when the toxicity endpoints and doses for risk assessment were selected. 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 1/15/98). These endpoints are summarized in Table 3a (acephate) and 3b (methamidophos).

Table 3a. Acephate Endpoints Used For Risk Assessment

Exposure Scenario	NOAEL for use in Risk Assessment	Uncertainty Factor	Endpoint
Acute Dietary	0.5 mg/kg/day (acute neurotoxicity range finding study) aRfD = 0.005 mg/kg/day aPAD = 0.005 mg/kg/day	100	Brain and plasma ChE inhibition
Chronic Dietary	0.12 mg/kg/day (90-day feeding study) cRfD = 0.0012 mg/kg/day cPAD = 0.0012 mg/kg/day	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)	0.0005 mg/kg/day (4 week Inhalation Toxicity Study)	100	Brain ChE inhibition
Carcinogenic	Acephate has been classified as a Group C, possible human carcinogen. Quantitative cancer risk assessment is not required.	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

NOAEL - No Observable Adverse Effect Level, ChE = Cholinesterase, MOE = Margins of Exposure, N/A = not applicable
 Note that long-term exposure/risk assessments are not 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 assessment are appropriate.

Table 3b. Methamidophos Endpoints Used For Risk Assessment

Exposure Scenario	NOAEL for use in Risk Assessment (Study)	Uncertainty Factor	Endpoint
Acute Dietary	0.3 mg/kg/day (Acute Neurotoxicity-rat) ARfD = 0.003 mg/kg/day aPAD = 0.001 mg/kg/day	300*	Plasma, erythrocyte and brain ChE inhibition
Chronic Dietary Adjusted RfD = 0.0001 mg/kg/day	0.03 mg/kg/day (8 week toxicity-rat) cRfD = 0.0003 mg/kg/day cPAD = 0.0001 mg/kg/day	300*	Brain ChE inhibition
Short-Term (1-7 days)	0.75 mg/kg/day (21 day dermal-rat)	100	Brain ChE inhibition
Intermediate-Term Exposure (1 week to several months)	0.75 mg/kg/day (21-day dermal-rat)	100	Brain ChE inhibition
Long-Term Exposure (several months to lifetime)	Not applicable The use pattern does not indicate potential long-term dermal or inhalation exposure.	N/A	N/A
Inhalation Exposure (any duration)	0.001 mg/L (90-day inhalation- rat)	100	plasma, brain and erythrocyte ChE inhibition
Carcinogenic	Methamidophos has been classified as a "not likely" human carcinogen. Risk assessment not required.	N/A	N/A
Aggregate Assessment	The dermal and inhalation MOE's may be combined to obtain a total MOE since a common toxicological endpoint (cholinesterase inhibition) was observed.	N/A	N/A
FQPA Considerations	For methamidophos the 10-fold uncertainty factor to account for the protection of infants and children has been reduced to 3X. Thus, for all scenarios, MOEs equal to or greater than 300 are appropriate.	N/A	N/A

NOAEL - No Observable Adverse Effect Level, ChE = Cholinesterase, MOE = Margin of Exposure, N/A = not applicable

Note that long- term exposure/risk assessments are not evaluated in this document. Exposures from the uses of methamidophos were determined to be of an intermittent nature (i.e., the frequency and duration of these exposures do not exhibit a chronic exposure pattern); therefore long-term assessment is not required.

*The 300x safety factor which includes a 3X factor for FQPA, is applicable for dietary exposures (residential exposures to methamidophos do not occur).

3.3 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.

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.

4.0 EXPOSURE ASSESSMENT

4.1 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, 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

4.2 Dietary Exposure

Potential dietary exposure to acephate residues in the diet occurs through food and water. Data supporting food exposure are adequate and are summarized in the Residue and Product Chemistry Chapters (Attachment 2). Exposure to acephate residues in ground and surface water was estimated using conservative modeling techniques; available monitoring data were assessed but were not considered adequate for quantitative risk assessment purposes.

4.2.1 Food Exposure.

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/or 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.

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, and 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.

Codex MRLs have been established for residues of acephate and methamidophos *per se*.

HED conducts dietary risk assessments using the Dietary Exposure Evaluation Model (DEEM™), which incorporates consumption data generated in USDA's Continuing Survey of Food Intakes by Individuals (CSFII), 1989-1992. For chronic dietary risk assessments, the three day average of consumption for each sub-population is combined with residues in commodities to determine average exposure in mg/kg/day. For acute dietary risk assessments, the entire distribution of single day food consumption events is combined with either a single residue level (deterministic analysis) or a distribution of residues (probabilistic analysis, referred to as "Monte Carlo") to obtain a distribution of exposure in mg/kg/day. For deterministic (Tier 1) analyses, the Agency regulates at the 95th percentile of exposure; when probabilistic assessments are conducted, the Agency regulates at the 99.9th percentile of exposure.

Dietary exposure assessments were 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.

Acute and chronic dietary exposure to acephate and methamidophos (acephate application only) result in risk estimates that are below the Agency's level of concern (<100% of the aPAD and cPAD, respectively). Residue refinements including anticipated residues generated from field trial and monitoring data, adjustments for percent crop treated, washing and cooking factors and a probabilistic/Monte Carlo acute analyses were utilized. Monitoring data for acephate and methamidophos were generated through the USDA Pesticide Data program (PDP) for succulent beans, celery and lettuce; and FDA Surveillance Monitoring data for cauliflower and peppers (acephate only; bell and non-bell). Monitoring data from the years 1994 through 1997 (PDP) and the years 1993 through 1998 (FDA) were considered. Field trial data were used for Brussels sprouts, dry beans, cottonseed, cranberry, mint, macadamia nuts, peanuts, peppers (methamidophos only), and soybean. Although FDA data were available for methamidophos on peppers, these data were not used because HED believes that these data would greatly overestimate the risk to methamidophos from application of acephate since these data represent monitoring data from application of acephate and application of methamidophos. Additionally, because fresh peppers are considered nonblended, these data would be decomposited which could further overestimate the risk.. Applying all of these

refinements, the most highly exposed population subgroup for both acute and chronic dietary risk to acephate was children 1-6 years with a percent chronic population adjusted dose (% cPAD) of 17 and a %aPAD of 33% at the 99.9th percentile exposure. Exposure to the general U.S. population is 7 %cPAD and 22% of the aPAD at the 99.9th percentile. For methamidophos (acephate application only), the most highly exposed population subgroup is children (1 to 6 years) for chronic dietary risk with an estimated exposure corresponding to 19% of the cPAD. The dietary exposure to the US population is 16% of the cPAD. Infants are the most highly exposed subpopulation for acute risk with 80% of the aPAD consumed. Estimated dietary exposure to the general US population is lower than that for infants, corresponding to 61% of the aPAD of methamidophos. Dietary risks are summarized in Table 4.

Table 4. Summary of Acephate and Methamidophos Acute and Chronic Non-Cancer Dietary Exposure and Risk Estimates

Population Subgroup	ACEPHATE				METHAMIDOPHOS			
	Acute (99.9%-ile)		Chronic		Acute (99.9%-ile)		Chronic	
	Exposure (mg/kg/day)	% aPAD	Exposure (mg/kg/day)	% cPAD	Exposure (mg/kg/day)	% aPAD	Exposure (mg/kg/day)	% cPAD
US Population	0.001111	22	0.000089	7	0.000611	61	0.000016	16
All infants (<1 year)	0.000795	16	0.000185	15	0.000801	80	0.000004	4
Children 1-6 years	0.001631	33	0.000209	17	0.000790	79	0.000019	19
Children 7 -12 years	0.001549	31	0.000131	11	0.000702	70	0.000018	18
Females 13 -50 years	0.000879	18	0.000068	6	0.000481	48	0.000016	16

1. Acephate - The acute Population Adjusted Dose (aPAD) is 0.005 mg/kg/day ; the chronic PAD (cPAD) is 0.0012 mg/kg/day.

2. Methamidophos - The acute Population Adjusted Dose (aPAD) is 0.001 mg/kg/day ; the chronic PAD (cPAD) is 0.0001 mg/kg/day.

4.22 Drinking Water

Limited drinking water monitoring data are available for acephate. Therefore, the surface and ground water assessments were based on modeling predictions. STORET contains no records for acephate in samples from lakes, ocean, estuary, canal, or reservoir sites. There is a very limited number of samples taken from municipal water intakes. The NAWQA (National Water Quality Assessment) program is not currently analyzing for acephate or methamidophos and they do not have analytical methods for these chemicals in place.

4.2.2.1 Surface Water

Tier II estimated environmental concentrations (EECs) for acephate were generated using the PRZM-EXAMS model and available environmental fate data for acephate. The surface water exposure estimates were determined from the uses with the maximum yearly total applications (six aerial applications at 1 lb acephate/A/application on cotton and three aerial applications at 1.33

lb acephate/A/application on tobacco). **Based on the modeling, concentrations of acephate are not likely to exceed 82 ppb for peak (acute) exposure and 15 ppb for mean (chronic) exposure.** Surface water EECs for drinking water exposure estimates for methamidophos were generated using GENEEC assuming a 25% conversion efficiency. A Tier II assessment using PRZM-EXAMS was not conducted because of the high uncertainty surrounding any estimate of the decay rate for acephate and the transformation rate of acephate to methamidophos needed for the PRZM simulation. **The EECs for methamidophos formed as a degradate from acephate used on cotton are 22 ppb for peak(acute) and 12 ppb for mean (chronic) exposure.** It should be remembered in interpreting these results that they represent the upper limit for possible exposure from these use patterns to aquatic environments at a single high exposure site.

4.2.2.2 Ground Water

Groundwater calculations for acephate and its degradate methamidophos were based on the SCI-GROW model (Screening Concentrations in Ground Water), which is a model for estimating concentrations of pesticides in ground water under conditions of maximum exposure. SCI-GROW provides a screening concentration or an estimate of likely ground water concentration if the pesticide is used at the maximum allowed label rate in areas with ground water that is exceptionally vulnerable to contamination. A majority of the use areas will have ground water that is less vulnerable to contamination than that in the areas used to derive the SCI-GROW estimate.

The ground water Tier I EEC for both acute and chronic drinking water exposure estimates was calculated using SCI-GROW for the acephate use with the maximum yearly total application (six applications at 1 lb acephate/A/application on cotton). **The EEC for acephate was 0.02 $\mu\text{g/L}$.** **The ground water Tier I EEC for the degradate methamidophos** (assuming a 25% conversion efficiency from acephate to methamidophos at time of application, resulting in six applications at 0.25 lb methamidophos/A/application on cotton) **was 0.005 $\mu\text{g/L}$.**

4.3 OCCUPATIONAL AND RESIDENTIAL EXPOSURE

Acephate (O,S-dimethyl acetylphosphoramidothioate) is an organophosphate insecticide used to control insects on a variety of field, fruit, and vegetable crops. Pesticidal properties and toxicity are due to inhibition of acetylcholinesterase enzyme. Another registered pesticide, methamidophos (O,S-dimethyl phosphoramidothioate), is a degradate of acephate and is a potent cholinesterase inhibitor by all routes of exposure. As well as quantifying risk to acephate exposures, the occupational and residential assessment will address methamidophos exposures and risks following the application of acephate products.

Acephate is currently formulated as manufacturing products (75, 97, and 98.9 % active ingredient [ai]), granulars (1.5 and 15 % ai), emulsifiable concentrates (4 and 8 % ai), wettable powders (75, 80, and 90 % ai), a pelleted/tableted product (97 % ai), pressurized liquids (0.25, 1, 3 and 12 % ai), a ready-to-use product (75 % ai), soluble-concentrate liquids (4, 8, 9.4, 15.6, 50, 75, 90, 96 and 97 % ai), and a dust product (75 % ai). Some wettable powder formulations are contained in water-soluble packaging.

Products of acephate have been registered for both occupational and residential uses. Acephate is registered for use on the following crops: beans (snap, dry and lima), brussels sprouts, cauliflower, celery, non-bearing citrus, cotton, cranberries, head lettuce, peanuts, pepper (non-bell and sweet), peppermint/spearmint, soybeans, and tobacco. It is also used on field-grown ornamentals (i.e., trees, shrubs), pasture, rangeland, and on sod and golf course turf. In addition, acephate has registered indoor and outdoor residential uses.

Occupational applications for granular and liquid acephate formulations can be made in numerous ways. Granular acephate applications can be made by belly grinder, hand, tractor-drawn spreader, push-type spreader, and shaker can. Liquid acephate applications can be made by aircraft, airblast sprayer, backpack sprayer, chemigation, groundboom spray, hand/handtool/shaker can, handgun (hydraulic sprayer), high-pressure sprayer, hopper box (seed treatment), low-pressure handwand, seed slurry treatment, sprinkler can, and transplanting in water (tobacco).

Residential acephate applications can be made by aerosol can, shaker can, backpack sprayer, hand/handtool/shaker can, hose-end sprayer, low-pressure handwand, and sprinkler can.

Several areas of the risk assessment and characterization would improve with more data. Valent recently completed several DFR and TTR studies; data for applicator scenarios for which no data are currently available to the Agency for assessment purposes would allow more refined risk estimates to be made. Additionally, specific data on typical use, types of mixing and loading completed for application equipment, types of packaging available to individual and professional pesticide applicators, types of potential engineering controls, additional information on slit-placement techniques for turf applications of granules, and information on post-application techniques for all crops could be submitted.

4.3.1 OCCUPATIONAL ASSESSMENT

4.3.1.1 Handler

The Agency believes that those involved in the application of acephate can be exposed. These people are generically referred to as handlers and represent those who prepare spray solutions for use (i.e., referred to as mixer/loaders), mark field for aerial application (flagger) and those who actually make the applications by driving the groundboom tractor, piloting the airplane or other piece of application equipment (referred to as applicators).

Due to the frequency and duration of acephate uses, it was determined that uses of acephate by individual and professional pesticide applicators result in short-term and intermediate-term exposures. However, the frequency and duration of these exposures do not exhibit a chronic exposure pattern (i.e., daily exposures which occur for a minimum of several months). The anticipated use patterns and current labeling indicate more than 25 exposure scenarios based upon the types of equipment that potentially can be used to make acephate applications. A summary of use patterns used in the occupational exposure assessment are described below.

4.3.1.1.1 Application Rates

These crop groupings have the following maximum application rates:

- Fruit Tree (non-bearing citrus) at 0.5 lb ai per acre;
- Field, Forage, Fiber, Small Fruit, and Vegetable Crops (including cranberries, cotton, tobacco, beans [fresh and dry], mint, peanuts, brussels sprouts, cauliflower, celery, head lettuce, non-bell peppers and sweet peppers) at 0.5 to 1.0 lb ai per acre;
- Cotton Seed Treatment (including slurry and hopper box) at 0.04 lb ai per 100 pounds of seed (when mixed before application) and 0.1875 lb ai per acre (when mixed at time of application using a drop-type spreader);
- Non Crop Areas (including field margins, pastures and wastelands) at 0.125 lb ai per acre;
- Evergreens in Large Stands (including Christmas tree plantations and various types of pine tree forests) at 0.5 to 1.0 lb ai per acre;
- Commercial Ornamentals Grown in Greenhouses at 0.5 to 1.0 lb ai per 100 gallons of water;
- Commercial Outdoor Ornamental Applications (not necessarily being grown for commercial use) [including deciduous shade trees, flowering trees and shrubs, evergreens, and roses] at 0.5 to 1.0 lb ai per 100 gallons of water;
- Commercial turf (including sod farms and golf courses) at 5.0 lb ai per acre;
- Ornamentals at residences and other public areas (including shade trees, evergreens, and roses) at 0.0076 to 0.035 lb ai per gallon, 1.5 tablespoon per mound of wettable powder for fire ant mounds, and 2 cans of 1 to 3 % ai aerosol cans for residential uses;
- Turf at residences and other public areas at 0.035 lb ai per gallon; and
- Spot Treatment at commercial and residential sites at 0.075 lb ai per gallon.

4.3.1.1.2. Methods and Types of Equipment For Mixing, Loading, and Application

The following mixing, loading and application methods are used for the previously described crop groupings:

- Fruit Trees (non-bearing citrus only) -- equipment used for commercial use includes airblast sprayer and high pressure handwand for trees;
- Field, Forage, Fiber, Small Fruit, and Vegetable Crops -- equipment used commercially includes groundboom, aerial, chemigation, and tractor-drawn drop-type spreader;
- Cotton Seed Treatment -- equipment used for commercial use includes slurry, hopper box application, and tractor-drawn drop-type spreader;
- Non-Crop Areas -- equipment used includes groundboom, handgun sprayer and aerial applications;
- Evergreens in Large Stands -- equipment used for commercial use includes airblast sprayer, aerial, and high pressure handwand;

- Commercial Ornamentals Grown in Greenhouses -- equipment used for commercial use includes low pressure handwand, backpack sprayer, high pressure handwand (mixing/loading separate), and applying soluble powder/granular by hand/handtool/shaker can;
- Commercial Outdoor Ornamental Applications -- equipment used for commercial use includes low pressure handwand, backpack sprayer, high pressure handwand (mixing/loading separate), airblast sprayer, and applying soluble powder/granular by hand/handtool/shaker can;
- Ornamentals at Residences -- equipment used for homeowner includes backpack sprayer, low pressure handwand, applying soluble powder/granular by hand/handtool/shaker can, hose-end sprayer, and aerosol can;
- Commercial Turf -- equipment used for application to turf includes aerial application, groundboom, and handgun sprayer;
- Residential Turf -- equipment used for application to residential turf includes low pressure handwand, backpack sprayer, hose-end sprayer, and sprinkling can; and
- Spot Treatment -- equipment used for spot treatment is Pest Control Operator (PCO) injector, low pressure handwand and aerosol can.

Two chemical-specific exposure monitoring studies were submitted in support of the reregistration of acephate. Because minimal chemical-specific handler exposure data were available for the assessment, the majority of analyses for both short- and intermediate-term exposures were performed using the Pesticide Handlers Exposure Database (PHED), Version 1.1 (August 1998)

PHED is a library of actual exposure monitoring data that can be used to analyze specific types of exposures for those individuals involved in the application of pesticides (e.g., mixer/loaders, applicators). This system has been in use worldwide since 1992 and was developed by a task force that includes the EPA, Health Canada, the California Department of Pesticide Regulation, and the pesticide industry. The scientific basis for PHED has long been accepted by these groups. PHED forms the backbone of the vast majority of handler risk assessments completed by the Agency. The system now contains data from approximately 1700 exposures which were monitored when individuals were making actual pesticide applications in a variety of settings.

The basis of PHED is that individual handler exposures are related to how an application is made and not the specific pesticide being applied. The aspects of an application that are thought to affect exposures include: the kinds of equipment involved in application; the nature of the product being used (e.g., formulation and packaging); the application parameters such as application rate and total pounds of active ingredient applied; and the devices used by an individual to protect themselves during an application (e.g., additional clothing, chemical-resistant gloves, and closed tractor cabs).

The values that are calculated using PHED are called unit exposures and are generally presented as milligrams (or 1/1000th of a gram) exposure of active ingredient per pound active ingredient applied. For example, if one makes similar groundboom applications of 10 pounds of pesticide A

or B, the unit exposures (1/10th of the exposure from applying 10 pounds of active ingredient A or B) would be proportional to the total amount applied and not whether pesticide A or B was in the spray tank. Separate unit exposures are typically calculated for the different equipment types that can be used in applications (e.g., open-cab groundboom and airblast applications would have different unit exposures). Separate unit exposures are also calculated for varying protective measures used during application with the same equipment. For example, there are specific unit exposures for groundboom applications for individuals wearing normal work clothing, wearing normal work clothing under coveralls and with gloves, and for making applications using a closed cab tractor. In cases where data are not complete, the Agency uses available data and standard measures of protection to estimate exposure levels. For example, the Agency believes that the use of a coverall or a pair of chemical-resistant gloves provide a certain amount of protection when worn. These levels of protection and similar exposure data are used to calculate exposures where directly applicable data are not complete.

Along with the exposure values considered in the risk assessment (obtained from PHED), other information is needed to calculate the risk. Values needed are application rates, number of acres treated per day, body weight, and frequency of application. Amount of active ingredient handled per day is based on the number of acres treated and the application rate. These values are coupled with the unit exposures to calculate the daily exposure to the worker.

Initially the Agency calculates the risk using the least amount of protective measures, which is called the baseline assessment. For those involved in applications this usually represents an individual's normal work clothing, i.e. long sleeve shirts, long pants, no gloves, and no respirator. If there is a concern at this level, the Agency would require the use of devices to lower the risk. The first kinds of devices we would require are referred to as personal protective equipment (PPE). PPE can include an extra layer of clothing, chemical-resistant gloves, and respirators. If concerns persist, then the Agency would require additional protective measures often described as engineering controls. Common examples of engineering controls include enclosed tractor cabs, closed loading systems, and gel packs. This approach is commonly referred to as a tiered approach, and is well established in the area of risk assessment.

Product labels generally specify a certain level of PPE. However because the labels for older products are generally not based on a risk assessment, the Agency must begin its assessment assuming baseline measures and increase those measures until an acceptable level is obtained. Therefore any proposed label modifications will be based on this risk assessment instead of standard label recommendations.

Toxicity studies are required to determine the endpoints (toxic effects) which could result from worker exposures to pesticides. Studies are completed reflecting the major routes of exposure for workers: dermal and inhalation. These studies also determine exposure levels at which the toxic effects occur, as well as the highest level at which the toxic effects are unlikely to occur, called the No Observed Adverse Effect Level (NOAEL). The NOAEL is compared to worker exposure to determine the risk, expressed as a Margin of Exposure ($MOE = NOAEL/exposure$). The higher the MOE, the less the concern over the use. Typically, for workers, the Agency has concerns for MOEs that are less than 100. The 100 accounts for differences between the animals used for the toxicity tests and people (inter-species extrapolation) as well as the differences that can occur

among people (intra-species variability). Worker risk may result from short-term exposures (1 to 7 days), or from intermediate-term exposures (1 week to several months). For acephate, the dermal and inhalation endpoints are the same (brain ChE inhibition); therefore, their margins of exposure (MOEs) are combined.

Twenty five exposure scenarios were identified for acephate. The occupational risk assessment has been completed based upon the exposure data available to HED. The handler exposure and risk calculations are presented in the tables contained in Appendix A entitled *Acephate Occupational Handler Exposure and Risk Assessment Tables (Short-Term and Intermediate-Term Exposures)*. These results are for both individual and professional pesticide applicators. The exposure factors (i.e., scenario descriptors, application rates, and daily treatment) and unit exposure values at varying levels of mitigation used in the assessment are presented in Table 1 of Appendix A. The calculations of daily exposure in milligrams/day (mg/day) at the baseline risk mitigation level, absorbed daily dose (mg/kg/day), individual dermal and inhalation MOEs using ST and IT NOAELs, and combined dermal and inhalation MOEs are presented in Table 2. Tables 3 and 4 contain similar calculations for increased levels of risk mitigation -- use of additional mitigation in the form of personal protective equipment (PPE) are presented in Table 3 and use of engineering controls are presented in Table 4. The format of these tables is similar to Table 2. The only differences are the unit exposure values taken from Table 1 which represent different levels of risk mitigation. All equations used in these tables are summarized at the end of the tables..

Table 5 of Appendix A summarizes the parameters and caveats specific to the PHED exposure data used for each exposure scenario and corresponding exposure/risk assessment. These caveats include the descriptions of the source of the data and an assessment of the overall quality of the data. Generally, the assessment of the data is based upon the number of observations and the available quality control data. Quality control data are assessed based upon a grading criteria established by the PHED Task Force. Additionally, it should be noted that all calculations were completed based on current HED policies pertaining to the completion of occupational and residential exposure/risk assessments (e.g., rounding, exposure factors and acceptable data sources).

The calculations of handler's combined dermal and inhalation risks indicate that at the highest level of mitigation available and/or feasible for a specific scenario, thirteen of the twenty-five scenarios do not exceed 100. There are also five scenarios for which no exposure data are available and four scenarios for which surrogate data from similar PHED scenarios were used. The range of combined dermal and inhalation MOEs for the individual and professional pesticide acephate applicators' scenarios was 0.065 to 2800.

4.3.1.2 Post-Application Exposure

HED has determined that workers may be exposed to acephate and methamidophos upon entering occupational areas which have been previously treated with acephate to perform specific work activities in these areas (e.g., scouting, staking/tieing, irrigating, harvesting). Due to the frequency and duration of post-application worker exposures, it was determined that occupational acephate uses result in potential intermediate-term dermal acephate and methamidophos post-application

worker exposures. Potential inhalation exposures are not anticipated for post-application worker exposures, and HED currently has no policy/method for evaluating non-dietary ingestion by workers due to poor hygiene practices or smoking. As a result, only dermal exposures were evaluated in the post-application worker assessment. Four dislodgeable foliar residue studies (DFRs) and one turf transferable residue study (TTR) which address the dissipation of acephate and methamidophos in fields/greenhouses of succulent beans, cauliflower, greenhouse roses, tobacco, and turfgrass have been submitted. These studies were used to evaluate potential post-application worker risks.

Re-entry intervals (REIs) were calculated for specific tasks. Calculated REIs for succulent beans while performing harvest by hand, stake/tie, scout, and irrigate were 5 days. Calculated REIs for cauliflower while performing scout, irrigate, and harvest by hand were 0 days. Calculated REIs for greenhouse roses while sorting and packing was 6 days and while pruning and harvesting by hand was 12 days. Calculated REIs for tobacco while performing stake/tie, scout and irrigate was 8 days and while harvesting by hand was 19 days. Calculated REIs for turfgrass while mowing with tractor or push-type mower was 0 days and while harvesting sod was 1 day. It should be noted that the default REI of 24 hours will still apply to cauliflower and turf under the Worker Protection Standard.

The results are presented in the tables contained in Appendix B entitled *Acephate Post-Application Worker Exposure and Risk Assessment Tables (Intermediate-Term Exposures)*. Table 1 contains post-application risks to workers following two applications of acephate to succulent beans at 1.0 lb ai/A. Table 2 contains post-application risks to workers following two applications of acephate to cauliflower at 1.0 lb ai/A. Table 3 contains post-application risks to workers following two applications of acephate to greenhouse roses at 2.15 lb ai/A. Table 4 contains post-application risks to workers following three applications of acephate to tobacco at 0.77 lb ai/A. Finally, Tables 5 and 6 contain post-application risks to workers following two applications of acephate to turf at 5.0 lb ai/A. All equations used in these tables are summarized at the end of the tables.

4.3.2 RESIDENTIAL EXPOSURE

4.3.2.1. Residential Handlers

HED has determined that residential pesticide applicators are likely to be exposed during acephate use. Due to the frequency and duration of acephate uses, it was determined that uses of acephate by residential pesticide applicators result in short-term exposures to these applicators. The anticipated use patterns and current labeling indicate several exposure scenarios based upon the types of equipment that potentially can be used to make acephate applications in the residential environment. These scenarios serve as the basis for the quantitative exposure and risk assessments. The following major residential exposure scenarios were identified for acephate:

- (1) mixing/loading/applying wettable powder using a low pressure hand wand;
- (2) mixing/loading/applying using a backpack sprayer;
- (3a) mixing/loading/applying using a hose-end sprayer;
- (3b) mixing/loading/applying using a hose-end sprayer (MRID # 405048-27);

- (4) mixing/loading/applying using a sprinkling can;
- (5) loading/applying soluble powder (dry) concentrate by hand/handtool/shaker can;
- (6) loading/applying granules by shaker can; and
- (7) applying by aerosol can.

Specific PHED data were unavailable for two residential applicator scenarios, so similar PHED data were used as surrogate data in the assessment. These scenarios are specified in Table 3 of Appendix C and summarized as follows. Surrogate data from PHED were used for scenarios (5) and (6). PHED data for granular bait dispersed by hand scenario were used for both of these scenarios.

The residential risk assessment has been completed based upon the exposure data available to HED. The residential pesticide applicator exposure and risk calculations are presented in the tables contained in Appendix C entitled *Acephate Non-Occupational (Residential) Exposure and Risk Assessment Tables (Short-Term Exposures)*. The exposure factors (i.e., scenario descriptors, application rates, and daily treatment) and residential unit exposure values are presented in Table 1 of Appendix C. The calculations of daily exposure in milligrams/day (mg/day), absorbed daily dose (mg/kg/day), individual dermal and inhalation MOEs using ST NOAELs, and combined dermal and inhalation MOEs are presented in Table 2. All equations used in these tables are summarized at the end of the tables.

Table 3 of Appendix C summarizes the parameters and caveats specific to the PHED exposure data used for each exposure scenario and corresponding exposure/risk assessment. These caveats include the descriptions of the source of the data and an assessment of the overall quality of the data. Generally, the assessment of the data is based upon the number of observations and the available quality control data. Quality control data are assessed based upon a grading criteria established by the PHED Task Force. Additionally, it should be noted that all calculations were completed based on current HED policies pertaining to the completion of occupational and residential exposure/risk assessments (e.g., rounding, exposure factors and acceptable data sources).

It is also important to note that residential PHED values represent an applicator wearing typical residential clothing of short-sleeved shirt, short pants and no gloves. In addition, it is assumed that all residential mixing/loading scenarios are performed by open mixing and loading procedures. Homeowner uses are not covered by the Worker Protection Standard. The Agency cannot require the use of PPE and/or engineering controls for residential applicators, because the Agency can only make recommendations to residential applicators. Therefore, the use of PPE and/or engineering controls is not considered in the residential applicator risk assessment.

The calculations of residential acephate applicators' combined dermal and inhalation risks indicate that two exposure scenarios exceed 100 while six scenarios do not. There are also two scenarios for which surrogate data from similar PHED scenarios were used. The Agency has concerns for MOEs that are less than 100. The range of combined dermal and inhalation MOEs for the residential acephate applicators' scenarios was 2.9 to 7,100.

4.3.2.2 Residential Post-Application Exposure

HED has determined that the public may be exposed to acephate and methamidophos upon entering residential areas which have been previously treated with acephate. Due to the frequency and duration of potential post-application residential exposures coupled with the dissipation of acephate and methamidophos following acephate treatments, it was determined that residential acephate uses result in potential short-term dermal and oral acephate and methamidophos post-application residential exposures to the public. Potential inhalation exposures are not anticipated for post-application residential exposures.

It is anticipated that adults and children may primarily be exposed to acephate and methamidophos through their contact with turfgrass and soil. Acephate and methamidophos exposures may also occur from contact (i.e., pruning, cutting and weeding) with treated ornamentals, flowers, trees, and shrubs. However, it is anticipated that these exposures would not be as significant as turfgrass and soil exposures because of lower contact rates and the frequency and duration of potential contacts. Therefore, potential exposures were calculated only for turf grass and soil.

The following post-application residential exposures were assessed for both acephate and methamidophos: dermal exposure from residues on turf (adult and child), incidental non-dietary ingestion of residues on grass from hand-to-mouth transfer (child), ingestion of treated grass (child), and incidental ingestion of soil from treated areas (child). The results for acephate and methamidophos risks are presented in Tables 4 and 5, respectively, of Appendix C entitled *Acephate Non-Occupational (Residential) Exposure and Risk Assessment Tables (Short-Term Exposures)*. The screening level equations used to quantify the potential residential exposures are from the Agency's *Standard Operating Procedures for Residential Exposure Assessments (December 1997)*. All equations used in these tables are summarized at the end of the tables.

It is important to note that potential post-application residential exposures were assessed on the same day acephate would be applied to the grass. The assessment was completed in this manner, because it is assumed that the public could be exposed immediately following an acephate treatment. As a result, the average of chemical-specific TTRs measured following the second application in the turf study submitted by the registrant were used in the post-application residential assessment. An adjustment for the difference in turf application rates between occupational and residential environments was made. In addition, the ratio of acephate and methamidophos TTRs was used to calculate the methamidophos application rate.

Although the residential SOPs specify that the residential exposure calculations are to be used as a screening basis, the following acephate post-application residential exposure scenarios may be of potential concern: dermal risks to adults and children (MOEs of 50 and 52, respectively), children's hand-to-mouth risks (MOE = 36), and children's turfgrass ingestion risks (MOE = 38). The calculated MOE for acephate children's incidental soil ingestion did not exceed HED's level of concern (MOE = 3,600), and none of the methamidophos post-application residential exposure scenarios exceed HED's level of concern (MOE range = 820 - 600,000).

4.3.2.3 Non-Occupational (Post-Application Recreational) Exposure

HED has determined that the public may be exposed to acephate and methamidophos upon entering recreational areas which have been previously treated with acephate. The recreational areas addressed in this assessment are golf courses. Due to the frequency and duration of potential post-application recreational exposures at golf courses coupled with the dissipation of acephate and methamidophos following acephate treatments, it was determined that occupational acephate uses at golf courses result in potential short-term dermal acephate and methamidophos post-application recreational exposures to adults and 13+ year-olds. Potential inhalation exposures are not anticipated for post-application recreational exposures. No potential hand-to-mouth exposures were estimated for recreational exposures.

It is important to note that potential post-application recreational exposures were assessed on the same day acephate would be applied to the golf course. The assessment was completed in this manner, because it is assumed that the public could be exposed immediately following an acephate treatment. As a result, the average of chemical-specific TTRs measured following the second application in the turf study submitted by the registrant were used in the post-application recreational assessment.

HED is not concerned regarding adult and 13+ year-old golfers' risks to acephate and methamidophos following an acephate treatment of golf course turf. The calculated MOEs for adult golfers' risks to acephate and methamidophos were 7,500 and 125,000, respectively while the calculated MOEs for 13+ year-old golfers' risks to acephate and methamidophos were 4,620 and 78,100, respectively.

4.4 Incident Reports

An Incident Data Report was completed for acephate by HED on September 8, 1999. Information from the OPP Incident Data System (IDS), the American Association of Poison Control Centers (AAPCC), the California Department of Pesticide Regulation, and the National Pesticide Telecommunications Network (NPTN) were considered in this report.

When both Poison Control Center and California data were considered, acephate generally had a lower hazard than other organophosphate and carbamate insecticides. There have been two accidental deaths reported associated with exposure. Both deaths involved misuse and in one case use of a particulate mask may have increased the risk of inhaling acephate. Minor and moderate symptoms of exposure have often been associated with inhalation indoors. Outdoor agricultural uses are associated with lower risks of illness and poisoning than most other organophosphate and carbamate insecticides.

5.0 FQPA Considerations

5.1 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. 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.

5.1.1 Acute and Chronic Aggregate Exposure/Risk/DWLOCs (Acephate and Methamidophos Residues (acephate application only))

Drinking Water Levels of Comparison (DWLOCs) represent the maximum contribution to the human diet, in $\mu\text{g/L}$, that may be attributed to residues of a pesticide in drinking water after dietary exposure is subtracted from the aPAD or cPAD. Acute and chronic DWLOCs for acephate and methamidophos were calculated based on dietary risk assessments using anticipated residues in food. These are presented in Tables 5 and 6. Comparisons are made between DWLOCs and the estimated concentrations of acephate and methamidophos in surface water and ground water generated via PRZM/EXAMS and SCI-GROW, respectively. If model estimate is less than the DWLOC, there is generally no drinking water concern.

Table 5. Acephate and Methamidophos (acephate application only) Summary of Chronic DWLOC Calculations

Population Subgroup	cPAD (mg/kg/day)	Food Exposure (mg/kg/day)	Available Water Exposure (mg/kg/day)	DWLOC (ug/L)	Surface Water ¹ (Overall mean) (ppb)	Ground Water (SCI-GROW) (ug/L)
Acephate						
U.S. Population	0.0012	0.000089	0.001111	38	15	0.02
Females 13-50 yrs	0.0012	0.000068	0.001132	34	15	0.02
Children 1-6 yr	0.0012	0.000209	0.000991	10	15	0.02
All Infants	0.0012	0.000185	0.001015	10	15	0.02

Population Subgroup	cPAD (mg/kg/day)	Food Exposure (mg/kg/day)	Available Water Exposure (mg/kg/day)	DWLOC (ug/L)	Surface Water ¹ (Overall mean) (ppb)	Ground Water (SCI-GROW) (ug/L)
Methamidophos						
U.S. Population	0.0001	0.000016	0.000084	3	12/3 =4	0.005
Females 13-50 yrs	0.0001	0.000016	0.000084	3	12/3 = 4	0.005
Children 1-6 yr	0.0001	0.000019	0.000081	0.81	12/3 = 4	0.005
All Infants	0.0001	0.000004	0.000096	0.96	12/3 = 4	0.005

Acephate EECs are from PRZM-EXAMS modeling

Methamidophos EECs are from GENEEC modeling. It is the policy of HED to divide GENEEC modeling numbers by 3 for comparison to chronic DWLOC.

DWLOC = $\frac{\text{water exposure} \times \text{body weight}}{\text{Liters of water} \times 10^{-3}}$ where water exposure = cPAD - food exposure

Body weight = 70 kg for U.S. Population, 60 kg for females, 10 kg for infants and children
Liters of water = 2L for Adults and 1L for infants and children

Table 6. Summary of Acute DWLOC Calculations

Population Subgroup	aPAD (mg/kg/day)	Food Exposure (mg/kg/day)	Available Water Exposure (mg/kg/day)	DWLOC (ug/L)	Surface Water ¹ (ppb)	Ground Water (ug/L)
Acephate						
U.S. Population	0.005	0.001111	0.003889	136	82	0.02
Females 13-50 yrs	0.005	0.000879	0.00412	124	82	0.02
Children 1-6 yr	0.005	0.001631	0.003369	34	82	0.02
All Infants	0.005	0.000795	0.004205	42	82	0.02
Methamidophos						
U.S. Population	0.001	0.000611	0.000389	14	22	0.02
Females 13-50 yrs	0.001	0.000481	0.000519	16	22	0.02
Children 1-6 yr	0.001	0.000790	0.00021	2	22	0.02
All Infants	0.001	0.000801	0.000199	2	22	0.02

Acephate EECs are from PRZM-EXAMS modeling

Methamidophos EECs are from GENEEC modeling.

DWLOC = $\frac{\text{water exposure} \times \text{body weight}}{\text{Liters of water} \times 10^{-3}}$ where water exposure = cPAD - food exposure

Body weight = 70 kg for U.S. Population, 60 kg for females, 10 kg for infants and children
Liters of water = 2L for Adults and 1L for infants and children

Chronic DWLOCs. Upon comparison of the chronic DWLOCs with the environmental concentrations of acephate estimated using conservative modeling, surface water concentrations are greater than the DWLOCs (Table 5) for infants and children. Consequently, there appears to be a potential for acephate residues in surface water to occur at levels of concern for infants and children. For methamidophos, EECs for surface water are greater than the DWLOCs for all subpopulations; therefore, there may be chronic dietary concern for methamidophos residues in drinking water from surface water sources. There is no chronic concern for drinking water from groundwater sources.

Acute DWLOCs. Acute surface water concentrations estimated using conservative modeling exceed the acute DWLOCs for acephate (infants and children) and for methamidophos (all subpopulations; ground water estimates are less than the DWLOCs (Table 6). Thus, there appears to be a potential for methamidophos residues in surface water to occur at levels of concern. There is no acute concern for drinking water from groundwater sources.

5.1.2 Acute and Chronic Aggregate Exposure/Risk/DWLOCs (Combined Methamidophos Residues from Application of Both Methamidophos and Acephate)

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 23% of the cPAD is consumed for the U.S. population. The most significantly exposed subpopulation, children (1 to 6 years) occupied 37.0% of the cPAD, respectively. The results indicate that HED has no concern for chronic aggregate exposure from food alone.

An acute aggregate risk (food) which considers methamidophos from application of acephate and methamidophos was also conducted. Residue refinements including anticipated residues generated from field trial and monitoring data, adjustments for percent crop treated, washing and cooking factors and a probabilistic/Monte Carlo acute analysis were utilized. Monitoring data for methamidophos (commodities with methamidophos registrations only) were generated through the USDA Pesticide Data Program (PDP) for potatoes, and tomatoes and through the FDA Surveillance Monitoring Program for peppers, squash, and strawberries. Field trial (FT) data were used for cotton. For methamidophos on commodities with only acephate registrations, the acute estimates are based on USDA Pesticide Data Program (PDP) monitoring data for succulent beans, celery and lettuce; and FDA Surveillance Monitoring data for cauliflower and peppers (bell and non-bell). Monitoring data from the years 1994 through 1997 (PDP) and the years 1993 through 1998 (FDA) were considered. Monitoring data show that detectable residues of methamidophos are found (percent detects ranged from 1% (potatoes) - 34% (peppers)). Field trial data were used for Brussels sprouts, dry beans, cottonseed, cranberry, mint, macadamia nuts, peanuts, and soybean. Applying all of these refinements, the most highly exposed population subgroup was children 1-6 years with a %aPAD of 120%. For the general U.S. population, 79% of

the aPAD was consumed. The results indicate that for infants and children, 100% of the aPAD is exceeded. Sensitivity analyses conducted show that tomatoes constitutes the majority of the dietary risk to methamidophos (Table 7).

Table 7. Aggregate Exposure: Summary of Methamidophos Acute and Chronic Non-Cancer Dietary Exposure and Risk Estimates

Population Subgroup	METHAMIDOPHOS					
	Acute (99.9%-ile)				Chronic	
	All Commodities		Excluding Tomatoes		Exposure (mg/kg/day)	%cPAD
	Exposure (mg/kg/day)	% aPAD	Exposure (mg/kg/day)	% aPAD		
General US Population	0.000787	79	0.000308	31	0.000023	23
All infants (<1 year)	0.001074	107	0.000774	77	0.000031	31
Children 1-6 years	0.001194	119	0.000604	60	0.000037	37
Children 7 -12 years	0.000976	98	0.000369	37	0.000030	30
Females 13 -50 years	0.000653	65	0.000240	24	0.000021	21

1. Methamidophos - The acute Population Adjusted Dose (aPAD) is 0.001 mg/kg/day ; the chronic PAD (cPAD) is 0.0001 mg/kg/day.

An aggregate exposure assessment which quantifies risk from food and water was conducted for chronic exposure only since HED has concerns for acute aggregate exposure from food alone. Using the aggregate chronic food exposure (exposure which incorporates residues from application of methamidophos combined with residues from application of acephate), DWLOCs were calculated (Table 8). The EECs used were from modeling data derived from the use of methamidophos *per se*. For children(1 to 6 years) and infants, the results indicated the potential for slight concern from surface water sources of drinking water.

Table 8. Summary of Chronic DWLOC Calculations Incorporating Methamidophos Exposure from Application of Methamidophos and Application of Acephate

Population Subgroup	cPAD (mg/kg/day)	Food Exposure (mg/kg/day)	Available Water Exposure (mg/kg/day)	DWLOC (ug/L)	PRZM/EXAMS (Overall mean) (ppb)	SCI-GROW (ug/L)
U.S. Population	0.0001	0.000023	0.000077	3	0.9	0.028
Females 13-50 yrs	0.0001	0.000021	0.000079	2	0.9	0.028
Children 1-6 yr	0.0001	0.000037	0.000063	0.6	0.9	0.028
All Infants	0.0001	0.000031	0.000069	0.7	0.9	0.028

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.

5.2 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 has determined that acephate has a common mechanism of toxicity with other organophosphate pesticides, but has not yet determined how to include this pesticide in a cumulative risk assessment.

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. .

5.3 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.

Information from the following memoranda were incorporated into this human health assessment.

- Acephate: Revisions of the Toxicology Chapter for the RED Document to Include Comments from the Registrant and Other Interested Members of the Public/Formal Response to the Comments Received from the Registrant and Other Interested Members of the Public; Nancy McCarroll, 6/9/99, DP Barcode D256734.
- Acephate: Support for the Toxicological Endpoint Selection For Dermal Risk Assessments; Nancy McCarroll, 6/20/99; HED Doc. No. 013613.
- Acephate: Hazard Identification Committee Report; George Ghali, 01/05/98, HED Doc. No. 012453; 01/15/98.
- FQPA SAFETY FACTOR RECOMMENDATIONS FOR THE ORGANOPHOSPHATES: A Combined Report of the Hazard Identification Assessment Review Committee and the FQPA Safety Factor Committee, Brenda Tarplee and Jess Rowland, 8/6/98
- Acephate: Revised Occupational and Non-Occupational Exposure and Risk Assessments for the Reregistration Eligibility Decision (RED) Document; Catherine Joseph; 9/30/99; DP Barcode D259628.
- Review of Acephate Incident Reports, Ruth Allen and Jerome Blondell, 9/8/99, DP Barcode D247487.
- Acephate: Revised Product and Residue Chemistry Chapters for the Reregistration Eligibility Decision. Felecia Fort, 10/5/99, DP Barcode D259662.
- Acephate. Revised Dietary Exposure Analysis for the HED Revised Human Health Risk Assessment, Felecia Fort, 9/28/99, DP Barcode D254604.
- Acephate Use Closure Memo, Lois Rossi, 12/23/97, no DP Barcode

APPENDICES

APPENDIX A

**ACEPHATE OCCUPATIONAL HANDLER
EXPOSURE AND RISK ASSESSMENT TABLES
(SHORT-TERM AND INTERMEDIATE-TERM EXPOSURES)**

Table 1: Numerical Inputs for Occupational Handler Exposure to Acephate.

Exposure Scenario	Application Rate ^a (lb ai/A or lb ai/gallons where noted)	Treated Area ^b (A/day or gallons/day where noted)	Baseline Unit Values		PPE Mitigation Unit Values ^c		Engineering Control Unit Values ^d	
			Dermal ^e (mg / lb ai handled)	Inhalation ^f (μ g / lb ai handled)	Dermal (mg / lb ai handled)	Inhalation (μ g / lb ai handled)	Dermal (mg / lb ai handled)	Inhalation (μ g / lb ai handled)
Mixer/Loader Exposure								
(1a) Mixing/Loading Soluble Powder for Aerial Application	Ag = 0.5	350	3.7	43	0.17	8.6	0.0098	0.24
	Ag = 1.0	350	3.7	43	0.17	8.6	0.0098	0.24
	Turf = 5.0	350	3.7	43	0.17	8.6	0.0098	0.24
	Pasture = 0.125	350	3.7	43	0.17	8.6	0.0098	0.24
(1b) Mixing/Loading Soluble Powder for Chemigation Application	Cranberries = 1.0	30	3.7	43	0.17	8.6	0.0098	0.24
(1c) Mixing/Loading Soluble Powder for Groundboom Application	Ag = 0.5	80	3.7	43	0.17	8.6	0.0098	0.24
	Ag = 1.0	80	3.7	43	0.17	8.6	0.0098	0.24
	Pasture = 0.125	80	3.7	43	0.17	8.6	0.0098	0.24
	Turf = 5.0	Sod = 80	3.7	43	0.17	8.6	0.0098	0.24
	Turf = 5.0	Golf course = 40	3.7	43	0.17	8.6	0.0098	0.24
(1d) Mixing/Loading Soluble Powder for Airblast Application	Non-bearing citrus = 0.5	40	3.7	43	0.17	8.6	0.0098	0.24
	Trees & Shrubs = 1.0 lb/100 gal	1000 gal	3.7	43	0.17	8.6	0.0098	0.24
	Outdoor Floral = 0.5 lb/100 gal	1000 gal	3.7	43	0.17	8.6	0.0098	0.24
(1e) Mixing/Loading Soluble Powder for Handgun (Hydraulic Sprayer) Application	Tobacco (fire ant) = 1.0 lb/80 gal	13 gal/acre; 6 acres	3.7	43	0.17	8.6	0.0098	0.24
	Trees, Shrubs, Outdoor Floral Crops = 1.0 lb/100 gal	1000 gal	3.7	43	0.17	8.6	0.0098	0.24

Exposure Scenario	Application Rate ^a (lb ai/A or lb ai/gallons where noted)	Treated Area ^b (A/day or gallons/day where noted)	Baseline Unit Values		PPE Mitigation Unit Values ^c		Engineering Control Unit Values ^d	
			Dermal ^e (mg / lb ai handled)	Inhalation ^f (μ g / lb ai handled)	Dermal (mg / lb ai handled)	Inhalation (μ g / lb ai handled)	Dermal (mg / lb ai handled)	Inhalation (μ g / lb ai handled)
	Trees, Shrubs, Outdoor Floral Crops = 0.5 lb/100 gal	1000 gal	3.7	43	0.17	8.6	0.0098	0.24
	Turf = 5.0	5	3.7	43	0.17	8.6	0.0098	0.24
(1f) Mixing/Loading Soluble Powder for Transplanting Water Application	Tobacco = 0.75	20	3.7	43	0.17	8.6	0.0098	0.24
(1g) Mixing/Loading Soluble Powder for Slurry Seed Treatment	Cotton seed = 0.04 lb/100 lb seed	200,000 lb seed	3.7	43	0.17	8.6	0.0098	0.24
(1h) Loading Soluble Powder for Hopper Box Application	Cotton seed = 0.1875	80	3.7	43	0.17	8.6	0.0098	0.24
(2) Mixing/Loading Dry Flowable for Slurry Seed Treatment	Cotton seed = 0.04 lb/100 lb seed	200,000 lb seed	0.066	0.77	0.066	0.15	0.0098	0.24
(3a) Mixing/Loading Liquids for Aerial Application	Pasture/Forest = 0.75	350	2.9	1.2	0.023	0.24	0.0086	0.083
	Forest = 0.75	800	2.9	1.2	0.023	0.24	0.0086	0.083
(3b) Mixing/Loading Liquids for Slurry Seed Treatment	Cotton seed = 0.04 lb/100 lb seed	200,000 lb seed	2.9	1.2	0.023	0.24	0.0086	0.083
(4) Loading Granular in Tractor-Drawn Drop-Type Spreader	Cotton = 1.0	80	0.0084	1.7	0.0069	0.34	0.00017	0.034
	Sod = 5.0	80	0.0084	1.7	0.0069	0.34	0.00017	0.034
	Golf Course Turf = 5.0	40	0.0084	1.7	0.0069	0.34	0.00017	0.034
Applicator Exposure								
(5) Applying Sprays with Fixed-Wing Aircraft	Ag = 0.5	350	NF	NF	NF	NF	0.005	0.068
	Ag = 1.0	350	NF	NF	NF	NF	0.005	0.068
	Turf = 5.0	350	NF	NF	NF	NF	0.005	0.068
	Pasture = 0.125	350	NF	NF	NF	NF	0.005	0.068

Exposure Scenario	Application Rate ^a (lb ai/A or lb ai/gallons where noted)	Treated Area ^b (A/day or gallons/day where noted)	Baseline Unit Values		PPE Mitigation Unit Values ^c		Engineering Control Unit Values ^d	
			Dermal ^e (mg / lb ai handled)	Inhalation ^f (μ g / lb ai handled)	Dermal (mg / lb ai handled)	Inhalation (μ g / lb ai handled)	Dermal (mg / lb ai handled)	Inhalation (μ g / lb ai handled)
(11) Applying as a Seed Treatment in a Slurry Tank	Cotton seed = 0.04 lb/100 lb seed	200,000 lb seed	No Data	No Data	No Data	No Data	No Data	No Data
(12) Applying Granular with Tractor-Drawn Drop-Type Spreader	Cotton = 1.0	80	0.0099	1.2	0.0072	0.24	0.0021	0.22
	Sod = 5.0	80	0.0099	1.2	0.0072	0.24	0.0021	0.22
	Golf Course Turf = 5.0	40	0.0099	1.2	0.0072	0.24	0.0021	0.22
Mixer/Loader/Applicator Exposure								
(13a) Mixing/Loading/Applying Soluble Powders Using Low Pressure Hand Wand	Trees, Shrubs, Roses, Ground Cover, Floral Crops = 0.5 lb/100 gal	40 gal	29	1100	8.6	220	NF	NF
	Trees, Shrubs, Roses, Ground Cover, Floral Crops = 1.0 lb/100 gal	40 gal	29	1100	8.6	220	NF	NF
	Wasps = 0.075 lb/1 gal	5 gal	29	1100	8.6	220	NF	NF
	Fire Ant (non-crop) = 0.047 lb/5 gal	5 gal	29	1100	8.6	220	NF	NF
	PCO = 0.088 lb/gal	40 gal	29	1100	8.6	220	NF	NF
(13b) Mixing/Loading/Applying Wettable Powders Using Low Pressure Hand Wand [MRID # 405048-23]	PCO = 0.08745 lb/gal	0.25 gal	160	2800	cannot apply PPE to registrant data	cannot apply PPE to registrant data	NF	NF
	PCO = 0.08745 lb/gal	4 gal	160	2800	cannot apply PPE to registrant data	cannot apply PPE to registrant data	NF	NF
	PCO = 0.08745 lb/gal	1 gal	170	2800	cannot apply PPE to registrant data	cannot apply PPE to registrant data	NF	NF
	PCO = 0.08745 lb/gal	40 gal	170	2800	cannot apply PPE to registrant data	cannot apply PPE to registrant data	NF	NF

Exposure Scenario	Application Rate ^a (lb ai/A or lb ai/gallons where noted)	Treated Area ^b (A/day or gallons/day where noted)	Baseline Unit Values		PPE Mitigation Unit Values ^c		Engineering Control Unit Values ^d	
			Dermal ^e (mg / lb ai handled)	Inhalation ^f (μ g / lb ai handled)	Dermal (mg / lb ai handled)	Inhalation (μ g / lb ai handled)	Dermal (mg / lb ai handled)	Inhalation (μ g / lb ai handled)
(14) Mixing/Loading/Applying Using Backpack Sprayer	Trees, Shrubs, Roses, Ground Cover, Floral Crops = 0.5 lb/100 gal	40 gal	2.5 (gloves)	30	2.5	6.0	NF	NF
	Trees, Shrubs, Roses, Ground Cover, Floral Crops = 1.0 lb/100 gal	40 gal	2.5 (gloves)	30	2.5	6.0	NF	NF
	Wasps = 0.075 lb/1 gal	5 gal	2.5 (gloves)	30	2.5	6.0	NF	NF
	Fire Ant (non-crop) = 0.047 lb/5 gal	5 gal	2.5 (gloves)	30	2.5	6.0	NF	NF
	PCO = 0.088 lb/gal	40 gal	2.5 (gloves)	30	2.5	6.0	NF	NF
(15) Mixing/Loading/Applying Using High Pressure Sprayer	Trees, Shrubs, Roses, Ground Cover, Floral Crops = 0.5 lb/100 gal	1000 gal	3.5	120	2.5	24	NF	NF
	Trees, Shrubs, Roses, Ground Cover, Floral Crops = 1.0 lb/100 gal	1000 gal	3.5	120	2.5	24	NF	NF
(16) Loading/Applying Using Aerosol Generator	Indoor Ornamentals, Flowers, Trees, Shrubs, Roses = 10 sec/100 sq. ft if 2 ft plants	No Data	No Data	No Data	No Data	No Data	NF	NF
	Outdoor Ornamentals, Flowers, Trees, Shrubs, Roses = 1 sec/row-foot; spray both sides of row	No Data	No Data	No Data	No Data	No Data	NF	NF
(17) Loading/Applying with PCO injector	PCO crack & crevice: 1% spray; 1 sec spray per spot; 1 spot/linear foot	No Data	No Data	No Data	No Data	No Data	NF	NF
(18) Loading/Applying Soluble Powder by Hand/Handtool/Shaker Can [label # 00239-02406]	Fire ants = 2 tsp/mound (0.00694 lb/mound)	10 mounds/acre; 1 acre	100	470	71	94	NF	NF

Exposure Scenario	Application Rate ^a (lb ai/A or lb ai/gallons where noted)	Treated Area ^b (A/day or gallons/day where noted)	Baseline Unit Values		PPE Mitigation Unit Values ^c		Engineering Control Unit Values ^d	
			Dermal ^e (mg / lb ai handled)	Inhalation ^d (μ g / lb ai handled)	Dermal (mg / lb ai handled)	Inhalation (μ g / lb ai handled)	Dermal (mg / lb ai handled)	Inhalation (μ g / lb ai handled)
(19) Mixing/Loading/Applying Soluble Powder Using Sprinkler Can	Fire ants = 0.047 oz/5 gal (0.0029 lb/5 gal)	1 gal/mound; 10 mounds/acre; 1 acre	31	9	No Data	No Data	NF	NF
(20) Loading/Applying Tree Injections	1.5 gm/injection	Dependent on tree size	No Data	No Data	No Data	No Data	NF	NF
(21) Loading/Applying Granules with Push-Type Granular Spreader	Turf = 5.0	5	2.9	6.3	0.73	0.63	NF	NF
(22) Loading/Applying Granules with Belly Grinder	Trees, Shrubs, Ornamentals = 0.1125 lb/1000 sq ft	87,000 sq ft	10	62	20	12	NF	NF
(23) Loading/Applying Granules with Shaker Can	Trees, Shrubs, Ornamentals = 0.1125 lb/1000 sq ft	10,000 sq ft	100	470	71	94	NF	NF
(24) Loading/Applying Granules by Hand [label # 59639-87]	0.00099 lb per pot up to 12 in diameter	1000 pots	100	470	71	94	NF	NF
	Fire ants = 2 tsp/mound (0.008 lb/mound)	1 acre; 10 mounds per acre	100	470	71	94	NF	NF
	Trees, Shrubs, Ornamentals = 0.1125 lb/1000 sq ft	1,000 sq ft	100	470	71	94	NF	NF
Flagger Exposure								
(25) Flagging Aerial Spray Applications	Ag= 0.5	350	0.011	0.35	0.010	0.070	0.0011	0.035
	Ag = 1.0	350	0.011	0.35	0.010	0.070	0.0011	0.035
	Turf = 5.0	350	0.011	0.35	0.010	0.070	0.0011	0.035
	Pasture = 0.125	350	0.011	0.35	0.010	0.070	0.0011	0.035
	Forest = 0.75	350	0.011	0.35	0.010	0.070	0.0011	0.035
	Forest = 0.75	80	80	0.011	0.35	0.010	0.070	0.0011

NF = Not feasible for scenario due to nature of task or equipment (i.e., HED assumes that all agricultural aerial applications are made with enclosed cab aircraft). No Data means no data are available for the scenario.

- a Maximum application rates are values found on currently registered labels.
- b Amounts of acreage treated per day are from the HED estimates of acreage that could be treated in a single day for each exposure scenario of concern.
- c Baseline dermal unit exposure represents a worker's estimated exposure while wearing long pants, long sleeved shirt, no gloves, open mixing/loading, open cab tractor for groundboom applications, and open flagging.
- d Baseline inhalation unit exposure represents no use of a respirator.
- e PPE: See Table # 5 for full description of PPE assumed for each exposure scenario. PPE generally represents the use of chemically-resistant gloves, an additional layer of clothing, and the use of an appropriate respirator.
- f Engineering controls: See Table #5 for full description of engineering controls assumed for each exposure scenario. Engineering controls generally represent the use of closed mixing/loading and closed cab application equipment and a single layer of clothing (exceptions are noted individually).

Note: aerial turf application of 5 lb ai/acre is not feasible; however, it is on current labels and therefore included in this assessment.

Table 2: Baseline Clothing Scenario Exposure and Risks for Occupational Handlers of Acephate, Short- and Intermediate-Term.

BASELINE Exposure Scenario	Application Rate (lb ai/A or lb ai/gallons where noted)	Treated Area (A/day or gallons/day where noted)	Daily Exposure (mg/day) ^a		Absorbed Daily Dose (mg/kg/day) ^b		Separate MOEs ^c		Combined MOEs ^d
			Dermal	Inhalation	Dermal	Inhalation	Dermal	Inhalation	
Mixer/Loader Exposure									
(1a) Mixing/Loading Soluble Powder for Aerial Application	Ag = 0.5	350	650	7.5	9.3	0.11	1.3	1.3	0.65
	Ag = 1.0	350	1300	15	19	0.21	0.63	0.67	0.32
	Turf = 5.0	350	6500	75	93	1.1	0.13	0.13	0.065
	Pasture = 0.125	350	160	1.9	2.3	0.027	5.2	5.2	2.6
(1b) Mixing/Loading Soluble Powder for Chemigation Application	Cranberries = 1.0	30	110	1.3	1.6	0.018	7.5	7.8	3.8
(1c) Mixing/Loading Soluble Powder for Groundboom Application	Ag = 0.5	80	150	1.7	2.1	0.024	5.7	5.8	2.8
	Ag = 1.0	80	300	3.4	4.3	0.049	2.8	2.9	1.4
	Pasture = 0.125	80	37	0.43	0.53	0.0061	23	23	12
	Turf = 5.0	Sod = 80	1500	17	21	0.24	0.57	0.58	0.28
	Turf = 5.0	Golf course = 40	740	8.6	11	0.12	1.1	1.2	0.58
(1d) Mixing/Loading Soluble Powder for Airblast Application	Non-bearing citrus = 0.5	40	74	0.86	1.1	0.012	11	12	5.8
	Trees & Shrubs = 1.0 lb/100 gal	1000 gal	37	0.43	0.53	0.0061	23	23	12
	Outdoor Floral = 0.5 lb/100 gal	1000 gal	19	0.22	0.27	0.0031	44	45	22
(1e) Mixing/Loading Soluble Powder for Handgun (Hydraulic Sprayer) Application	Tobacco (fire ant) = 1.0 lb/80 gal	13 gal/acre; 6 acres	3.6	0.042	0.051	0.00060	240	230	120
	Trees, Shrubs, Outdoor Floral Crops = 1.0 lb/100 gal	1000 gal	37	0.43	0.53	0.0061	23	23	12
	Trees, Shrubs, Outdoor	1000 gal	19	0.22	0.27	0.0031	44	45	22

BASELINE Exposure Scenario	Application Rate (lb ai/A or lb ai/gallons where noted)	Treated Area (A/day or gallons/day where noted)	Daily Exposure (mg/day) ^a		Absorbed Daily Dose (mg/kg/day) ^b		Separate MOEs ^c		Combined MOEs ^d
			Dermal	Inhalation	Dermal	Inhalation	Dermal	Inhalation	
	Turf = 5.0	5	93	1.1	1.3	0.016	9.2	8.8	4.5
(1f) Mixing/Loading Soluble Powder for Transplanting Water Application	Tobacco = 0.75	20	55.5	0.65	0.79	0.0093	15	15	7.5
(1g) Mixing/Loading Soluble Powder for Slurry Seed Treatment	Cotton seed = 0.04 lb/100 lb seed	200,000 lb seed	296	3.4	4.3	0.049	2.8	2.9	1.5
(1h) Loading Soluble Powder for Hopper Box Application	Cotton seed = 0.1875	80	56	0.65	0.80	0.0093	15	15	7.5
(2) Mixing/Loading Dry Flowable for Slurry Seed Treatment	Cotton seed = 0.04 lb/100 lb seed	200,000 lb seed	5.3	0.062	0.076	0.00089	160	160	80
(3a) Mixing/Loading Liquids for Aerial Application	Pasture/Forest = 0.75	350	760	0.32	11	0.0046	1.1	30	1.1
	Forest = 0.75	800	1700	0.72	24	0.010	0.50	14	0.50
(3b) Mixing/Loading Liquids for Slurry Seed Treatment	Cotton seed = 0.04 lb/100 lb seed	200,000 lb seed	230	0.096	3.3	0.0014	3.6	100	3.6
(4) Loading Granular in Tractor-Drawn Drop-Type Spreader	Cotton = 1.0	80	0.67	0.14	0.0096	0.0020	1300	70	68
	Sod = 5.0	80	3.4	0.68	0.048	0.0097	250	14	13
	Golf Course Turf = 5.0	40	1.7	0.34	0.024	0.0048	500	29	28
Applicator Exposure									
(5) Applying Sprays with Fixed-Wing Aircraft	Ag = 0.5	350	NF	NF	NF	NF	NF	NF	NF
	Ag = 1.0	350	NF	NF	NF	NF	NF	NF	NF
	Turf = 5.0	350	NF	NF	NF	NF	NF	NF	NF
	Pasture = 0.125	350	NF	NF	NF	NF	NF	NF	NF
	Forest = 0.75	350	NF	NF	NF	NF	NF	NF	NF
	Forest = 0.75	80	NF	NF	NF	NF	NF	NF	NF

BASELINE Exposure Scenario	Application Rate (lb ai/A or lb ai/gallons where noted)	Treated Area (A/day or gallons/day where noted)	Daily Exposure (mg/day) ^a		Absorbed Daily Dose (mg/kg/day) ^b		Separate MOEs ^c		Combined MOEs ^d
			Dermal	Inhalation	Dermal	Inhalation	Dermal	Inhalation	
(6) Applying Spray with a Groundboom Sprayer	Ag = 0.5	80	0.56	0.030	0.0080	0.00043	1500	330	270
	Ag = 1.0	80	1.1	0.059	0.016	0.00084	750	170	140
	Pasture = 0.125	80	0.14	0.0074	0.0020	0.00011	6000	1300	1100
	Turf = 5.0	Sod = 80	5.6	0.30	0.080	0.0043	150	33	27
	Turf = 5.0	Golf course = 40	2.8	0.15	0.040	0.0021	300	67	56
(7) Applying Spray with Airblast Sprayer	Non-bearing Citrus = 0.5	40	7.2	0.090	0.10	0.0013	120	110	59
	Trees & Shrubs = 1.0 lb/100 gal	1000 gal	3.6	0.045	0.051	0.00064	240	220	110
	Outdoor Floral = 0.5 lb/100 gal	1000 gal	1.8	0.023	0.026	0.00033	460	420	220
(8) Applying Spray with Handgun Sprayer	Tobacco (fire ant) = 1.0 lb/80 gal	13 gal/acre; 6 acres	1.3	0.0038	0.019	0.000054	630	2600	500
	Trees, Shrubs, Outdoor Floral Crops = 1.0 lb/100 gal	1000 gal	13	0.039	0.19	0.00056	63	250	50
	Trees, Shrubs, Outdoor Floral Crops = 0.5 lb/100 gal	1000 gal	6.5	0.020	0.093	0.00029	130	480	100
	Turf = 5.0	5	33	0.098	0.47	0.0014	26	100	21
(9) Applying in Transplanting Water	Tobacco = 0.75	20	0.21	0.011	0.003	0.00016	4000	880	710
(10) Applying as a Seed Treatment in a Hopper Box	Cotton = 0.1875	80	No Data	No Data	No Data	No Data	No Data	No Data	No Data
(11) Applying as a Seed Treatment in a Slurry Tank	Cotton seed = 0.04 lb/100 lb seed	200,000 lb seed	No Data	No Data	No Data	No Data	No Data	No Data	No Data
(12) Applying Granular with Tractor-Drawn Drop-Type Spreader	Cotton = 1.0	80	0.79	0.096	0.011	0.0014	1100	100	91

BASELINE Exposure Scenario	Application Rate (lb ai/A or lb ai/gallons where noted)	Treated Area (A/day or gallons/day where noted)	Daily Exposure (mg/day) ^a		Absorbed Daily Dose (mg/kg/day) ^b		Separate MOEs ^c		Combined MOEs ^d
			Dermal	Inhalation	Dermal	Inhalation	Dermal	Inhalation	
	Sod = 5.0	80	4.0	0.48	0.057	0.0068	210	20	18
	Turf = 5.0	40	2.0	0.24	0.028	0.0034	430	41	37
Mixer/Loader/Applicator Exposure									
(13a) Mixing/Loading/Applying Soluble Powders Using Low Pressure Hand Wand	Trees, Shrubs, Roses, Ground Cover, Floral Crops = 0.5 lb/100 gal	40 gal	5.8	0.22	0.083	0.0031	140	45	34
	Trees, Shrubs, Roses, Ground Cover, Floral Crops = 1.0 lb/100 gal	40 gal	12	0.44	0.17	0.0063	71	22	17
	Wasps = 0.075 lb/1 gal	5 gal	11	0.41	0.16	0.0059	75	24	18
	Fire Ant (non-crop) = 0.047 lb/5 gal	5 gal	1.4	0.052	0.020	0.00074	600	190	140
	PCO = 0.088 lb/gal	40 gal	100	3.9	1.4	0.056	8.6	2.5	1.9
(13b) Mixing/Loading/Applying Wettable Powders Using Low Pressure Hand Wand [MRID # 405048-23]	PCO = 0.08745 lb/gal	0.25 gal	3.4	0.06	0.049	0.00086	250	160	100
	PCO = 0.08745 lb/gal	4 gal	56	0.98	0.8	0.014	15	10	5.9
	PCO = 0.08745 lb/gal	1 gal	15	0.24	0.214	0.00343	56	41	24
	PCO = 0.08745 lb/gal	40 gal	600	9.8	8.57	0.14	1.4	1	0.59
(14) Mixing/Loading/Applying Using Backpack Sprayer	Trees, Shrubs, Roses, Ground Cover, Floral Crops = 0.5 lb/100 gal	40 gal	0.5	0.0060	0.00714	0.000086	1700	1600	830
	Trees, Shrubs, Roses, Ground Cover, Floral Crops = 1.0 lb/100 gal	40 gal	1	0.012	0.0143	0.00017	840	820	420
	Wasps = 0.075 lb/1 gal	5 gal	0.94	0.011	0.0134	0.00016	890	880	450
	Fire Ant (non-crop) = 0.047 lb/5 gal	5 gal	0.12	0.0014	0.0017	0.000020	7000	7000	3500
	PCO = 0.088 lb/gal	40 gal	8.8	0.11	0.1257	0.0016	95	88	48

BASELINE Exposure Scenario	Application Rate (lb ai/A or lb ai/gallons where noted)	Treated Area (A/day or gallons/day where noted)	Daily Exposure (mg/day) ^a		Absorbed Daily Dose (mg/kg/day) ^b		Separate MOEs ^c		Combined MOEs ^d
			Dermal	Inhalation	Dermal	Inhalation	Dermal	Inhalation	
(15) Mixing/Loading/Applying Using High Pressure Sprayer	Trees, Shrubs, Roses, Ground Cover, Floral Crops = 0.5 lb/100 gal	1000 gal	18	0.60	0.26	0.0086	46	16	12
	Trees, Shrubs, Roses, Ground Cover, Floral Crops = 1.0 lb/100 gal	1000 gal	35	1.2	0.50	0.017	24	8.2	6.2
(16) Loading/Applying Using Aerosol Generator	Indoor Ornamentals, Flowers, Trees, Shrubs, Roses = 10 sec/100 sq. ft if 2 ft plants	No Data	No Data	No Data	No Data	No Data	No Data	No Data	No Data
	Outdoor Ornamentals, Flowers, Trees, Shrubs, Roses = 1 sec/row-foot; spray both sides of row	No Data	No Data	No Data	No Data	No Data	No Data	No Data	No Data
(17) Loading/Applying with PCO injector	PCO crack & crevice: 1% spray; 1 sec spray per spot; 1 spot/linear foot	No Data	No Data	No Data	No Data	No Data	No Data	No Data	No Data
(18) Loading/Applying Soluble Powder by Hand/Handtool/Shaker Can [label # 00239-02406]	Fire ants = 2 tsp/mound (0.00694 lb/mound)	10 mounds/acre; 1 acre	6.94	0.0326	0.099	0.0046	120	30	24
(19) Mixing/Loading/Applying Soluble Powder Using Sprinkler Can	Fire ants = 0.047 oz/5 gal (0.0029 lb/5 gal)	1 gal/mound; 10 mounds/acre; 1 acre	0.182	0.000053	0.0026	0.0000007	4600	190000	4500
(20) Loading/Applying Tree Injections	1.5 gm/injection	Dependent on tree size	No Data	No Data	No Data	No Data	No Data	No Data	No Data
(21) Loading/Applying Granules with Push-Type Granular Spreader	Turf = 5.0	5	725	0.16	1.0	0.0023	12	61	10
(22) Loading/Applying Granules with Belly Grinder	Trees, Shrubs, Ornamentals = 0.1125 lb/1000 sq ft	87,000 sq ft	97.9	0.606	1.4	0.0087	9	16	5.9

BASELINE Exposure Scenario	Application Rate (lb ai/A or lb ai/gallons where noted)	Treated Area (A/day or gallons/day where noted)	Daily Exposure (mg/day) ^a		Absorbed Daily Dose (mg/kg/day) ^b		Separate MOEs ^c		Combined MOEs ^d
			Dermal	Inhalation	Dermal	Inhalation	Dermal	Inhalation	
(23) Loading/Applying Granules with Shaker Can	Trees, Shrubs, Ornamentals = 0.1125 lb/1000 sq ft	10,000 sq ft	112.5	0.53	1.6	0.0075	8	19	5.9
(24) Loading/Applying Granules by Hand [label # 59639-87]	0.00099 lb per pot up to 12 in diameter	1000 pots	99	0.4653	1.4	0.0066	8	21	5.9
	Fire ants = 2 tsp/mound (0.008 lb/mound)	1 acre; 10 mounds per acre	8	0.0376	0.11	0.00054	105	260	77
	Trees, Shrubs, Ornamentals = 0.1125 lb/1000 sq ft	1,000 sq ft	11.25	0.0529	0.16	0.00076	75	185	56
Flagger Exposure									
(25) Flagging Aerial Spray Applications	Ag = 0.5	350	1.9	0.061	0.027	0.00087	440	160	120
	Ag = 1.0	350	3.9	0.12	0.056	0.0017	210	82	59
	Turf = 5.0	350	19	0.61	0.27	0.0087	44	16	12
	Pasture = 0.125	350	0.48	0.015	0.0069	0.00021	1700	670	480
	Forest = 0.75	350	2.9	0.092	0.041	0.0013	290	110	83
	Forest = 0.75	80	6.6	0.21	0.094	0.003	130	47	34

NF = Not feasible due to equipment used. HED believes all agricultural aircraft are enclosed cab; helicopter PHED data are insufficient for evaluation. No Data means no data are available for the scenario.

a Daily Exposure (mg/day) = Application Rate (lb ai/A or lb ai/gallon) * Treated Area (A/day or gallons/day) * Unit Exposure Value (mg or μg exposure/ lb ai handled) * [1mg/1000 μg (conversion factor if necessary)].

b Absorbed Daily Dose (mg/kg/day) = Daily Exposure (mg/day) * Absorption (1) \div Body Weight (70kg).

c MOE (unitless) = NOAEL (mg/kg/day) \div Absorbed Daily Dose (mg/kg/day). Where NOAEL_{dermal} = 12 mg/kg/day and NOAEL_{inhalation} = 0.14 mg/kg/day.

d Combined MOEs = $\frac{1}{\left(\frac{1}{\text{MOE}_{\text{derm}}} + \frac{1}{\text{MOE}_{\text{inhal}}}\right)}$; MOE of 100 is an acceptable margin of exposure.

Table 3: PPE Mitigation Scenario Exposure and Risks for Occupational Handlers of Acephate, Short- and Intermediate-Term.

PPE Exposure Scenario	Application Rate (lb ai/A or lb ai/gallons where noted)	Treated Area (A/day or gallons/day where noted)	Daily Exposure (mg/day) ^a		Absorbed Daily Dose (mg/kg/day) ^b		Separate MOEs ^c		Combined MOEs ^d
			Dermal	Inhalation	Dermal	Inhalation	Dermal	Inhalation	
Mixer/Loader Exposure									
(1a) Mixing/Loading Soluble Powder for Aerial Application	Ag = 0.5	350	30	1.5	0.43	0.021	28	6.7	5.6
	Ag = 1.0	350	60	3.0	0.86	0.043	14	3.3	2.7
	Turf = 5.0	350	300	15	4.3	0.21	2.8	0.67	0.56
	Pasture = 0.125	350	7.4	0.38	0.11	0.0054	110	26	21
(1b) Mixing/Loading Soluble Powder for Chemigation Application	Cranberries = 1.0	30	5.1	0.26	0.073	0.0037	160	38	31
(1c) Mixing/Loading Soluble Powder for Groundboom Application	Ag = 0.5	80	6.8	0.34	0.097	0.0049	120	29	23
	Ag = 1.0	80	14	0.69	0.20	0.0099	60	14	11
	Pasture = 0.125	80	1.7	0.086	0.024	0.0012	500	120	97
	Turf = 5.0	Sod = 80	68	3.4	0.97	0.049	12	2.9	2.3
	Turf = 5.0	Golf course = 40	34	1.7	0.49	0.024	24	5.8	4.8
(1d) Mixing/Loading Soluble Powder for Airblast Application	Non-bearing citrus = 0.5	40	3.4	0.17	0.049	0.0024	240	58	48
	Trees & Shrubs = 1.0 lb/100 gal	1000 gal	1.7	0.086	0.024	0.0012	500	120	97
	Outdoor Floral = 0.5 lb/100 gal	1000 gal	0.85	0.043	0.012	0.00061	1000	230	190
(1e) Mixing/Loading Soluble Powder for Handgun (Hydraulic Sprayer) Application	Tobacco (fire ant) = 1.0 lb/80 gal	13 gal/acre; 6 acres	0.17	0.0084	NA	NA	NA	NA	NA
	Trees, Shrubs, Outdoor Floral Crops = 1.0 lb/100 gal	1000 gal	1.7	0.086	0.024	0.0012	500	120	100

PPE Exposure Scenario	Application Rate (lb ai/A or lb ai/gallons where noted)	Treated Area (A/day or gallons/day where noted)	Daily Exposure (mg/day) ^a		Absorbed Daily Dose (mg/kg/day) ^b		Separate MOEs ^c		Combined MOEs ^d
			Dermal	Inhalation	Dermal	Inhalation	Dermal	Inhalation	
	Trees, Shrubs, Outdoor Floral Crops = 0.5 lb/100 gal	1000 gal	0.85	0.043	0.012	0.00061	1000	230	190
	Turf = 5.0	5	4.3	0.22	0.061	0.0031	200	45	37
(1f) Mixing/Loading Soluble Powder for Transplanting Water Application	Tobacco = 0.75	20	2.55	0.129	0.0364	0.0018	330	76	62
(1g) Mixing/Loading Soluble Powder for Slurry Seed Treatment	Cotton seed = 0.04 lb/100 lb seed	200,000 lb seed	14	0.69	0.20	0.0099	60	14	11
(1h) Loading Soluble Powder for Hopper Box Application	Cotton seed = 0.1875	80	2.6	0.13	0.037	0.0019	320	74	62
(2) Mixing/Loading Dry Flowable for Slurry Seed Treatment	Cotton seed = 0.04 lb/100 lb seed	200,000 lb seed	5.3	0.012	0.076	0.00017	160	820	140
(3a) Mixing/Loading Liquids for Aerial Application	Pasture/Forest = 0.75	350	6.0	0.063	0.086	0.00090	140	160	77
	Forest = 0.75	800	14	0.14	0.20	0.0020	60	70	32
(3b) Mixing/Loading Liquids for Slurry Seed Treatment	Cotton seed = 0.04 lb/100 lb seed	200,000 lb seed	1.8	0.019	0.026	0.00027	460	520	240
(4) Loading Granular in Tractor-Drawn Drop-Type Spreader	Cotton = 1.0	80	0.55	0.027	0.0079	0.00039	1500	360	290
	Sod = 5.0	80	2.8	0.14	0.04	0.002	300	70	56
	Turf = 5.0	40	1.4	0.068	0.02	0.00097	600	140	110
Applicator Exposure									
(5) Applying Sprays with Fixed-Wing Aircraft	Ag = 0.5	350	NF	NF	NF	NF	NF	NF	NF
	Ag = 1.0	350	NF	NF	NF	NF	NF	NF	NF
	Turf = 5.0	350	NF	NF	NF	NF	NF	NF	NF
	Pasture = 0.125	350	NF	NF	NF	NF	NF	NF	NF
	Forest = 0.75	350	NF	NF	NF	NF	NF	NF	NF

PPE Exposure Scenario	Application Rate (lb ai/A or lb ai/gallons where noted)	Treated Area (A/day or gallons/day where noted)	Daily Exposure (mg/day) ^a		Absorbed Daily Dose (mg/kg/day) ^b		Separate MOEs ^c		Combined MOEs ^d
			Dermal	Inhalation	Dermal	Inhalation	Dermal	Inhalation	
(18) Loading/Applying Soluble Powder by Hand/Handtool/Shaker Can [label # 00239-02406]	Fire ants = 2 tsp/mound (0.00694 lb/mound)	10 mounds/acre; 1 acre	4.9	0.0065	0.070	0.00009	170	1500	150
(19) Mixing/Loading/Applying Soluble Powder Using Sprinkler Can	Fire ants = 0.047 oz/5 gal (0.0029 lb/5 gal)	1 gal/mound; 10 mounds/acre; 1 acre	No Data	No Data	No Data	No Data	No Data	No Data	No Data
(20) Loading/Applying Tree Injections	1.5 gm/injection	Dependent on tree size	No Data	No Data	No Data	No Data	No Data	No Data	No Data
(21) Loading/Applying Granules with Push-Type Granular Spreader	Turf = 5.0	5	18	0.016	0.26	0.00023	46	610	42
(22) Loading/Applying Granules with Belly Grinder	Trees, Shrubs, Ornamentals = 0.1125 lb/1000 sq ft	87,000 sq ft	196	0.117	2.8	0.0017	4.3	83	4.2
(23) Loading/Applying Granules with Shaker Can	Trees, Shrubs, Ornamentals = 0.1125 lb/1000 sq ft	10,000 sq ft	80	0.105	1.14	0.0015	10	93	9.1
(24) Loading/Applying Granules by Hand [label # 59639-87]	0.00099 lb per pot up to 12 in diameter	1000 pots	70.3	0.09	1.0	0.0013	12	105	11
	Fire ants = 2 tsp/mound (0.008 lb/mound)	1 acre; 10 mounds per acre	5.68	0.0075	0.08	0.0001	150	1303	150
	Trees, Shrubs, Ornamentals = 0.1125 lb/1000 sq ft	1,000 sq ft	8.0	0.0105	0.114	0.00015	105	926	91
Flagger Exposure									
(25) Flagging Aerial Spray Applications	Ag = 0.5	350	1.8	0.012	NA	NA	NA	NA	NA
	Ag = 1.0	350	3.5	0.025	0.050	0.00036	240	390	150
	Turf = 5.0	350	18	0.12	0.25	0.0017	48	82	30
	Pasture = 0.125	350	0.44	0.0031	NA	NA	NA	NA	NA
	Forest = 0.75	350	2.6	0.018	0.038	0.00026	320	540	200
	Forest = 0.75	80	6.0	0.042	0.086	0.00060	140	230	91

NF = Not Feasible. HED believes all agricultural aircraft are enclosed cab. No Data means no data are available for the exposure scenario. NA = Not Applicable; not necessary to estimate MOE since the MOE at baseline was equal to or greater than 100.

a Daily Exposure (mg/day) = Application Rate (lb ai/A or lb ai/gallon) * Treated Area (A/day or gallons/day) * Unit Exposure Value (mg or μg exposure/ lb ai handled) * [1mg/1000 μg (conversion factor if necessary)].

b Absorbed Daily Dose (mg/kg/day) = Daily Exposure (mg/day) * Absorption (1) \div Body Weight (70kg).

c MOE (unitless) = NOAEL (mg/kg/day) \div Absorbed Daily Dose (mg/kg/day). Where NOAEL_{dermal} = 12 mg/kg/day and NOAEL_{inhalation} = 0.14 mg/kg/day.

d Combined MOEs = $\frac{1}{\left(\frac{1}{\text{MOE}_{\text{derm}}} + \frac{1}{\text{MOE}_{\text{inhal}}}\right)}$; MOE of 100 is an acceptable margin of exposure.

Table 4: Engineering Controls Scenario Exposure and Risks for Occupational Handlers of Acephate, Short- and Intermediate-Term.

ENGINEERING CONTROLS Exposure Scenario	Application Rate (lb ai/A or lb ai/gallons where noted)	Treated Area (A/day or gallons/day where noted)	Daily Exposure (mg/day) ^a		Absorbed Daily Dose (mg/kg/day) ^b		Separate MOEs ^c		Combined MOEs ^d
			Dermal	Inhalation	Dermal	Inhalation	Dermal	Inhalation	
Mixer/Loader Exposure									
(1a) Mixing/Loading Soluble Powder for Aerial Application	Ag = 0.5	350	1.7	0.042	0.025	0.00060	480	230	160
	Ag = 1.0	350	3.4	0.084	0.049	0.0012	240	120	83
	Turf = 5.0	350	17	0.42	0.25	0.0060	48	23	16
	Pasture = 0.125	350	0.43	0.011	0.0061	0.00016	2000	880	620
(1b) Mixing/Loading Soluble Powder for Chemigation Application	Cranberries = 1.0	30	0.29	0.0072	0.0041	0.00010	2900	1400	1000
(1c) Mixing/Loading Soluble Powder for Groundboom Application	Ag = 0.5	80	0.39	0.0096	0.0056	0.00014	2100	1000	670
	Ag = 1.0	80	0.78	0.019	0.011	0.00027	1100	520	360
	Pasture = 0.125	80	0.098	0.0024	0.0014	0.000034	8600	4100	2800
	Turf = 5.0	Sod = 80	3.9	0.096	0.056	0.0014	210	100	67
	Turf = 5.0	Golf course = 40	2.0	0.048	0.029	0.00069	430	200	140
(1d) Mixing/Loading Soluble Powder for Airblast Application	Non-bearing citrus = 0.5	40	0.20	0.0048	0.0029	0.000069	4300	2000	1400
	Trees & Shrubs = 1.0 lb/100 gal	1000 gal	0.098	0.0024	0.0014	0.000034	8600	4100	2800
	Outdoor Floral = 0.5 lb/100 gal	1000 gal	0.049	0.0012	NA	NA	NA	NA	NA
(1e) Mixing/Loading Soluble Powder for Handgun (Hydraulic Sprayer) Application	Tobacco (fire ant) = 1.0 lb/80 gal	13 gal/acre; 6 acres	0.0096	0.00023	NA	NA	NA	NA	NA
	Trees, Shrubs, Outdoor Floral Crops = 1.0 lb/100 gal	1000 gal	0.098	0.0024	0.0014	0.000034	8600	4100	2800

ENGINEERING CONTROLS Exposure Scenario	Application Rate (lb ai/A or lb ai/gallons where noted)	Treated Area (A/day or gallons/day where noted)	Daily Exposure (mg/day) ^a		Absorbed Daily Dose (mg/kg/day) ^b		Separate MOEs ^c		Combined MOEs ^d
			Dermal	Inhalation	Dermal	Inhalation	Dermal	Inhalation	
	Trees, Shrubs, Outdoor Floral Crops = 0.5 lb/100 gal	1000 gal	0.049	0.0012	NA	NA	NA	NA	NA
	Turf = 5.0	5	0.25	0.0060	0.0035	0.000086	3400	1600	1100
(1f) Mixing/Loading Soluble Powder for Transplanting Water Application	Tobacco = 0.75	20	0.147	0.00357	0.0021	0.000051	5700	2700	1800
(1g) Mixing/Loading Soluble Powder for Slurry Seed Treatment	Cotton seed = 0.04 lb/100 lb seed	200,000 lb seed	0.78	0.019	0.011	0.00027	1100	520	360
(1h) Loading Soluble Powder for Hopper Box Application	Cotton seed = 0.1875	80	0.15	0.0036	0.0021	0.000051	5700	2700	1800
(2) Mixing/Loading Dry Flowable for Slurry Seed Treatment	Cotton seed = 0.04 lb/100 lb seed	200,000 lb seed	0.78	0.019	NA	NA	NA	NA	NA
(3a) Mixing/Loading Liquids for Aerial Application	Pasture/Forest = 0.75	350	2.3	0.022	0.032	0.00031	380	450	208
	Forest = 0.75	800	5.2	0.050	0.074	0.00071	160	200	91
(3b) Mixing/Loading Liquids for Slurry Seed Treatment	Cotton seed = 0.04 lb/100 lb seed	200,000 lb seed	0.69	0.0066	NA	NA	NA	NA	NA
(4) Loading Granular in Tractor-Drawn Drop- Type Spreader	Cotton = 1.0	80	0.014	0.0027	NA	NA	NA	NA	NA
	Sod = 5.0	80	0.068	0.014	0.00097	0.0002	12000	700	670
	Golf Course Turf = 5.0	40	0.034	0.0068	0.00048	0.000097	25000	1400	1300
Applicator Exposure									
(5) Applying Sprays with Fixed-Wing Aircraft	Ag = 0.5	350	0.88	0.012	0.013	0.00017	920	820	430
	Ag = 1.0	350	1.8	0.024	0.026	0.00034	480	410	220
	Turf = 5.0	350	8.8	0.12	0.13	0.0017	92	82	43
	Pasture = 0.125	350	0.22	0.0030	0.0031	0.000043	3900	3300	1800
	Forest = 0.75	350	1.3	0.018	0.019	0.00026	630	540	290

ENGINEERING CONTROLS Exposure Scenario	Application Rate (lb ai/A or lb ai/gallons where noted)	Treated Area (A/day or gallons/day where noted)	Daily Exposure (mg/day) ^a		Absorbed Daily Dose (mg/kg/day) ^b		Separate MOEs ^c		Combined MOEs ^d
			Dermal	Inhalation	Dermal	Inhalation	Dermal	Inhalation	
(12) Applying Granular with Tractor-Drawn Drop-Type Spreader	Cotton = 1.0	80	0.17	0.018	NA	NA	NA	NA	NA
	Sod = 5.0	80	0.84	0.088	0.012	0.0012	1000	120	110
	Golf Course Turf = 5.0	40	0.42	0.044	0.0060	0.00063	2000	220	200
Mixer/Loader/Applicator Exposure									
(13a) Mixing/Loading/Applying Soluble Powders Using Low Pressure Hand Wand	Trees, Shrubs, Roses, Ground Cover, Floral Crops = 0.5 lb/100 gal	40 gal	NF	NF	NF	NF	NF	NF	NF
	Trees, Shrubs, Roses, Ground Cover, Floral Crops = 1.0 lb/100 gal	40 gal	NF	NF	NF	NF	NF	NF	NF
	Wasps = 0.075 lb/l gal	5 gal	NF	NF	NF	NF	NF	NF	NF
	Fire Ant (non-crop) = 0.047 lb/5 gal	5 gal	NF	NF	NF	NF	NF	NF	NF
	PCO = 0.088 lb/gal	40 gal	NF	NF	NF	NF	NF	NF	NF
(13b) Mixing/Loading/Applying Wettable Powders Using Low Pressure Hand Wand [MRID # 405048-23]	PCO = 0.08745 lb/gal	0.25 gal	NF	NF	NF	NF	NF	NF	NF
	PCO = 0.08745 lb/gal	4 gal	NF	NF	NF	NF	NF	NF	NF
	PCO = 0.08745 lb/gal	1 gal	NF	NF	NF	NF	NF	NF	NF
	PCO = 0.08745 lb/gal	40 gal	NF	NF	NF	NF	NF	NF	NF
(14) Mixing/Loading/Applying Using Backpack Sprayer	Trees, Shrubs, Roses, Ground Cover, Floral Crops = 0.5 lb/100 gal	40 gal	NF	NF	NF	NF	NF	NF	NF
	Trees, Shrubs, Roses, Ground Cover, Floral Crops = 1.0 lb/100 gal	40 gal	NF	NF	NF	NF	NF	NF	NF
	Wasps = 0.075 lb/l gal	5 gal	NF	NF	NF	NF	NF	NF	NF

ENGINEERING CONTROLS Exposure Scenario	Application Rate (lb ai/A or lb ai/gallons where noted)	Treated Area (A/day or gallons/day where noted)	Daily Exposure (mg/day) ^a		Absorbed Daily Dose (mg/kg/day) ^b		Separate MOEs ^c		Combined MOEs ^d
			Dermal	Inhalation	Dermal	Inhalation	Dermal	Inhalation	
	Fire Ant (non-crop) = 0.047 lb/5 gal	5 gal	NF	NF	NF	NF	NF	NF	NF
	PCO = 0.088 lb/gal	40 gal	NF	NF	NF	NF	NF	NF	NF
(15) Mixing/Loading/Applying Using High Pressure Sprayer	Trees, Shrubs, Roses, Ground Cover, Floral Crops = 0.5 lb/100 gal	1000 gal	NF	NF	NF	NF	NF	NF	NF
	Trees, Shrubs, Roses, Ground Cover, Floral Crops = 1.0 lb/100 gal	1000 gal	NF	NF	NF	NF	NF	NF	NF
(16) Loading/Applying Using Aerosol Generator	Indoor Ornamentals, Flowers, Trees, Shrubs, Roses = 10 sec/100 sq. ft if 2 ft plants	No data	NF	NF	NF	NF	NF	NF	NF
	Outdoor Ornamentals, Flowers, Trees, Shrubs, Roses = 1 sec/row-foot; spray both sides of row	No data	NF	NF	NF	NF	NF	NF	NF
(17) Loading/Applying with PCO injector	PCO crack & crevice: 1% spray; 1 sec spray per spot; 1 spot/linear foot	No data	NF	NF	NF	NF	NF	NF	NF
(18) Loading/Applying Soluble Powder by Hand/Handtool/Shaker Can [label # 00239-02406]	Fire ants = 2 tsp/mound (0.00694 lb/mound)	10 mounds/acre; 1 acre	NF	NF	NF	NF	NF	NF	NF
(19) Mixing/Loading/Applying Soluble Powder Using Sprinkler Can	Fire ants = 0.047 oz/5 gal (0.0029 lb/5 gal)	1 gal/mound; 10 mounds/acre; 1 acre	NF	NF	NF	NF	NF	NF	NF
(20) Loading/Applying Tree Injections	1.5 gm/injection	Dependent on tree size	NF	NF	NF	NF	NF	NF	NF
(21) Loading/Applying Granules with Push- Type Granular Spreader	Turf = 5.0	5	NF	NF	NF	NF	NF	NF	NF

ENGINEERING CONTROLS Exposure Scenario	Application Rate (lb ai/A or lb ai/gallons where noted)	Treated Area (A/day or gallons/day where noted)	Daily Exposure (mg/day) ^a		Absorbed Daily Dose (mg/kg/day) ^b		Separate MOEs ^c		Combined MOEs ^d
			Dermal	Inhalation	Dermal	Inhalation	Dermal	Inhalation	
(22) Loading/Applying Granules with Belly Grinder	Trees, Shrubs, Ornamentals = 0.1125 lb/1000 sq ft	87,000 sq ft	NF	NF	NF	NF	NF	NF	NF
(23) Loading/Applying Granules with Shaker Can	Trees, Shrubs, Ornamentals = 0.1125 lb/1000 sq ft	10,000 sq ft	NF	NF	NF	NF	NF	NF	NF
(24) Loading/Applying Granules by Hand [label # 59639-87]	0.00099 lb per pot up to 12 in diameter	1000 pots	NF	NF	NF	NF	NF	NF	NF
	Fire ants = 2 tsp/mound (0.008 lb/mound)	1 acre; 10 mounds per acre	NF	NF	NF	NF	NF	NF	NF
	Trees, Shrubs, Ornamentals = 0.1125 lb/1000 sq ft	1,000 sq ft	NF	NF	NF	NF	NF	NF	NF
Flagger Exposure									
(25) Flagging Aerial Spray Applications	Ag = 0.5	350	0.19	0.0061	NA	NA	NA	NA	NA
	Ag = 1.0	350	0.39	0.012	NA	NA	NA	NA	NA
	Turf = 5.0	350	1.9	0.061	0.27	0.00874	440	160	120
	Pasture = 0.125	350	0.048	0.0015	NA	NA	NA	NA	NA
	Forest = 0.75	350	0.29	0.092	NA	NA	NA	NA	NA
	Forest = 0.75	80	0.66	0.021	0.0094	0.0003	1300	470	340

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. No Data means no data are available for the exposure scenario. NA = Not Applicable; not necessary to estimate MOE since the MOE at baseline or PPE was equal to or greater than 100.

a Daily Exposure (mg/day) = Application Rate (lb ai/A or lb ai/gallon) * Treated Area (A/day or gallons/day) * Unit Exposure Value (mg or μ g exposure/ lb ai handled) * [1mg/1000 μ g (conversion factor if necessary)].

b Absorbed Daily Dose (mg/kg/day) = Daily Exposure (mg/day) * Absorption (1) \div Body Weight (70kg).

c MOE (unitless) = NOAEL (mg/kg/day) \div Absorbed Daily Dose (mg/kg/day). Where NOAEL_{dermal} = 12 mg/kg/day and NOAEL_{inhalation} = 0.14 mg/kg/day.

d Combined MOEs = $\frac{1}{\left(\frac{1}{MOE_{derm}} + \frac{1}{MOE_{inhal}}\right)}$; MOE of 100 is an acceptable margin of exposure.

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

Exposure Scenario (Number)	Data Source	Standard Assumptions ^a (8-hr work day)	Comments ^b
MIXER/LOADER DESCRIPTORS			
<p>(1a/1b/1c/1d/1e/1f/1g/1h) Mixing/Loading Soluble Powder</p>	<p>PHED V1.1</p>	<p>350 acres for aerial application/ chemigation; 80 acres for groundboom on agricultural; 40 acres for groundboom 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 lb seed for slurry seed treatment; 20 acres for transplanting on a tobacco farm; and 80 acres for hopper box application</p> <p>Note: aerial turf application of 5 lb ai/acre is not feasible; however, it is on current label and therefore included in this assessment</p> <p>Note: Per comments received by the Agency, 30 acres are being used for the treated area of cranberries in this assessment; the Agency requires additional exposure monitoring data, use information and cultural practices with regard to treatment of cranberries; label modifications with regard to the maximum acreage should be made.</p> <p>Note: PHED data for wettable powders have been used due to the lack of data for soluble powders</p>	<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>

Exposure Scenario (Number)	Data Source	Standard Assumptions ^a (8-hr work day)	Comments ^b
(2) Mixing/ Loading Dry Flowable	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. No additional information was provided by the registrant regarding the use of engineering controls.</p>
(3a/3b) Mixing/Loading Liquids	PHED V1.1	350 acres, for agricultural settings; 800 acres used for forest application; and 200,000 lb 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>
(4) Mixing/Loading Granular	PHED V1.1	80 acres for cotton; 80 acres for sod; and 40 acres for golf course turf	<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>
APPLICATOR DESCRIPTIONS			

Exposure Scenario (Number)	Data Source	Standard Assumptions ^a (8-hr work day)	Comments ^b
(5) Applying Sprays with Fixed Wing Aircraft	PHED VI.1	350 acres for crops and 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>
(6) Applying with Ground Boom Sprayer	PHED VI.1	80 acres (agriculture) and 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>
(7) Applying with Airblast Sprayer	PHED VI.1	40 acres and 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>

Exposure Scenario (Number)	Data Source	Standard Assumptions ^a (8-hr work day)	Comments ^b
(8) Applying Spray with Handgun Sprayer	PHED VI.1	Fire Ants 13 gal/acre and 6 acres gallons; trees & shrubs 1,000 gal; and 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>
(9) Applying in Transplanting Water	PHED VI.1	20 acres	No PHED data were available for this scenario; therefore, PHED data for groundboom were used (which may over-estimate transplant water application for tobacco). See scenario (7)
(10) Applying in Seed Treatment Hopper Box	No Data	No Data	NA
(11) Applying as a Seed Treatment in a Slurry Tank	No Data	No Data	NA
(12) Applying Granular with Tractor-Drawn Drop-Type Spreader	PHED VI.1	80 acres for cotton; 80 acres for sod; and 40 acres for golf course turf	<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>
MIXER/LOADER/APPLICATOR			
(13a) Mixing/Loading/Applying Soluble Powders Using Low Pressure Hand Wand	PHED VI.1	40 gallons for floral crops and 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>

Exposure Scenario (Number)	Data Source	Standard Assumptions ^a (8-hr work day)	Comments ^b
(13b) Mixing/Loading/Applying Wettable Powders Using Low Pressure Hand Wand	MRID 405048-23	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	9 replicates for residential sites 9 replicates for commercial sites
(14) Mixing/Loading/Applying Using Backpack Sprayer	PHED VI.1	40 gallons; for floral crops; 5 gallons for Wasps and Fire ants	Baseline: Hand data are ABC grade, dermal are AB grades, and inhalation data are A grades. Hand = 11 replicates (with gloves); dermal = 9 to 11 replicates; and inhalation = 11 replicates. Low confidence in hand/dermal and inhalation data. 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. Engineering Controls: Not feasible for this scenario.
(15) Mixing/Loading/Applying using High Pressure Sprayer	PHED VI.1	1,000 gallons	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. 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. Engineering Controls: Not feasible for this scenario.
(16) Loading/Applying Using Aerosol Generator	No Data	---	No Data
(17) Loading/Applying with PCO injector	No Data	---	See scenario 14(b) for similar scenario for crack and crevice treatment
(18) Loading/Applying Soluble Powder by Hand/Handtool/Shaker Can	PHED VI.1	10 mounds /acre and 1 acre	No PHED data were available for this scenario. Therefore, PHED data for the granular bait dispersed by hand scenario were used. See scenario (24).
(19) Mixing/Loading /Applying Soluble Powder using Sprinkler Can	No Data	1 gal/mound; 10 mound/acre; and 1 acre	No PHED data were available for this scenario. Therefore, PHED data for the garden hose-end sprayer were used. 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.
(20) Loading/Applying Tree Injections	No Data	No Data	NA

Exposure Scenario (Number)	Data Source	Standard Assumptions ^a (8-hr work day)	Comments ^b
(21) Mixing/Loading/Applying Granular with Push-Type Granular Spreader	PHED VI.1	5 acres for turf	<p>Baseline: Hand and dermal = C grade and inhalation = acceptable grades. Hand = 15 replicates; dermal = 0 to 15 replicates; and inhalation = 15 replicates. Low to medium confidence in the dermal and hand data. High confidence in the inhalation data. No protection factor was required to define the unit exposure scenario.</p> <p>PPE: Derived by calculation from baseline data. The same dermal data and hand data are used (as for the baseline) with a 50% protection factor applied to non-hand dermal data to account for the use of an additional layer of clothing (coveralls), a 90% protection factor to hand data to account for the use of chemically-resistant gloves, and a 90% PF was applied to account for the use of appropriate respiratory protection.</p> <p>Engineering Controls: There are no known engineering controls for this scenario.</p>
(22) Loading/ Applying Granular with Belly Grinder	PHED VI.1	2 acres	<p>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.</p> <p>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.</p> <p>Engineering Controls: Not feasible for this scenario.</p>
(23) Loading/Applying/ Granular with Shaker Can	PHED VI.1	10,000 sq. ft	No PHED data were available for this scenario; therefore, PHED data for the granular bait dispersed by hand scenario were used. See scenario (24)
(24) Loading/Applying Granular by Hand	PHED VI.1	1000 pots	<p>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.</p> <p>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</p> <p>Engineering Controls: There is the possibility of mechanical application; however, for this scenario extrapolation is not appropriate.</p>
FLAGGER DESCRIPTORS			

Exposure Scenario (Number)	Data Source	Standard Assumptions ^a (8-hr work day)	Comments ^b
(25) Flagging Aerial Applications	PHED V1.1	350 acres agricultural and 800 acres forest	<p>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.</p> <p>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.</p> <p>Engineering Controls: The same data are used as for baseline with a 90% protection factor to simulate a closed cab.</p>

a 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 yields 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 yields 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 yields all grades (any run that includes D or E grade data) or has less than 15 replicates per body part.

Note: PHED data for wettable powders have been used due to the lack of data for soluble powders.

APPENDIX B**ACEPHATE OCCUPATIONAL POST-APPLICATION WORKER
EXPOSURE AND RISK ASSESSMENT TABLES
(INTERMEDIATE-TERM EXPOSURES)**

Table 1: Post-Application Risks to Workers Following Acephate Application to Beans in OR (1.0 lb ai/acre -- 2 applications).

Day After Treatment	ACEPHATE			METHAMIDOPHOS		
	Calculated DFR ($\mu\text{g}/\text{cm}^2$)	S/T, S, I & H Dose (mg/kg/day)	MOE	Calculated DFR ($\mu\text{g}/\text{cm}^2$)	S/T, S, I & H Dose (mg/kg/day)	MOE
0	0.6063	0.277	43	0.02815	0.013	58
1	0.4961	0.227	53	0.02506	0.011	65
2	0.4059	0.186	65	0.02230	0.010	74
3	0.3321	0.152	79	0.01985	0.009	83
4	0.2718	0.124	97	0.01767	0.008	93
5	0.2224	0.101	118	0.01573	0.007	104

NOTE: Values rounded; calculations are based on spreadsheet analyses.

Days After Treatment (DAT). Workers wearing long pants, long sleeved shirts and no gloves.

Dislodgeable Foliar Residue (DFR) calculated by Versar using Excel® Spreadsheet and ANOVA.

S/T, S, I & H = Stake/Tie, Scout, Irrigate & Harvest

S/T, S, I & H Dose (mg/kg/day) = DFR ($\mu\text{g}/\text{cm}^2$) * Transfer Coefficient (4,000 cm^2/hr for bean harvest by hand, stake/tie, scout and irrigate) * (8 hr/work day) * (1mg/1000 μg conversion factor) \div 70 kg Body Weight.

Dermal Intermediate-term MOE = $\text{NOAEL}_{\text{dermal}} / \text{Dose}$; where $\text{NOAEL}_{\text{dermal}} = 12 \text{ mg/kg/day}$ for acephate and $\text{NOAEL}_{\text{dermal}} = 0.75 \text{ mg/kg/day}$ for methamidophos. MOE of 100 is acceptable margin of exposure.

Table 2: Post-Application Risks to Workers Following Acephate Application to Cauliflower in CA (1.0 lb ai/acre -- 2 applications).

Day After Treatment	ACEPHATE					METHAMIDOPHOS				
	Average DFR ($\mu\text{g}/\text{cm}^2$)	Scout/Irrigate Dose (mg/kg/day)	Harvest Dose (mg/kg/day)	Scout/Irr MOE	Harvest MOE	Average DFR ($\mu\text{g}/\text{cm}^2$)	Scout/Irrigate Dose (mg/kg/day)	Harvest Dose (mg/kg/day)	Scout/Irr MOE	Harvest MOE
0	0.2003	0.023	0.057	522	210	0.0029	0.00033	0.00083	2270	900

NOTE: Values rounded; calculations are based on spreadsheet analyses.

Days After Treatment (DAT). Workers wearing long pants, long sleeved shirts and no gloves.

Dislodgeable Foliar Residue (DFR) averaged from actual field measurements made following the second application.

Scout/Irrigate Dose (mg/kg/day) = DFR ($\mu\text{g}/\text{cm}^2$) * Transfer Coefficient (1,000 cm^2/hr for cauliflower scouting/irrigating) * (8 hr/work day) * (1mg/1000 μg conversion factor) \div 70 kg Body Weight.

Harvest Dose (mg/kg/day) = DFR ($\mu\text{g}/\text{cm}^2$) * Transfer Coefficient (2,500 cm^2/hr for cauliflower harvest by hand) * (8 hr/work day) * (1mg/1000 μg conversion factor) \div 70 kg Body Weight.

Dermal Intermediate-term MOE = $\text{NOAEL}_{\text{dermal}} / \text{Dose}$; where $\text{NOAEL}_{\text{dermal}} = 12 \text{ mg/kg/day}$ for acephate and $\text{NOAEL}_{\text{dermal}} = 0.75 \text{ mg/kg/day}$ for methamidophos. The respective scout/irrigate and harvest doses are used to determine the scout/irrigate and harvest MOEs. MOE of 100 is acceptable margin of exposure.

Table 3: Post-Application Risks to Workers Following Acephate Application to Greenhouse Roses in CA (2.15 lb ai/acre -- 2 applications).

Day After Treatment	ACEPHATE					METHAMIDOPHOS				
	Calculated DFR ($\mu\text{g}/\text{cm}^2$)	Sort/Pack Dose (mg/kg/day)	Prune/Harvest Dose (mg/kg/day)	Sort/Pack MOE	Prune/Harv MOE	Calculated DFR ($\mu\text{g}/\text{cm}^2$)	Sort/Pack Dose (mg/kg/day)	Prune/Harvest Dose (mg/kg/day)	Sort/Pack MOE	Prune/Harv MOE
0	1.517	0.433	1.734	28	7	0.03150	0.009	0.036	83	21
1	1.206	0.344	1.378	35	9	0.02713	0.008	0.031	97	24
2	0.9584	0.274	1.095	44	11	0.02336	0.007	0.027	112	28
3	0.7617	0.218	0.870	55	14	0.02012		0.023		33
4	0.6054	0.173	0.692	69	17	0.01732		0.020		38
5	0.4812	0.137	0.550	87	22	0.01492		0.017		44
6	0.3824	0.109	0.437	110	27	0.01284		0.015		51
7	0.3039		0.347		35	0.01106		0.013		59
8	0.2416		0.276		43	0.009523		0.011		69
9	0.1920		0.219		55	0.0082		0.009		80
10	0.1526		0.174		69	0.007061		0.008		93
11	0.1213		0.139		87	0.006081		0.007		108
12	0.09639		0.110		109					

NOTE: Values rounded; calculations are based on spreadsheet analyses.

Days After Treatment (DAT). Workers wearing long pants, long sleeved shirts and no gloves.

Dislodgeable Foliar Residue (DFR) calculated by Versar using Excel® Spreadsheet and ANOVA.

Sort/Pack Dose (mg/kg/day) = DFR ($\mu\text{g}/\text{cm}^2$) * Transfer Coefficient (2,500 cm^2/hr for roses sorting and packing) * (8 hr/work day) * (1 mg/1000 μg conversion factor) \div 70 kg Body Weight.

Prune/Harvest Dose (mg/kg/day) = DFR ($\mu\text{g}/\text{cm}^2$) * Transfer Coefficient (10,000 cm^2/hr for roses pruning and harvest by hand) * (8 hr/work day) * (1 mg/1000 μg conversion factor) \div 70 kg Body Weight.

Dermal Intermediate-term MOE = $\text{NOAEL}_{\text{dermal}} / \text{Dose}$; where $\text{NOAEL}_{\text{dermal}} = 12 \text{ mg/kg/day}$ for acephate and $\text{NOAEL}_{\text{dermal}} = 0.75 \text{ mg/kg/day}$ for methamidophos. The respective sort/pack and prune/harvest doses are used to determine the sort/pack and prune/harvest MOEs. MOE of 100 is acceptable margin of exposure.

Table 4: Post-Application Risks to Workers Following Acephate Application to Tobacco in NC (0.77 lb ai/acre -- 3 applications).

Day After Treatment	ACEPHATE					METHAMIDOPHOS				
	Calculated DFR ($\mu\text{g}/\text{cm}^2$)	S/T, S & I Dose (mg/kg/day)	Harvest Dose (mg/kg/day)	S/T, S & I MOE	Harvest MOE	Calculated DFR ($\mu\text{g}/\text{cm}^2$)	S/T, S & I Dose (mg/kg/day)	Harvest Dose (mg/kg/day)	S/T, S & I MOE	Harvest MOE
0	0.3139	0.143	0.359	84	33	0.03145	0.014	0.036	52	21
1	0.2745	0.125	0.314	96	38	0.02884	0.013	0.033	57	23
2	0.2400	0.110	0.274	109	44	0.02644	0.012	0.030	62	25
3	0.2099		0.240		50	0.02425	0.011	0.028	68	27
4	0.1836		0.210		57	0.02224	0.010	0.025	74	30
5	0.1605		0.183		65	0.02040	0.009	0.023	80	32
6	0.1404		0.160		75	0.01870	0.009	0.021	88	35
7	0.1228		0.140		86	0.01715	0.008	0.020	96	38
8	0.1074		0.123		98	0.01573	0.007	0.018	104	42
9	0.09389		0.107		112	0.01442		0.016		45
10						0.01323		0.015		50
11						0.01213		0.014		54
12						0.01112		0.013		59
13						0.01020		0.012		64
14						0.009355		0.011		70
15						0.008579		0.010		76
16						0.007867		0.009		83
17						0.007214		0.008		91
18						0.006616		0.008		99
19						0.006067		0.007		108

NOTE: Values rounded; calculations are based on spreadsheet analyses.

Days After Treatment (DAT). Workers wearing long pants, long sleeved shirts and no gloves.

Dislodgeable Foliar Residue (DFR) calculated by Versar using Excel® Spreadsheet and ANOVA.

S/T, S & I = Stake/Tie, Scout & Irrigate

S/T, S & I Dose (mg/kg/day) = DFR ($\mu\text{g}/\text{cm}^2$) * Transfer Coefficient (4,000 cm^2/hr for tobacco stake/tie, scouting & irrigating) * (8 hr/work day) * (1mg/1000 μg conversion factor) \div 70 kg Body Weight.

Harvest Dose (mg/kg/day) = DFR ($\mu\text{g}/\text{cm}^2$) * Transfer Coefficient (10,000 cm^2/hr for tobacco harvest by hand) * (8 hr/work day) * (1mg/1000 μg conversion factor) \div 70 kg Body Weight.

Dermal Intermediate-term MOE = $\text{NOAEL}_{\text{dermal}} / \text{Dose}$; where $\text{NOAEL}_{\text{dermal}} = 12 \text{ mg/kg/day}$ for acephate and $\text{NOAEL}_{\text{dermal}} = 0.75 \text{ mg/kg/day}$ for methamidophos. The respective S/T, S & I and harvest doses are used to determine the S/T, S & I and harvest MOEs. MOE of 100 is acceptable margin of exposure.

Table 5: Post-Application Risks to Workers Following Acephate Application to Turf in FL (5.0 lb ai/A -- 2 applications).

Day After Treatment	ACEPHATE					METHAMIDOPHOS				
	Average TTR ($\mu\text{g}/\text{cm}^2$)	Tractor Mow Dose (mg/kg/day)	Push-type Mow Dose (mg/kg/day)	Tractor Mow MOE	Push-type Mow MOE	Average TTR ($\mu\text{g}/\text{cm}^2$)	Tractor Mow Dose (mg/kg/day)	Push-type Mow Dose (mg/kg/day)	Tractor Mow MOE	Push-type Mow MOE
0	0.289	0.016	0.033	750	364	0.00106	0.000060	0.00012	12500	6250

NOTE: Values rounded; calculations are based on spreadsheet analyses.

Days After Treatment (DAT). Workers wearing long pants, long sleeved shirts and no gloves.

Turf Transferable Residue (TTR) averaged from actual field measurements made following the second application.

Tractor Mow Dose (mg/kg/day) = TTR ($\mu\text{g}/\text{cm}^2$) * Transfer Coefficient (500 cm^2/hr for tractor mowing) * (8 hr/work day) * (1mg/1000 μg conversion factor) \div 70 kg Body Weight.

Push-type Mow Dose (mg/kg/day) = TTR ($\mu\text{g}/\text{cm}^2$) * Transfer Coefficient (1,000 cm^2/hr for push-type mowing) * (8 hr/work day) * (1mg/1000 μg conversion factor) \div 70 kg Body Weight.

Dermal Intermediate-term MOE = $\text{NOAEL}_{\text{dermal}} / \text{Dose}$; where $\text{NOAEL}_{\text{dermal}} = 12 \text{ mg/kg/day}$ for acephate and $\text{NOAEL}_{\text{dermal}} = 0.75 \text{ mg/kg/day}$ for methamidophos. The respective tractor mow and push-type mow doses are used to determine the tractor mow and push-type mow MOEs. MOE of 100 is acceptable margin of exposure.

Table 5 (continued): Post-Application Risks to Workers Following Acephate Application to Turf in FL (5.0 lb ai/A -- 2 applications).

Day After Treatment	ACEPHATE			METHAMIDOPHOS		
	Average TTR ($\mu\text{g}/\text{cm}^2$)	Harvest Dose (mg/kg/day)	MOE	Average TTR ($\mu\text{g}/\text{cm}^2$)	Harvest Dose (mg/kg/day)	MOE
0	0.289	0.33	36	0.00106	0.0012	625
1	0.0391	0.045	267			

NOTE: Values rounded; calculations are based on spreadsheet analyses.

Days After Treatment (DAT). Workers wearing long pants, long sleeved shirts and no gloves.

Turf Transferable Residue (TTR) averaged from actual field measurements made following the second application.

Harvest Dose (mg/kg/day) = TTR ($\mu\text{g}/\text{cm}^2$) * Transfer Coefficient (10,000 cm^2/hr for sod harvesting) * (8 hr/work day) * (1mg/1000 μg conversion factor) \div 70 kg Body Weight.

Dermal Intermediate-term MOE = $\text{NOAEL}_{\text{dermal}} / \text{Dose}$; where $\text{NOAEL}_{\text{dermal}} = 12 \text{ mg/kg/day}$ for acephate and $\text{NOAEL}_{\text{dermal}} = 0.75 \text{ mg/kg/day}$ for methamidophos. MOE of 100 is acceptable margin of exposure.

APPENDIX C

**ACEPHATE NON-OCCUPATIONAL (RESIDENTIAL)
EXPOSURE AND RISK ASSESSMENT TABLES
(SHORT-TERM EXPOSURES)**

Table 1: Numerical Inputs for Non-Occupational (Residential) Handler Exposure to Acephate.

Exposure Scenario	Application Rate ^a (lb ai/A or lb ai/gallons where noted)	Treated Area ^b (A/day or gallons/day where noted)	Residential Unit Values	
			Dermal ^c (mg / lb ai handled)	Inhalation ^d (μ g / lb ai handled)
Residential Exposure				
(1) Mixing/Loading/Applying Wettable Powder Using a Low Pressure Hand Wand	Ornamentals, Flowers, Shrubs, Trees, Fire Ants = 0.023 lb / gal	2 gallons	250	1100
	Turf = 0.035 lb / gal	2 gallons	250	1100
	Roses, Flowers, Shrubs, Trees = 0.0076 lb / gal (LUIS)	2 gallons	250	1100
(2) Mixing/Loading/Applying Using a Backpack Sprayer	Ornamentals, Flowers, Shrubs, Trees, Fire Ants = 0.023 lb (4.5 grams) / gal	2 gallons	5.1	30
	Turf = 0.035 lb / gal	2 gallons	5.1	30
	Roses, Flowers, Shrubs, Trees = 0.0076 lb / gal (LUIS)	2 gallons	5.1	30
(3a) Mixing/Loading/Applying Using a Hose-End Sprayer	Ornamentals, Flowers, Shrubs, Trees = 0.023 lb / gal	50 gallons	30	9.5
	Turf = 0.035 lb / gal	50 gallons	30	9.5
	Roses, Flowers, Shrubs, Trees = 0.0076 lb / gal (LUIS)	50 gallons	30	9.5
	Shade Trees = 0.013 lb / gal (LUIS)	50 gallons	30	9.5
	Ornamentals and Turf = 0.058 lb / 1000 sq ft (LUIS)	20,000 sq ft (0.5 A)	30	9.5
(3b) Mixing/Loading/Applying Using a Hose-End Sprayer [MRID # 405048-27]	Shrubbery = 0.01175 lb / gal	50 gallons	480	150
(4) Mixing/Loading/Applying Using a Sprinkling Can	Ornamentals, Flowers, Shrubs, Trees, Fire Ants = 0.023 lb / gal	5 gallons	30	9.5
	Turf = 0.035 lb / gal	5 gallons	30	9.5
	Roses, Flowers, Shrubs, Trees = 0.0076 lb / gal (LUIS)	5 gallons	30	9.5

Exposure Scenario	Application Rate ^a (lb ai/A or lb ai/gallons where noted)	Treated Area ^b (A/day or gallons/day where noted)	Residential Unit Values	
			Dermal ^c (mg / lb ai handled)	Inhalation ^d (μ g / lb ai handled)
(5) Loading/Applying Soluble Powder (dry) Concentrate by Hand/Handtool/Shaker Can	Fire Ants = 0.0069 lb / mound	7 mounds	430	470
(6) Loading/Applying Granules by Shaker Can (NOTE: Label #239-2472 specifies 3 shaker cups of 1.5% / 25 sq ft; 0.5 lb/1000 sq ft used as per registrant)	Ornamentals = 0.5 lb / 1000 sq ft	100 sq ft	430	470
	Roses = 0.1125 lb / 1000 sq ft	5 sq ft / rose; 20 roses	430	470
(7) Applying by Aerosol Can	Crack & Crevice = 0.01 lb / can	2 cans (32 oz)	220	2400
	Ornamentals = 0.03 lb / can	2 cans (32 oz)	220	2400

- a Application rates are values found on currently registered labels, through Agency sources (LUIS) and from information provided by the registrant.
- b Amounts of acreage treated per day are from the HED estimates of acreage that could be treated in a single day for each exposure scenario of concern, through other Agency sources (LUIS) and from information provided by the registrant.
- c Baseline dermal unit exposure represents an individual's estimated exposure while wearing short pants, short sleeved shirt, no gloves, open mixing/loading.
- d Baseline inhalation unit exposure represents no use of a respirator.

Table 2: Exposure and Risks for Non-Occupational (Residential) Handlers of Acephate.

RESIDENTIAL Exposure Scenario	Application Rate (lb ai/A or lb ai/gallons where noted)	Treated Area (A/day or gallons where noted)	Daily Exposure (mg/day) ^a		Absorbed Daily Dose (mg/kg/day) ^b		Separate MOEs ^c		Combined MOEs ^d
			Dermal	Inhalation	Dermal	Inhalation	Dermal	Inhalation	
Residential Exposure									
(1) Mixing/Loading/Applying Wettable Powder Using a Low Pressure Hand Wand	Ornamentals, Flowers, Shrubs, Trees, Fire Ants = 0.023 lb / gal	2 gallons	12	0.051	0.17	0.00073	70	190	53
	Turf = 0.035 lb / gal	2 gallons	18	0.077	0.26	0.0011	46	130	33
	Roses, Flowers, Shrubs, Trees = 0.0076 lb / gal (LUIS)	2 gallons	3.8	0.017	0.054	0.00024	220	580	160
(2) Mixing/Loading/Applying Using a Backpack Sprayer	Ornamentals, Flowers, Shrubs, Trees, Fire Ants = 0.023 lb (4.5 grams) / gal	2 gallons	0.23	0.0014	0.0033	0.00002	3600	7000	2400
	Turf = 0.035 lb / gal	2 gallons	0.36	0.0021	0.0051	0.00003	2400	4700	1600
	Roses, Flowers, Shrubs, Trees = 0.0076 lb / gal (LUIS)	2 gallons	0.078	0.00046	0.0011	0.0000065	11000	22000	7100
(3a) Mixing/Loading/Applying Using a Hose-End Sprayer	Ornamentals, Flowers, Shrubs, Trees = 0.023 lb / gal	50 gallons	35	0.011	0.50	0.00016	24	880	23
	Turf = 0.035 lb / gal	50 gallons	53	0.017	0.76	0.00024	16	580	16
	Roses, Flowers, Shrubs, Trees = 0.0076 lb / gal (LUIS)	50 gallons	11	0.0036	0.16	0.000051	75	2700	73
	Shade Trees = 0.013 lb / gal (LUIS)	50 gallons	20	0.0062	0.29	0.000088	41	1600	40
	Ornamentals and Turf = 0.058 lb / 1000 sq ft (LUIS)	20,000 sq ft (0.5 A)	35	0.011	0.50	0.00016	24	880	23

RESIDENTIAL Exposure Scenario	Application Rate (lb ai/A or lb ai/gallons where noted)	Treated Area (A/day or gallons where noted)	Daily Exposure (mg/day) ^a		Absorbed Daily Dose (mg/kg/day) ^b		Separate MOEs ^c		Combined MOEs ^d
			Dermal	Inhalation	Dermal	Inhalation	Dermal	Inhalation	
(3b) Mixing/Loading/Applying Using a Hose-End Sprayer [MRID # 405048-27]	Shrubbery = 0.01175 lb / gal	50 gallons	280	0.088	4.0	0.0012	3.0	120	2.9
(4) Mixing/Loading/Applying Using Sprinkling Can	Ornamentals, Flowers, Shrubs, Trees, Fire Ants = 0.023 lb / gal	5 gallons	3.5	0.0011	0.05	0.000016	240	8800	230
	Turf = 0.035 lb / gal	5 gallons	5.3	0.0017	0.076	0.000024	160	5800	160
	Roses, Flowers, Shrubs, Trees = 0.0076 lb / gal (LUIS)	5 gallons	1.1	0.00036	0.016	0.0000051	750	27000	730
(5) Loading/Applying Soluble Powder (dry) Concentrate by Hand/Handtool/Shaker Can	Fire Ants = 0.0069 lb / mound	7 mounds	21	0.022	0.30	0.00031	40	450	37
(6) Loading/Applying Granules by Shaker Can (NOTE: Label #239-2472 specifies 3 shaker cups of 1.5% / 25 sq ft; 0.5 lb/1000 sq ft used as per registrant)	Ornamentals = 0.5 lb / 1000 sq ft	100 sq ft	22	0.024	0.31	0.00034	39	410	36
	Roses = 0.5 lb / 1000 sq ft	5 sq ft / rose; 20 roses	22	0.024	0.31	0.00034	39	410	36
(7) Applying by Aerosol Can	Crack & Crevice = 0.01 lb / can	2 cans (32 oz)	4.4	0.048	0.063	0.00069	190	200	97
	Ornamentals = 0.03 lb / can	2 cans (32 oz)	13	0.14	0.19	0.002	63	70	33

a Daily Exposure (mg/day) = Application Rate (lb ai/A or lb ai/gallon) * Treated Area (A/day or gallons/day) * Unit Exposure Value (mg or μ g exposure/ lb ai handled) * [1mg/1000 μ g (conversion factor if necessary)].

b Absorbed Daily Dose (mg/kg/day) = Daily Exposure (mg/day) * Absorption (1) \div Body Weight (70kg).

c MOE (unitless) = NOAEL (mg/kg/day) \div Absorbed Daily Dose (mg/kg/day). Where NOAEL_{dermal} = 12 mg/kg/day and NOAEL_{inhalation} = 0.14 mg/kg/day.

d Combined MOEs =

$$\frac{1}{\left(\frac{1}{\text{MOE}_{\text{derm}}} + \frac{1}{\text{MOE}_{\text{inh}}}\right)}$$

MOE of 100 is an acceptable margin of exposure.

Table 3: Non-Occupational (Residential) Exposure Scenario Descriptions for the Use of Acephate

Exposure Scenario (Number)	Data Source	Standard Assumptions ^a	Comments ^{b,c}
(1) Mixing/Loading /Applying Wettable Powder Using a Low Pressure Hand Wand	PHED V1.1	2 gallons (per registrant; label modification required to reflect such)	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.
(2) Mixing /Loading/Applying Using a Backpack Sprayer	PHED V1.1	2 gallons (per registrant; label modification required to reflect such)	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.
(3a) Mixing/Loading/Applying Using a Hose-End Sprayer	PHED V1.1	50 gallons of spray solution and 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.
(3b) Mixing/Loading/Applying Using a Hose-End Sprayer	MRID # 405048-27	50 gallons	5 replicates
(4) Mixing/ Loading /Applying Using Sprinkling Can	PHED V1.1	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.
(5) Loading/Applying Soluble Powder (dry) Concentrate by Hand/Handtool/Shaker Can	PHED V1.1	7 mounds	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.
(6) Loading/Applying Granules by Shaker Can	PHED V1.1	100 sq ft and 5 sq ft/rose for 20 roses NOTE: Label #239-2472 specifies 3 shaker cups of 1.5% / 25 sq ft; 0.5 lb/1000 sq ft used as per registrant; label modification required to reflect such	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.
(7) Applying By Aerosol Can	PHED V1.1	2 cans (32 oz.)	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. Accounting for the use of PPE is not considered appropriate in residential risk assessments, as the Agency can only make recommendations to residential handlers regarding the use of PPE.

Table 4: Post-Application Risks to Public Following Acephate Application to Turf in FL (5.0 lb ai/A – 2 applications) [ACEPHATE].

Scenario	Exposed Individual	Application Rate Per Treatment (AR) (lb ai/A) ^a	DFR (ug/cm ²) ^b	GRt (ug/cm ²) ^c	SRt (ug/g) ^d	Transfer Coefficient (Tc) (cm ² /hr)	Exposure Time (ET) (hrs/day)	Dermal Abs. (%)	Surface Area (SA) (cm ² /event)	Freq. (FQ) (events/hr)	IgR (cm ² /day) or (mg/day) ^e	BW (kg)	ADD (mg/kg/day)	MOE ^f
Dermal exposure	Adult	3.5	0.20	-	-	43,000	2	100	-	-	-	70	0.24	50
	Child					8,700								
Hand-to-Mouth	Child	3.5	0.20	-	-	-	2	-	350	1.56	-	15	0.014	36
Turfgrass ingestion	Child	3.5	-	7.8	-	-	-	-	-	-	25	15	0.013	38
Incidental soil ingestion	Child	3.5	-	-	21	-	-	-	-	-	100	15	0.00014	3600

a Maximum application rate for residential turf = 3.5 lb ai/acre.

b Dislodgeable foliar residue = $0.289 \text{ ug/cm}^2 * 3.5 / 5.0$ (ratio of application rates) = 0.20 ug/cm^2 ; Turf Transferable Residue (TTR) averaged from actual field measurements made following the second application of registrant's study and corrected for application rate of 3.5 lb ai/A.

c Grass residue (ug/cm²) = [AR (lb ai/A) * fraction ai retained on foliage (20%) * $4.54\text{E}+8 \text{ ug/lb} * 2.47\text{E}-8 \text{ A/cm}^2$] = 7.8 ug/cm^2 .

d Soil residue (ug/g soil) = [AR (lb ai/A) * fraction ai not retained on foliage (80%) * $4.54\text{E}+8 \text{ ug/lb} * 2.47\text{E}-8 \text{ A/cm}^2 * 0.67 \text{ cm}^3/\text{g soil}$] = 21 ug/g soil .

e Ingestion rate: cm²/day for grass ingestion, and mg/day for incidental soil ingestion.

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

Dermal exposure: = [DFR (ug/cm²) * Tc (cm²/hr) * mg/1,000 ug * ET (hrs/day) * absorption factor (1.0)] / [BW (kg)];
 Hand-to-mouth: = [DFR (ug/cm²) * SA (cm²/event) * FQ (events/hr) * mg/1,000 ug * ET (2 hrs/day)] / [BW (kg)];
 Turfgrass ingestion: = [GRt (ug/cm²) * IgR (cm²/day) * mg/1,000 ug] / [BW (kg)]; and
 Incidental soil ingestion: = [SRt (ug/g) * IgR (mg/day) * g/1,000,000 ug] / [BW (kg)].

g MOE = NOAEL / ADD where acephate NOAEL_{dermal} = 12 mg/kg/day and acephate NOAEL_{oral} = 0.5 mg/kg/day; the dermal NOAEL is used to calculate the dermal MOE and the acute oral NOAEL is used to calculate the hand-to-mouth, turfgrass ingestion and incidental soil ingestion MOEs. MOE of 100 is an acceptable margin of exposure.

Table 5: Post-Application Risks to Public Following Acephate Application to Turf in FL (5.0 lb ai/A – 2 applications) [METHAMIDOPHOS].

Scenario	Exposed Individual	Application Rate Per Treatment (AR) (lb ai/A) ^a	DFR (ug/cm ²) ^b	GRt (ug/cm ²) ^c	SRt (ug/g) ^d	Transfer Coefficient (Tc) (cm ² /hr)	Exposure Time (ET) (hrs/day)	Dermal Abs. (%)	Surface Area (SA) (cm ² /event)	Freq. (FQ) (events/hr)	IgR (cm ² /day) or (mg/day) ^e	BW (kg)	ADD (mg/kg/day)	MOE ^f
Dermal exposure	Adult	0.013 (3.5 lb ai/A acephate)	0.00074	-	-	43,000	2	100	-	-	-	70	0.00091	820
	Child					8,700						15	0.00086	870
Hand-to-Mouth	Child	0.013 (3.5 lb ai/A acephate)	0.00074	-	-	-	2	-	350	1.56	-	15	0.000054	5600
Turfgrass ingestion	Child	0.013 (3.5 lb ai/A acephate)	-	0.029	-	-	-	-	-	-	25	15	0.000048	6200
Incidental soil ingestion	Child	0.013 (3.5 lb ai/A acephate)	-	-	0.078	-	-	-	-	-	100	15	0.0000005	600000

- a Maximum application rate for residential turf = 3.5 lb ai/acre acephate * 0.00106 / 0.289 (ratio of methamidophos to acephate TTRs) = 0.013 lb ai/acre methamidophos.
- b Dislodgeable foliar residue = 0.00106 ug/cm² * 3.5 / 5.0 (ratio of application rates) = 0.00074 ug/cm²; Turf Transferable Residue (TTR) averaged from actual field measurements made following the second application of registrant's study and corrected for application rate of 3.5 lb ai/A.
- c Grass residue (ug/cm²) = [AR (lb ai/A) * fraction ai retained on foliage (20%) * 4.54E+8 ug/lb * 2.47E-8 A/cm²] = 0.029 ug/cm².
- d Soil residue (ug/g soil) = [AR (lb ai/A) * fraction ai not retained on foliage (80%) * 4.54E+8 ug/lb * 2.47E-8 A/cm² * 0.67 cm³/g soil] = 0.078 ug/g soil.
- e Ingestion rate: cm²/day for grass ingestion, and mg/day for incidental soil ingestion.
- f Average daily dose (ADD) (mg/kg/day)
- Dermal exposure: = [DFR (ug/cm²) * Tc (cm²/hr) * mg/1,000 ug * ET (hrs/day) * absorption factor (1.0)] / [BW (kg)];
- Hand-to-mouth: = [DFR (ug/cm²) * SA (cm²/event) * FQ (events/hr) * mg/1,000 ug * ET (2 hrs/day)] / [BW (kg)];
- Turfgrass ingestion: = [GRt (ug/cm²) * IgR (cm²/day) * mg/1,000 ug] / [BW (kg)]; and
- Incidental soil ingestion: = [SRt (ug/g) * IgR (mg/day) * g/1,000,000 ug] / [BW (kg)].
- g MOE = NOAEL / ADD where methamidophos NOAEL_{dermal} = 0.75 mg/kg/day and NOAEL_{oral} = 0.3 mg/kg/day; the dermal NOAEL is used to calculate the dermal MOE and the acute oral NOAEL is used to calculate the hand-to-mouth, turfgrass ingestion and incidental soil ingestion MOEs. MOE of 300 is an acceptable margin of exposure.

APPENDIX D**ACEPHATE NON-OCCUPATIONAL (RECREATIONAL)
EXPOSURE AND RISK ASSESSMENT TABLES
(SHORT-TERM EXPOSURES)**

Table 1: Non-Occupational Risk Assessment for Adult Golfers Following Acephate Application to Turf in FL (5.0 lb ai/A -- 2 applications).

Day After Treatment	ACEPHATE			METHAMIDOPHOS		
	Average TTR ($\mu\text{g}/\text{cm}^2$)	Adult Golfer Dose (mg/kg/day)	MOE	Average TTR ($\mu\text{g}/\text{cm}^2$)	Adult Golfer Dose (mg/kg/day)	MOE
0	0.289	0.0016	7500	0.00106	0.000006	125000

NOTE: Values rounded; calculations are based on spreadsheet analyses.

Days After Treatment (DAT). It is assumed that golfers are wearing long pants, long sleeved shirts and no gloves.

Turf Transferable Residue (TTR) averaged from actual field measurements made following the second application.

Adult Golfer Dose (mg/kg/day) = TTR ($\mu\text{g}/\text{cm}^2$) * Transfer Coefficient (100 cm^2/hr for golfing) * (4 hr/day) * (1mg/1000 μg conversion factor) \div 70 kg Body Weight.

NOTE: this does not include possible hand-to-mouth exposures.

Dermal Short-term MOE = $\text{NOAEL}_{\text{dermal}} / \text{Dose}$; where $\text{NOAEL}_{\text{dermal}} = 12 \text{ mg/kg/day}$ for acephate and $\text{NOAEL}_{\text{dermal}} = 0.75 \text{ mg/kg/day}$ for methamidophos. MOE of 100 is acceptable margin of exposure.

Table 2: Non-Occupational Risk Assessment for 13+ Year-Old Golfers Following Acephate Application to Turf in FL (5.0 lb ai/A -- 2 applications).

Day After Treatment	ACEPHATE			METHAMIDOPHOS		
	Average DFR ($\mu\text{g}/\text{cm}^2$)	13+ Golfer Dose (mg/kg/day)	MOE	Average DFR ($\mu\text{g}/\text{cm}^2$)	13+ Golfer Dose (mg/kg/day)	MOE
0	0.289	0.0026	4620	0.00106	0.0000096	78100

NOTE: Values rounded; calculations are based on spreadsheet analyses.

Days After Treatment (DAT). It was assumed that children golfers are wearing long pants, long sleeved shirts and no gloves.

Turf Transferable Residue (TTR) averaged from actual field measurements made following the second application.

13+ Year-Old Golfer Dose (mg/kg/day) = TTR ($\mu\text{g}/\text{cm}^2$) * Transfer Coefficient (100 cm^2/hr for golfing) * (4 hr/day) * (1mg/1000 μg conversion factor) \div 44 kg Body Weight. NOTE: this does not include possible hand-to-mouth exposures.

Dermal Short-term MOE = $\text{NOAEL}_{\text{dermal}} / \text{Dose}$; where $\text{NOAEL}_{\text{dermal}} = 12 \text{ mg/kg/day}$ for acephate and $\text{NOAEL}_{\text{dermal}} = 0.75 \text{ mg/kg/day}$ for methamidophos. MOE of 100 is acceptable margin of exposure.

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