TITLE

FMC's Response to
EPA's Carbofuran Interim
Reregistration Eligibility Decision (IRED)
(Docket ID#: EPA-HQ-OPP-2005-0162)

REQUIREMENT

Not applicable

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STATEMENT OF NO DATA CONFIDENTIALITY CLAIMS

No claim of confidentiality is made for any information contained in this study on the basis of its falling within the scope of FIFRA §10 (d) (1) (A), (B), or (C).

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GOOD LABORATORY PRACTICE COMPLIANCE STATEMENT

This FMC response to the US EPA's document titled "**Interim Reregistration Eligibility Decision: Carbofuran.**" dated August 3, 2006, presented herein is not subject to the principles of 40 CFR 160, GOOD LABORATORY PRACTICE STANDARDS (FIFRA).

Jm Carlson — 11/30/06

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I. EXECUTIVE SUMMARY

FMC Corporation appreciates the opportunity to respond to EPA's Interim Reregistration Eligibility Decision (IRED) for carbofuran, which issued in August of 2006. FMC strongly disagrees with EPA's assessment of carbofuran and the Agency's proposed cancellation of all registrations. Carbofuran is a critically important, but limited-use pesticide for feed and food production pest control that does not pose unacceptable risks to human health or the environment. The Agency continues to fail to account for carbofuran's niche-market nature, its value as a resistance management tool, its limited use profile with commensurate limited risks, and the substantial benefits that this product provides in those markets where it is used.

EPA's benefits analyses and assessments of alternatives dramatically understate the benefits associated with Carbofuran.

- Information provided by FMC, University Extension Specialists, individual growers and crop consultants establishes that carbofuran is a critically important niche product in a number of key crop segments including, corn rootworm rescue, aphid control in cotton, and stalk borer pest control in sunflowers.
    - Carbofuran's niche use patterns limit the scope and scale of carbofuran use, as well as exposure to humans and the environment, which necessarily limits the product's risks.
- The EPA downplays the critical role carbofuran plays in pesticide resistance management programs generally, and with respect to particularly persistent pests, such as the Colorado potato beetle and the cotton aphid.
- The EPA ignores the significant additional costs to growers forced to find substitutes for carbofuran, from both product cost and agronomic perspectives.

EPA's dietary risk assessment dramatically overstates potential risks from carbofuran.

- The available data do not support application of a 5X database uncertainty factor to account for the alleged increased sensitivity of red blood cell (RBC) cholinesterase (ChE) inhibition as compared to brain ChE inhibition.
    - EPA's conclusion that RBC ChE inhibition is more sensitive than brain ChE inhibition to carbofuran is principally an artifact of the absence of brain ChE data in the FMC time-course study. Moreover, the three studies relied on by EPA employed study designs and test methods not intended for toxicity endpoint determinations, which likely led to differences in dose response and patterns of response over time. Therefore, the conclusions reached by EPA using these studies together were flawed, and an inappropriate basis for risk assessment.

- Notwithstanding EPA's current default of a BMDL10 (lower 95% interval Benchmark Dose for 10% response) for both brain and RBC ChE inhibition, there are indications in the database that RBC ChE inhibition cannot be reliably measured at a 10% inhibition level.

- The approach taken by EPA is fundamentally inconsistent with EPA's conclusions in the carbamate cumulative risk assessment, in which EPA concluded that brain and RBC ChE inhibition are similar, and "thus, brain ChE inhibition data provide a health protective endpoint."[1] In the carbamate cumulative risk assessment, EPA chose to use BMD_{10} estimates based on brain ChE inhibition rather than BMD10 estimates using RBC ChE inhibition because brain ChE inhibition data have tighter confidence intervals, and therefore will confer less uncertainty.[2] Also "brain ChE inhibition represents a direct measure of the common mechanism of toxicity as opposed to using surrogate measures."[3]

- At a June 16 meeting with FMC, EPA scientists agreed with the above assessment regarding defects in EPA's ChE inhibition analysis, but then advanced two entirely new rationales for the 5X UF: (1) FMC's Comparative Cholinesterase Assay (CCA) study might have missed the time of peak effect; and (2) the $BMDL_{10}$ calculated from the CCA study might not be sufficiently protective against adverse effects. Scientifically, both of these concerns are weak since the CCA study's first sampling was at the shortest feasible time point,[4] and the $BMDL_{10}$ calculation is a very conservative extrapolation from real data points. While FMC believes these new issues with its prior CCA study to be without merit, FMC nonetheless is conducting a new CCA study to address these concerns. It would be inappropriate for EPA to finalize its assessment of carbofuran until that study is completed.

- EPA should apply a 1X uncertainty factor to extrapolate from animals to humans because carbofuran has a confirmatory human study that supports what is predicted by evolutionary and enzyme kinetic information – that other mammals and humans tend to be equally sensitive to ChE inhibition. Indeed, based on human evidence, EPA concluded in its Weight of the Evidence Presentation for carbofuran that the appropriate interspecies uncertainty factor is 1X.

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1 United States Environmental Protection Agency. 2005. Preliminary n-methyl carbamate cumulative risk assessment. Office of Pesticide Programs, Washington D.C., Section I.B., page 46, *available at* http:// www.epa.gov/scipoly/sap/ index.htm#sept.

2 *Id.*

3 *Id.*

4 The first testing point for FMC's CCA study was 15 minutes.

- Now, however, EPA rejects any consideration of FMC's confirmatory human study based on an unlawful Human Studies Review Board (HSRB) assessment of that study. Specifically, EPA improperly recused two members of the HSRB from participating in the Board's consideration of the carbofuran human studies – even though there was no basis for this recusal under the government ethics regulations. This improper recusal prejudiced FMC's right to fair consideration of the human studies. Therefore, it is improper for EPA to rely on the HSRB report unless and until this violation is rectified.

EPA has overstated the potential risks to workers from exposure to carbofuran.

- EPA's point of departure for the occupational risk benchmark is overly conservative. The point of departure (POD) of 0.01 mg/kg is lower than the POD for dietary risk assessment in children (0.03 mg/kg). It defies logic to have a lower POD for healthy adult workers than is used for a sensitive subpopulation such as children. In addition, a 10X interspecies uncertainty factor is unnecessary and inappropriate for the reasons described above.

- EPA improperly declined to use FMC's valid, 21-day dermal study in rabbits to evaluate risks to workers from dermal exposure to carbofuran, based on the Agency's unsupported vague "belief" that carbofuran is more toxic than this study showed and the mistaken belief that cholinesterase determinations had not been made. Notwithstanding our disagreement with this decision, FMC is conducting a new 21-day dermal study in rats to confirm the results of the rabbit study, and to provide an appropriate basis for determining occupational risks to carbofuran. EPA should defer issuing the RED until FMC has had an opportunity to complete and submit this study.

- EPA should not have retained a 6% dermal absorption factor for assessing occupational exposure. The 1987 Shah, *et al.* study, on which EPA relied, applied a methodology that almost certainly significantly overestimates carbofuran dermal absorption, as reliable-EPA-guideline study data confirm that carbofuran has extremely low dermal absorption. At most, EPA should have used the Shah study to extrapolate an 8-hour dermal absorption factor (3.5%), rather than use the 24-hour value.

- Use of a more realistic and appropriate set of assumptions will show that carbofuran has acceptable worker risk.

EPA's drinking water assessment for carbofuran fails to take into account carbofuran's limited usage as a niche product and produces estimated drinking water exposures that do not comport with reality.

- EPA has rigidly applied its standard water modeling techniques to carbofuran and thereby failed to account for carbofuran's limited usage as a niche product,

resulting in drinking water exposure estimates that simply do not comport with reality. EPA did not consider more realistic models provided by FMC. Modeling results were not compared to reality, despite the extensive water monitoring database available for carbofuran.

- A more appropriate approach for niche pesticides is to account for the percent of the crop acreage that is actually treated with the pesticide, by incorporating percent crop treated (PCT) into EPA's screening level models. The WARP data provided by FMC confirm that EPA's modeling dramatically overstates real-world carbofuran concentrations, and further confirms that use of the PCT approach results in appropriately conservative, but more realistic results than EPA's modeling. In fact, real-world levels of carbofuran measured from large scale monitoring programs, as well as from public drinking water supplies, are consistent with FMC's model predictions, which are significantly lower than levels predicted by EPA's less refined modeling.

- Additionally, EPA's drinking water assessment does not incorporate significant mitigation measures that FMC has implemented over the years on the carbofuran label that reduce risk concerns, including: 1) significantly reducing, and in some circumstances prohibiting, applications to vulnerable soils (> 90% sand, < 1% organic matter (OM), with a shallow water table (< 30 feet)); 2) reduction in labeled application rates; 3) reduction in the number of applications per season; 4) express prohibitions against the application of carbofuran or the disposal of equipment wash water or rinsate into water bodies; and, 5) voluntary geographical restrictions for the potato use which totally eliminated at-plant applications in the more vulnerable potato growing areas east of the Mississippi River.

- EPA's position that drinking water exposures to carbofuran exceed acceptable risk levels is an artifact of the Agency's overly conservative estimation of the human health benchmark for carbofuran. Use of more reasonable and appropriate uncertainty factors would result in no exceedance of the risk cup from carbofuran drinking water exposures.

EPA has overstated the environmental risks of carbofuran

Avian

- EPA has grossly overstated the avian risks associated with current uses of flowable carbofuran. The limited quantity of active ingredient applied annually, coupled with carbofuran's niche usage pattern, mean that *actual risks* to birds – as opposed to hazards – are extremely low.

- The Agency rejected FMC's alternative probabilistic assessments and retained multiple overly conservative assumptions, rendering the overall avian assessment highly suspect and scientifically unjustified.

- EPA's probabilistic risk assessment (PRA) employs assumptions that are both unlikely and overly conservative, rendering the assessment of carbofuran utterly unrealistic, including:

  - Assuming that all of a bird's diet and all of a bird's water contains carbofuran at the maximum residue levels.

  - Assuming that every avian species potentially consuming carbofuran was as sensitive as the most sensitive species in any test, notwithstanding the fact that the available database shows a significant range in sensitivities.

  - Using the LD_{50} (single, bolus dose) rather than the LC_{50} (dietary exposure) in the assessment, even though an LC_{50} is far more representative of actual avian feeding behavior from a flowable product, and therefore exposure to carbofuran.

  - Assuming that two very short feeding windows occur for all birds, both of which resemble a gorging scenario that is not representative of the actual feeding patterns of the species that are found in and around agricultural fields where carbofuran might be applied.

  - Assuming that census data of unmarked birds can be used to represent how much time individual birds spend on treated fields. Census results provide no information on how much time individual birds spend on the fields, and therefore, cannot be used to predict what proportion of daily food and water intake of individual birds is obtained from the treated fields.

  - Assuming that birds exposed to sublethal doses of carbofuran, who experience sublethal toxicity, will return to feed in the treated field and ingest additional doses that result in mortality. Studies show that once a bird ingests a sufficient dose to elicit sublethal toxicity, those birds are unlikely to continue to feed until they recover from that dose.

  - Using inaccurate assumptions about the half-life and physical characteristics of carbofuran in soil and water, further compounding the overly conservative nature of its assessment.

  - Failing to attempt to correlate how its modeled results, which are based on species that use the crops selected by the Agency, relate to the majority of the species that do not make such extensive use of those crop fields.

  - Rejecting monitoring study data that covered almost 37,000 acres in 7 states and which demonstrated *no* adverse effects on birds arising from carbofuran under normal use.

- EPA's analysis does not separate exposure incidents associated with infrequent labeled uses from illegal uses or misuses.

- EPA's model fails to capture the reversibility of ChE inhibition on toxicity.

Terrestrial Mammals

- EPA's deterministic risk assessment employs assumptions that are both unlikely and overly conservative, rendering the assessment of carbofuran's risk to mammals completely unrealistic, including:

    - Assuming that small mammals consume a diet that consists entirely of feed items containing maximum estimated pesticide residues over the duration of the short-term and long-term exposure periods.

    - Assuming small mammals ingest only the types of feed items (primarily plant feed items) included in the modified Hoerger and Kenaga nomogram.

    - Assuming small mammals consume a diet consisting entirely of a single type of feed item containing maximum residues.

    - Assuming small and large insects contain initial pesticide residues equivalent to those found on leaf foliage and forage, or seed and fruits, respectively.

    - Assuming no degradation of the applied pesticide occurs over the short-term exposure period.

    - Assuming carbofuran is always applied at the maximum label rate, over multiple application scenarios, at the maximum number of applications permitted with the minimum interval in between applications.

Aquatic

- EPA employed cascading tiers of overly conservative assumptions in its modeling for carbofuran, which, taken together, result in estimated carbofuran concentrations that are implausible for the vast majority of water bodies. For example:

    - Assuming the receiving water directly abuts the treated field (no buffer at all), notwithstanding the fact that a GIS study that was conducted in the area of Mississippi where EPA's standard cotton scenario is located, determined that very few, if any, small farm ponds (or other water bodies) actually satisfy this key model assumption.

- Assuming carbofuran is applied at the maximum label rate for a given crop type to the entire watershed, which is 10 times the area of the pond and assuming the maximum number of applications per season and the minimum interval between applications.

- Assuming the soil type and field slope are such that "site vulnerability was at the high end for the crop and carbofuran use scenario . . . to produce runoff greater than would be expected at 90% of the sites for a given crop/use."

- Assuming there is no inflow to or outflow from the pond, no precipitation input, and no water loss by evaporation.

- Assuming the pond receives all the carbofuran contained in runoff from the treated field, rather than allowing for watershed dilution.

- Assuming that carbofuran instantaneously and homogenously mixes throughout the entire pond, such that there is no "safe zone" in the pond with lower pesticide concentrations.

- Assuming runoff from the entire treated field reaches the pond, but that none of the runoff water actually does.

- Assuming all water bodies – no matter where located – have a pH of 7, even though marine, estuarine and hard freshwater bodies typically will have pHs in the 7.7 to 8.4 range where carbofuran degrades far more rapidly.

- Failure to use actual field water data, which happens to support FMC's model and is significantly lower than predicted by EPA's model.

- Although EPA claims to have conducted a refined, probabilistic assessment for aquatic organisms, it appears that the Agency did not modify any of its overly conservative assumptions, resulting in an allegedly "probabilistic" assessment that bears no relation to actual risks to aquatic ecosystems.

- The use of overly conservative assumptions and inputs in a compounding fashion has led to an unreasonable and unrealistic prediction of risk by the EPA that is not confirmed by field incident data.

EPA has made unsupported assertions about the risks associated with the remaining uses of granular carbofuran.

- The IRED does not contain a new risk assessment for the granular formulation of carbofuran, EPA merely extrapolated from prior risk assessments based on uses no longer on the carbofuran label, even though previous granular carbofuran

assessments have indicated widely varying potential exposure and risks depending on the use pattern, which argues against extrapolation.

- The annual sales of the granular formulation are capped at 2,500 pounds per year per a settlement with EPA, and are limited to specific crop types and application rates. In spite of these significant changes to both the scale and scope of the granular carbofuran use patterns, EPA made no effort to update its granular risk assessment.

- Additionally, field data do not support the linear relationship between application rate and theoretical risk hypothesized by EPA. Actual data indicate that the risks associated with the granular formulation bear no clear relationship to the EPA's simplistic LD_{50} per square foot risk index. By failing to capture the variation in the risks associated with different uses, EPA's model overstates the potential risks associated with current uses.

- EPA's analysis fails to acknowledge that the remaining uses are within the FQPA risk cup for carbofuran.

- Similarly the EPA's analysis ignores the fact that granular carbofuran does not present a significant exposure risk to workers because of the physical characteristics of the formulation.

- EPA's regulatory decision with respect to granular carbofuran ignores the continuing benefits, expressly noted in the IRED, associated with the granular formulation.

For the foregoing reasons and as described in more detail below, FMC believes that EPA's assessment of carbofuran is fatally flawed and biased by overly-conservative assumptions. The risk assessment is inconsistent with the fundamental principles of using sound science in regulatory decision-making. EPA's overly conservative and compounding assumptions are not grounded in valid scientific methodology and are at odds with 30+ years of real-world usage, experience and data for this product. FMC believes that carbofuran – a limited-use, but critically important pesticide – can be used safely and should be reregistered. While FMC believes that the existing record provides ample grounds for EPA to reconsider its interim conclusions and conclude that carbofuran should be reregistered, FMC is conducting additional studies (described within) which we expect will remove any concerns regarding the risks associated with carbofuran. These studies should be finished in the early part of 2007. We believe it is in the best interests of the American agriculture industry and growers for EPA to delay issuance of the carbofuran RED until the results of such studies are available and EPA takes time to consider this additional information.

II. INTRODUCTION

FMC Corporation appreciates the opportunity to respond to EPA's Interim Reregistration Eligibility Decision (IRED) for carbofuran, which issued in August of 2006. In the IRED, EPA concludes that carbofuran is not eligible for reregistration because of alleged risks to both human health and the environment. FMC respectfully, but strongly, disagrees with this conclusion, and asserts that when used in accordance with widespread and commonly recognized practice, carbofuran does not cause unreasonable adverse effects on the environment or human health when all *economic, social, and environmental* costs and benefits are considered. FMC believes that the IRED reached a contrary conclusion because EPA understated the benefits and overstated the risks associated with carbofuran use.

The EPA's conclusion is a result of an inadequate and incomplete assessment of the information (both economic and scientific) made available by FMC and other interested members of the public with respect to carbofuran. In particular, EPA's analyses defaulted to a number of overly conservative assumptions with respect to its risk analyses. FMC acknowledges that EPA's assessment can and should employ conservative assumptions based on good science; however, defaulting to overly conservative assumptions, applied in a compounding manner, not grounded in the best available science, as EPA has done here, is *not required or contemplated* by FIFRA or the FFDCA. When the substantial benefits associated with carbofuran use are coupled with the significant mitigation measures taken by FMC since the early 1990s and the small number of incidents associated with labeled usage over that same period, and then compared against the low actual risks to human health and terrestrial and aquatic animals, it is readily apparent that carbofuran does not present unreasonable risks to the environment or human health, and it should therefore be reregistered.

III. EPA BENEFITS ANALYSES AND ASSESSMENTS OF ALTERNATIVES UNDERSTATE THE BENEFITS ASSOCIATED WITH CARBOFURAN.

Carbofuran is a limited-use pesticide that (a) is critically important to growers in the crop segments where it is applied, and (b) provides clear and quantifiable benefits to U.S. agriculture. Proper consideration of these benefits paired with more realistic assessments of risk would result in a determination that carbofuran complies with FIFRA and should be reregistered. EPA's proposed action would unreasonably deprive agriculture and individual growers of a valuable tool for meeting the public's food and agricultural needs.

A. Carbofuran is a Limited-Use Pesticide that is Critically Important in the Crop Segments Where it is Applied

Carbofuran serves critical niche markets. Although geographically widespread, carbofuran use tends to be at very low quantities, both in terms of percentage of crop treated (PCT) and in terms of pounds of active ingredient applied per acre. It is often applied to control pests that are not wide-spread and that do not impact a large percentage of the total crop acreage. Yet, these pests are devastating when and where these infestations occur. The variation in location and magnitude of these infestations vary from season to season, which causes the use of carbofuran to vary accordingly. Notwithstanding these niche usage patterns, carbofuran is an

important product for the agricultural community, the loss of which would have significant quantifiable impacts on growers, crop economics, and various agricultural communities.

One notable niche market for carbofuran is for corn rootworm rescue treatments. Carbofuran is a critical tool for growers who need to respond to corn rootworm infestations after other at-plant treatments have failed. Due to the widespread use of genetically modified (GM) corn, corn rootworm is not an issue everywhere. However, the EPA's mandate that GM corn not exceed more than 80% of a grower's total corn acreage, together with those farmers who continue to plant conventional corn, means that significant US corn acreage is protected only by seed or other at-plant treatments. "Corn rootworm larvae can devastate a corn corp. When other products have failed to achieve adequate at-planting control, [carbofuran] has proven to be the only effective rescue product…"[5] Such failures can result in devastating yield losses, creating the potential for grower bankruptcy, unless a rescue treatment is successfully applied.[6] As stated in a number of comments submitted to the EPA by growers and crop consultants, carbofuran is the only "viable option for emergency control" when other insecticides fail that can save the crop and the grower from devastating economic damage.[7] Additionally, should the efficacy of GM corn for controlling rootworms be reduced, as has recently been observed by some crop consultants in states experiencing high rootworm pressure,[8] carbofuran availability will become even more important. That said, EPA should remember that carbofuran applications for rootworm rescue will remain a niche use relative to total corn acreage.[9]

Carbofuran also occupies similar niches in the sunflower, potato, alfalfa, grapes and cotton crop segments. For sunflowers, carbofuran "…is the only product currently registered for use on commercial sunflowers that is effective against virtually all of the stalk-boring insects."[10] While other products are labeled for these pests, carbofuran "…is the only one with truly systemic activity within the plant."[11] The National Sunflower Association has estimated that the loss of carbofuran would cost sunflower growers between $50-$70 an acre.[12] On potatoes, Washington State University officials have noted "carbofuran is useful against several insect

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5 Comment letter from the National Corn Growers Association (EPA-HQ-OPP-2005-0162-0145 & 0145.1).

6 Comment letter from Mark Hinze (EPA-HQ-OPP-2005-0162-0338)

7 *See e.g.*, Comment letter from Larry Appel (EPA-HQ-OPP-2005-0162-0350); Comment letter from Jim Gleason (EPA-HQ-OPP-2005-0162-0348); Comment letter from Orvin Bontrager (EPA-HQ-OPP-2005-0162-0338); Comment from Phillip E. Sloderbeck. EPA-HQ-OPP-2005-0162-0173); Comment from Kenneth Ferrie (EPA-HQ-OPP-2005-0162-0348); Comment from Kenneth Ferrie (EPA-HQ-OPP-2005-0162-0285).

8 Comment letter from Larry Appel (EPA-HQ-OPP-2005-0162-0350)

9 Comment letter from Orvin Bontrager (EPA-HQ-OPP-2005-0162-0338) (noting that carbofuran is used on only a small percentage of the corn acres they manage, probably less than 5%).

10 Comment letter from J.P. Michaud (EPA-HQ-OPP-2005-0162-0333).

11 Comment letter from J.P. Michaud (EPA-HQ-OPP-2005-0162-0333). FMC is aware of the bird kill incident in Hugo, Colorado that occurred in a sunflower field; however, FMC asserts that the carbofuran use in that circumstance was not consistent with the label.

12 Comment letter from Larry Kleingartner (EPA-HQ-OPP-2005-0162-0326)

pests in potatoes, but especially Colorado potato beetle, beet leafhopper, and potato tuberworm.[13] On alfalfa, carbofuran is the most efficacious product for control of the Egyptian alfalfa weevil.[14] Carbofuran has also been identified as the only product available that will control alfalfa stem nematode, a localized, but very destructive pest that can result in substantial stand loss.[15] Similarly, California grape growers rely heavily on carbofuran to control grape phylloxera. Phylloxera "is a perennial problem" and "carbofuran remains the most efficacious means of managing" this pest.[16] Both California officials and grape growers have strongly opposed any voluntary cancellation of the carbofuran registration for grapes, because there is no effective alternative for grape phylloxera.[17] Finally, carbofuran offers unique and important aphid control for cotton growers, which is why FMC has had a registration request for this use pending since 1995. For example, trials by agriculture consultants have shown that carbofuran gave at least 90% control for 21 days whereas neonicotinoid alternatives gave less than 80% control for only 7-10 days.[18] Carbofuran also possesses a unique ability to control aphids in cotton growing areas experiencing drought conditions.[19]

One of the central assumptions that appears to drive much of the EPA's assessment of the benefits of carbofuran is that low usage implies low derived benefits.[20] If EPA's analysis had appreciated the niche significance of carbofuran, as demonstrated by the comments submitted to the carbofuran docket, the Agency would have identified the significant benefits and limited risks associated with existing carbofuran use patterns.

B. Carbofuran Provides Concrete Benefits to the Agricultural Community

In addition to the niche benefits highlighted above, carbofuran provides other benefits to the agricultural community because of its (a) importance for resistance management programs,

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13 Comment letter from Keith Pike (EPA-HQ-OPP-2005-0162-0344).

14 Comment letter from Eric T. Natwick (EPA-HQ-OPP-2005-0162-0352); Comment letter from Tony Martinez (EPA-HQ-OPP-2005-0162-0150)

15 FMC, Response Comments for EPA's Brief Analysis of Alternatives and Benefits for Selected Carbofuran Uses (Feb. 15, 2006) at 17; *see also* Comments from Gregory E. Hogue (0162-0133).

16 See March 31, 2006 Letter from Rick Melnicoe, Director, Western IPM Center, to Stephanie Plummer, Office of Pesticide Programs, United States Environmental Protection Agency at 3 (the Agency received this letter in response to the questions it posed to the Integrated Pest Management Centers).

17 United States Environmental Protection Agency: Biological and Economic Analysis Division, Carbofuran Response to Comments and Alternatives Assessment for Crops with Low Usage (D330261) (July 7, 2006) at 11.

18 Comment letter from Roger Carter (EPA-HQ-OPP-2005-0162-0360).

19 Comment letter from Angus Catchot (EPA-HQ-OPP-2005-0162-0343); Comment letter from Roger Leonard (EPA-HQ-OPP-2005-0162-0328).

20 United States Environmental Protection Agency: Biological and Economic Analysis Division, Preliminary Impact Analysis for Carbofuran on Potatoes (DP 328865) (June 7, 2006) ("Impact Analysis on Potatoes") at 7; United States Environmental Protection Agency: Biological and Economic Analysis Division, Carbofuran Response to Comments and Alternatives Assessment for Crops with Low Usage (D330261) (July 7, 2006) at 1.

and (b) cost effectiveness relative to other alternatives. The EPA has not adequately considered these benefits, and therefore has understated the importance of carbofuran.

FMC believes that carbofuran is an important tool for insecticide resistance management. The key to managing resistance is to reduce the selection pressure caused by the over-use of insecticides, particularly within the same chemistry, which can result in the selection of resistant forms of the pest and the consequent evolution of populations that are resistant to that particular pesticide or chemistry. Ideally, an effective resistance management program involves the rotation of different chemical classes of pesticides from application to application, thereby reducing selection pressure.[21] In order to have such a program, however, a variety of classes of pesticide chemistry must be available to minimize the potential for resistance development to all of the chemistries being used. In circumstances where resistance management is an issue, the loss of a chemical class increases the potential for resistance development to the remaining chemistries. In the case of carbofuran, it represents a unique pesticide chemistry to control a number of prolific and adaptable pests (e.g., Colorado potato beetle and the cotton aphid). The loss of carbofuran would result in only one or two classes of chemistry being available for use on some crops.[22] The importance of carbofuran for resistance management is readily apparent from its use to control cotton, potato and cucurbit pests.[23]

> Cotton: The cotton aphid is a prolific pest that readily develops resistance to pesticide chemistries. The only effective alternatives to carbofuran for aphid control are flonicamid (a pyridinecarboxamide) and the neonicotinoid class of insecticides. As noted above, the neonicotinoid chemistries have recently begun to experience aphid resistance.[24] The available data "…suggests that multiple applications of the neonicotinoids on individual fields provide sufficient levels of selection pressure to compromise future control" by the neonicotinoids.[25] With respect to flonicamid, inadequate quantities were available to meet treatment needs this year. The EPA did not consider these benefits based solely on the fact that carbofuran is not currently labeled for cotton aphid, even though a label request has been pending since 1995. Regardless of

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21 United States Environmental Protection Agency. 2005. Pesticide Registration (PR) Notice 2001- 5; IRAC. 2005. Mode of Action Classification document version: 5.1, September 2005.

22 Denholm, I., A.L. Devonshire, and D.W. Holloman, eds. 1992 Achievements and Developments in Combating Pesticide Resistance. Elsevier Science Publishers, London; Graves, J.B. 1984. Insecticide Resistance Management Strategies. In *Beltwide Cotton Production Research Conference*, at 43-45. National Cotton Council, Memphis, Tenn.; Watkinson, IA. 1994. Principles of Resistance Management Strategies. In *Beltwide Cotton Production Research Conference*, at 112-113. National Cotton Council, Memphis, Tenn.

23 The resistance management benefits associated with carbofuran are not limited to the crop segments discussed above. *See e.g.*, Comment letter from Donald S. Murray (EPA-HQ-OPP-2005-0162-0323) (bananas); Comment letter from James M. Shine (EPA-HQ-OPP-2005-0162-0361) (sugar cane).

24 Comment letter from Angus Catchot (EPA-HQ-OPP-2005-0162-0338) (neonicotinoid resistance reduced that ability of Mississippi cotton growers to adequately control aphids); Comment letter from Roger Leonard (EPA-HQ-OPP-2005-0162-0328); Comment letter from Roger Carter (EPA-HQ-OPP-2005-0162-0360).

25 Catchot, *supra*.

the label status, the EPA's benefits analysis should have recognized that 37 separate FIFRA § 18 exemptions have been issued over the period 1997 through 2003 for carbofuran to control cotton aphids, thereby amply demonstrating carbofuran's benefits in this niche market.

Potatoes: Carbofuran is used and needed on potatoes to control the Colorado potato beetle, among other pests. The Colorado potato beetle is a prolific pest that, according to the EPA, has already developed resistance to most classes of insecticides.[26] This resistance is to older chemistry, as well as the newer replacement chemistry (e.g. neonicotinoids).[27] The elimination of carbofuran, which the agency concurs "provides effective control" of the Colorado potato beetle,[28] will cause growers to lose an effective treatment against a particularly pervasive pest and will unnecessarily hamper insecticide resistance management efforts.[29] In addition to the potato beetle, carbofuran also provides cost effective broad spectrum control of other potato pests (e.g., flea beetles, aphids, European corn borer, flea beetles, leafhoppers and potato tuberworm).[30]

Cucurbits: Carbofuran is used on cucurbits primarily to control the cucumber beetle (both adult and larval stages). These beetles cause crop damage directly (by feeding on plants) and indirectly (by transmitting damaging bacterial wilt to plants). The Agency has recognized that early season control is essential to protect grower incomes and yields, and that carbofuran provides such control.[31] The only other pesticides that provide any early season control are both neonicotinoids,[32] which is problematic for a pest like the cucumber beetle that readily develops pesticide resistance. The elimination of carbofuran will cause growers to lose an effective treatment against a pervasive pest and will unnecessarily hamper resistance management efforts. To replace carbofuran, cucurbit growers will have to resort to multiple foliar applications of pyrethroid, carbamate, or

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26 United States Environmental Protection Agency: Biological and Economic Analysis Division, Preliminary Impact Analysis for Carbofuran on Potatoes (DP 328865) (June 7, 2006) ("Impact Analysis on Potatoes") at 4.

27 *Id*. at 5.

28 United States Environmental Protection Agency: Biological and Economic Analysis Division, Preliminary Impact Analysis for Carbofuran on Potatoes (DP 328865) (June 7, 2006) ("Impact Analysis on Potatoes") at 5.

29 *See e.g.*, Comment letter from Paul Hobson (EPA-HQ-OPP-2005-0162-0338); Comment letter from Brad Bishop (EPA-HQ-OPP-2005-0162-0342).

30 FMC, Response Comments for EPA's Brief Analysis of Alternatives and Benefits for Selected Carbofuran Uses (Feb. 15, 2006) at 23 (carbofuran is one, of only two, carbamate products effective against the potato tubeworm).

31 United States Environmental Protection Agency: Biological and Economic Analysis Division, Impact Assessment for Carbofuran on Cucurbits (Cucumbers, Pumpkins, Squash, and Watermelon) (D328865) (June 14, 2006) at 7.

32 *Id*.

organophospate products because of their shorter residual activity.[33] Such repeated applications enhance the potential for resistance development.

In addition to the resistance management and other biological benefits discussed above, carbofuran should be retained for the simple reason that it continues to provide concrete economic benefits to growers because it is lower cost and/or more cost effective than alternatives. For example, EPA's own Benefits Analysis concluded that artichoke growers would be significantly impacted by no longer being able to use carbofuran. The Agency "estimates that 0 to 15% yield losses (depending on the pest) could occur if carbofuran is no longer available for use [on artichokes]." This level of yield loss, combined with production cost changes, may result in a net revenue losses ranging from 4% to 135%."[34]

Noticeably understated in the EPA's benefits analyses is the fact that growers forced to find carbofuran substitutes would experience significant cost-of-treatment changes. For example, cucurbit growers could see an increase in treatment costs of up to $39 per acre, should they be forced to find substitutes for carbofuran.[35] EPA's own projections suggest that such increases would result in a 1% to 7% income decline for those growers forced to substitute for carbofuran.[36] Melon Acres, Inc., in comments submitted to the Agency, estimated that the loss of carbofuran would cost it approximately $700,000.[37] Potato growers could see an increase of up to $41.30 per acre.[38] Corn growers would experience treatment cost increases of up to $4 per acre,[39] which is significant given the corn acreages involved. On cotton, the loss of carbofuran would require growers to switch to other pesticides that require additional applications because of their reduced residual activity, which would increase costs by approximately $15 per acre. These treatment cost increases place substantial burdens on impacted growers and clearly demonstrate the substantial financial benefits associated with carbofuran.

As EPA proceeds with its reregistration analysis and considers FMC's comments with respect to the health and environmental risks, it should remain cognizant of the importance of carbofuran in various niche markets, its value as a resistance management tool, its limited use profile with commensurate limited risks, and the substantial benefits that this product provides in those markets where it is relied on by growers for pest control. This combination of limited

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33 Comment letter from Jonathon Edelson (EPA-HQ-OPP-2005-0162-0339).

34 United States Environmental Protection Agency: Biological and Economic Analysis Division, Preliminary Impact Analysis for Carbofuran on Artichoke (D328865) (June 28, 2006) at 1.

35 *Id*. at 9.

36 *Id*. at 10.

37 Comment letter from Michael O. Horrall (EPA-HQ-OPP-2005-0162-0337).

38 Impacts Analysis on Potatoes at 5. In addition to the increased cost of alternatives, potatoes growers faced with the loss of carbofuran would be left with pyrethroid alternatives that flare mites requiring those growers to apply additional pesticides to deal with the mites. FMC, Response Comments for EPA's Brief Analysis of Alternatives and Benefits for Selected Carbofuran Uses (Feb. 15, 2006) at 24; *see also* Comments from Gregory E. Hogue (0162-0133).

39 United States Environmental Protection Agency: Biological and Economic Analysis Division, Alternatives Assessment for Carbofuran on Field Corn (D328865) (May 31, 2006) at 9.

usage and critical importance in the markets where it is used makes it imperative that EPA employ realistic assumptions in its risk assessments so as not to unreasonably deprive agriculture of this valuable tool. When EPA balances carbofuran's benefits against its *actual risks*, as required by FIFRA, the Agency will see that carbofuran's registration should be maintained.

IV. EPA'S DIETARY RISK ASSESSMENT DRAMATICALLY OVERSTATES POTENTIAL RISKS FROM CARBOFURAN

FMC has previously provided extensive data and documentation explaining why EPA dramatically overstated the risks posed by dietary exposure to carbofuran. Specifically, the assumptions employed by EPA in the carbofuran risk assessment (a) do not employ the best science; (b) are overly conservative; and, (c) result in predicted risks that do not comport with actual risks. FMC believes with respect to the toxicological endpoints that, (1) the available data do not support application of a 5X database uncertainty factor to account for the alleged increased sensitivity of red blood cell (RBC) cholinesterase (ChE) inhibition as compared to brain cholinesterase inhibition, and (2) EPA should apply a 1X uncertainty factor (UF) to extrapolate from animals to humans because carbofuran has a confirmatory human study that supports what is predicted by evolutionary and enzyme kinetic information – that other mammals and humans tend to be equally sensitive to cholinesterase inhibition. EPA previously used the human study as point of departure (POD) for several years – 1997 to 2001. Correction of these overly conservative assumptions would result in all existing carbofuran uses easily fitting within the FQPA risk cup. Moreover, EPA has failed to respond adequately to these issues when FMC previously raised them in its comments.

A. As FMC Has Previously Demonstrated, A Comparison Of The RBC And Brain Cholinesterase Data Supports The Position That The 5X Database Uncertainty Factor Is Not Warranted

In calculating the human health benchmark for carbofuran, EPA applied a 5X UF to the brain ChE inhibition BMD_{10} from the FMC comparative cholinesterase study in neonatal and adult rats. EPA justifies this UF by stating that (a) the RBC data from the FMC study is not reliable, and (b) the RBC BMD_{10} that the Agency calculated using combined data from three other studies arguably showed that RBC ChE inhibition is five-fold more sensitive than brain ChE inhibition. EPA's application of a 5X UF to carbofuran was incorrect.[40]

FMC previously provided extensive documentation and scientifically valid explanations regarding why a 5X database UF was unjustified, including: (1) the five-fold difference in sensitivities was primarily an artifact of EPA combining data from three different studies that employed radically different study designs which increased variability; (2) the available data

[40] NRDC contends that the 5X UF for carbofuran established pursuant to the FQPA is not adequately protective of juveniles, this claim is patently incorrect. *See* Comment by J. Sass, Natural Resources Defense Council, at 3 (EPA-HQ-OPP-2005-0162-0385). While FMC disagrees with EPA's selection of a 5X UF, FMC contends that a properly determined UF under the FQPA (which would be 1X in this case) is protective of juveniles because the juvenile end point is established as the point of departure. Therefore, it is inexplicable how NRDC can claim that an EPA UF is not adequately protective of juveniles.

demonstrate that RBC ChE inhibition cannot be reliably measured at a BMD_{10} level, such that a BMD_{20} (Benchmark Dose for 20% response) is more appropriate (and using this level, a five-fold difference in sensitivity is not seen); and, (3) the approach is fundamentally inconsistent with the conclusions that EPA reached – *and which the Science Advisory Panel (SAP) endorsed* – with respect to the carbamate cumulative risk assessment, based on the same data that are evaluated here.[41] Each of these issues is addressed in turn.

First, EPA concluded that RBC ChE inhibition is more sensitive than brain ChE inhibition to carbofuran exposure, based on a comparison between the BMD_{10} for brain and the BMD_{10} for RBC ChE inhibition. However, this result is principally an artifact of the absence of brain data in the FMC time-course study, which was one of three studies EPA used to calculate RBC ChE inhibition for carbofuran (the other two studies were conducted by EPA). Moreover, these three studies employed significantly different methodologies, and it has been documented that variations in RBC activities can be highly dependent upon differences in assay conditions between laboratories. Specifically, the FMC study and the EPA studies used different strains of rat, experimental design including sampling times, methods for processing the samples, and assays for measuring ChE inhibition activity.[42] These differences can – *and most likely did* – lead to differences in dose response and patterns of response over time.

Of particular significance, a comparison of the brain and RBC ChE inhibition in the EPA studies shows no meaningful difference at all. Indeed, EPA's studies show a BMD_{10} for brain ChE inhibition of 0.16 mg/kg and a BMD_{10} for RBC ChE inhibition of 0.14 mg/kg.[43] The FMC study, which employed a dramatically different study design and used a different strain of rat, did not measure brain ChE inhibition at all and had a BMD_{10} for RBC inhibition that was lower (and significantly more variable) than the levels found in the EPA studies. Thus, EPA calculated the brain ChE inhibition levels solely by reference to the EPA studies, but calculated the RBC inhibition BMD_{10} incorporating the lower ChE levels found in the FMC study – and the 5X difference in sensitivity that EPA found is attributable entirely to this difference.[44] Accordingly, it is inappropriate and scientifically unsound to combine the FMC and EPA datasets to derive an "average" BMD_{10} for RBC ChE inhibition from carbofuran exposure.

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41 United States Environmental Protection Agency. 2005. Estimation of Cumulative Risk From N-Methyl Carbamate Pesticides: Preliminary Assessment. August 2, 2005. Office of Pesticide Programs, Health Effects Division. Washington D.C., Section I.B., at. 46. *available at* http://www.epa.gov/scipoly/sap/index.htm#sept.

42 Contrary to NRDC's claims, EPA did not apply a 5X safety factor "quantitatively derived from studies comparing brain cholinesterase inhibition in the male rat pup with the adult rat." *See* Comment by J. Sass, Natural Resources Defense Council, at 3 (EPA-HQ-OPP-2005-0162-0385). As discussed above, EPA simply applied an assumption that RBC ChE inhibition is five times lower than brain ChE based on the alleged absence of reliable RBC ChE data in FMC's CCA study.

43 Li, A. et al. Comments on EPA Health Effects Division's March 2006 Revised Risk Assessment for Reregistration Eligibility Decision of Carbofuran: Benchmark Dose Analyses and Point of Departure.

44 Moreover, within the FMC study, RBC measurements were taken at 15 and 30 minutes (and showed the highest inhibition levels of this whole time-course study), but brain ChE inhibition was not measured at these intervals in the EPA studies (they were measured at 40 minutes past dosing) – resulting in what was likely an artificially higher BMD_{10} for brain ChE inhibition in that study.

Second, notwithstanding EPA's current default of a BMD_{10} for both brain and RBC ChE inhibition, there are indications in the database that RBC ChE inhibition cannot be reliably measured at this level. An analysis of the available data shows that the detectable differences range from 19.1-24.5 percent for RBC ChE inhibition – whereas a 10 percent difference in brain ChE inhibition can reliably be detected. This conclusion is in agreement with those of the Joint FAO/WHO Meeting on Pesticide Residues, where it was recommended that a reduction of greater than 20 percent RBC ChE inhibition be used as a regulatory endpoint.[45] Similarly, the American Conference of Government Industrial Hygienists (ACGIH) recommends a threshold of greater than 30 percent decrease in RBC ChE inhibition activity for typical worker exposure situations.[46] RBC ChE enzyme is a marker, not a toxicological endpoint, and is variable and greatly influenced by diet, health, hormones, diurnal rhythm and other endogenous factors.

A comparison of the appropriate threshold detection for brain ChE inhibition (10 percent), with the appropriate threshold detection for RBC ChE inhibition (20 percent), shows that RBC ChE inhibition is *not* more sensitive than brain ChE inhibition. As such, a 5X UF is unwarranted. Alternatively, a comparison of BMD_{20} for brain and BMD_{20} for RBC ChE inhibition, does not show any statistically significant difference in sensitivities – and certainly not enough to warrant a 5X UF.

Third, the approach taken here is fundamentally inconsistent with the EPA's conclusions in the carbamate cumulative risk assessment. Specifically, EPA, in its cumulative risk assessment for the carbamates, concluded that *brain* ChE inhibition is the appropriate endpoint for deriving the relative potency factors for these chemicals.[47] Significantly, this cumulative risk assessment did not find RBC ChE inhibition to be more sensitive than brain ChE inhibition, based on the same dataset evaluated here, thus rendering the conclusions in EPA's carbofuran Phase 4 documents inconsistent with the conclusion reached in the carbamate cumulative risk assessment, which was endorsed by the SAP. Specifically, in assessing this issue in the context of the carbamate cumulative risk assessment, EPA concluded:

> BMD_{10} estimates of brain ChE inhibition are generally similar to those for RBC ChE inhibition data. For the five most potent NMCs, brain ChE inhibition is equally sensitive or more sensitive compared to RBC ChE inhibition. Thus, brain ChE inhibition data

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45 See Nuber, D., Senior Research Toxicologist, FMC Corp. 2005. Discussion of the EPA Policy on the use of Plasma Cholinesterase Inhibition and the Carbofuran Toxicology Endpoint, at 11 (*citing*, WHO. 1990. Principles for the Toxicological Assessment of Pesticide Residues in Food. Environmental Health Criteria, No. 104. World Health Organization, Geneva; WHO/JMPR. 1999. Report of Joint Meeting of the FAO Panel of Experts on Pesticide Residues in Food and the Environment and the WHO Core Assessment Group. Rome, 21-30 September, 1998.).

46 American Conference of Government Industrial Hygienists. 2006. TLVs and BEIs Based on the Documentation of the Threshold Limit Values for Chemical Substances and Physical Agents & Biological Exposure Indices at 96.

47 RBC ChE inhibition was not used as an endpoint in the organophosphate cumulative risk assessment and EPA did not estimate the detection limit for RBC ChE inhibition. EPA also did not estimate a detection limit for RBC ChE inhibition in the carbamate cumulative risk assessment.

> provide a health protective endpoint for estimating cumulative risk on both the central and peripheral nervous system. Compared to BMD_{10} estimates based on RBC ChE inhibition, BMD_{10} estimates based on brain ChE inhibition have tighter confidence intervals and therefore will confer less uncertainty on cumulative risk estimates. Moreover, brain ChE inhibition represents a direct measure of the common mechanism of toxicity as opposed to using surrogate measures (e.g., blood measures).[48]

In endorsing this conclusion, the SAP further commented:

> RBC AChE inhibition is difficult to assay and has no known physiologic function. Inhibition of this enzyme is therefore at best a surrogate for the actual mechanism of toxicity. Likewise, although AChE inhibition in peripheral tissues might ultimately provide a sensitive and direct index of toxicity, there are no extensive data to support this concept as yet, and the accurate dissection and assay of such tissues requires care and skill. . . . Further support for focusing on brain AChE inhibition comes from NHEERL data summarized in the current document. These data showed that BMD_{10} values for AChE inhibition in the brains of carbamate-dosed rats were, on average, as low as those derived by measuring the enzyme in RBCs.[49]

FMC believes that both EPA and the SAP were correct: RBC ChE inhibition is not a more sensitive endpoint than brain ChE inhibition in most cases; it is more difficult to measure accurately; and it is an indirect, as opposed to a direct, measure of carbamate toxicity and thus is inherently inferior to brain ChE as a POD.

EPA, in its IRED, offers no meaningful response to these data and analyses or any explanation as to why the SAP-endorsed approach used in the cumulative assessment should not be applied here. Instead, the IRED simply reiterates the prior rationale,[50] notwithstanding the fact that at a meeting with FMC representatives on June 16, 2006, EPA scientists essentially admitted that the alleged five-fold difference in brain and RBC ChE inhibition was simply an artifact of the various study methodologies, and thus not scientifically supportable. Alternatively, in the June 16 meeting, and again in its Phase 6 HED Revised Risk Assessment, EPA verbally offered an *entirely new rationale* for the 5X database uncertainty factor. That new

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[48] United States Environmental Protection Agency. 2005. Preliminary n-methyl carbamate cumulative risk assessment. Office of Pesticide Programs, Washington D.C., Section I.B., page 46, available *at* http://www.epa.gov/scipoly/sap/index.htm#sept.

[49] United States Environmental Protection Agency: FIFRA Scientific Advisory Panel, *A Set of Scientific Issues Being Considered by the Environmental Protection Agency Regarding: Preliminary N-Methyl Carbamate Cumulative Risk Assessment*, at. 22-23 (August 23-25, 2005).

[50] IRED at 7-8.

rationale – that the FMC dose-response study might have missed the time of peak inhibition, and that there is uncertainty in the BMD_{10} for pups because they are more sensitive than adults – had never before been presented to FMC. Consequently, FMC was provided no meaningful opportunity to respond. EPA did not explain this new rationale in the IRED; instead the Agency merely raised the issue in the Phase 6 Revised Risk Assessment, and did not provide FMC with an opportunity to respond. Therefore, it is FMC's position that EPA cannot ground its decision on the rationale asserted at the June 16th meeting.

Promptly upon learning of these new concerns, FMC commenced development of a new protocol for a comparative cholinesterase assay (CCA) study, which would address these newly identified issues.[51] That study is currently underway. FMC strongly believes that it would be both inappropriate and profoundly unfair for EPA to issue the carbofuran RED with a 5X database uncertainty factor, without first giving FMC time to finalize this study and submit it to the Agency. Importantly, all existing carbofuran crop uses fit within the FQPA dietary risk cup if this database uncertainty factor is reduced to 1X.[52]

B. A 10X Interspecies Uncertainty Factor Is Unnecessary And Overprotective For Carbofuran

To determine the human health toxicity benchmark for carbofuran, EPA applied its traditional 10X UF to extrapolate from animals to humans. As FMC explained to the Agency in its comments on the Phase 4 HED Assessment, however, a 10X interspecies uncertainty factor is unnecessary and overprotective in the case of carbofuran. A 10X UF is typically applied when no information is available about the effects of a chemical on humans, relative to non-human test species, to account for the unidentified differences between the tested species (in this case rats) and humans. The basic assumption is that humans may be as much as 10 times more sensitive to the chemical than the tested animal. However, when human data are available, those data may

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[51] FMC had commenced protocol development well before EPA recommended this additional study in the IRED.

[52] Because it relates to EPA's selection of a UF, FMC elects to object at this time to NRDC's contention that there are significant gaps in the database. See Comment by J. Sass, Natural Resources Defense Council, at 4 (EPA-HQ-OPP-2005-0162-0385). While it is true that a 90-day oral toxicity study in rodents is not available, such a study was not provided because FMC undertook higher tier, two-year, comprehensive chronic studies on rats and mice. NRDC's claim regarding the unavailability of a 90-day oral toxicity study for non-rodents is simply false. FMC provided such a subchronic study in dogs to EPA on November 14, 2005 (MRID# 46688903). Similarly, NRDC's contention that FMC did not provide a CCA study is also false. On November 14, 2005 FMC submitted a CCA study to EPA (MRID#s 46688911, 46688912 and 46688913) . At this time, FMC is voluntarily undertaking another CCA study. With respect to the alleged, missing, 90-day dermal study, because of carbofuran's rapid reversibility, EPA did not establish a chronic reference dose for carbofuran, and therefore, EPA does not need this repeated dose study as NRDC contends. All necessary information related to the dermal toxicity of carbofuran can be easily gleaned from the 21/28-day dermal study. Additionally, the applicable regulations (40 C.F.R. § 158.340) clearly indicated that a 90-day dermal study is only conditionally required under certain circumstances. Carbofuran does not satisfy any of the criteria that would make a 90-day dermal study required. Finally, NRDC's claim that the absence of a 28-day inhalation study in rats is significant from a regulatory perspective ignores the fact that EPA has imposed a much more conservative assumption in lieu of data from a 28-day inhalation study.

be used to more accurately estimate the necessary interspecies UF. For example, EPA used available human ChE data to lower the interspecies UF for aldicarb from the default value of 10X to 2X.[53] In the case of carbofuran, there are data from human studies that can inform the animal data used to set the POD. In particular, data from an acute oral study in humans (Arnold 1976[54]) indicate that RBC ChE inhibition is of equal magnitude in humans and rats, demonstrating that an interspecies uncertainty factor of 1X is appropriate for carbofuran.[55] As stated previously, EPA had used the human study as the POD from approximately 1997 through 2001.

The appropriateness of a 1X interspecies uncertainty factor for carbofuran is confirmed by EPA's recent Weight of the Evidence Presentation for carbofuran (EPA, 2006)[56], which included an evaluation of Arnold (1976) and two other human studies for their scientific validity and usefulness for single chemical and cumulative risk assessment.[57] The EPA Weight of Evidence Report used a rat RBC BMD_{10} of 0.03 mg/kg (the same value adopted by HED as the point of departure based on brain ChE inhibition) and a human RBC BMD_{10} of 0.038, from Arnold.[58] Based on these data, and its view that Arnold "provides useful information into the sensitivity of RBC ChE inhibition of rats compared to humans,"[59] EPA explicitly concluded:

> Similar to the approach proposed by the Agency . . . for aldicarb, methomyl, and oxamyl for informing the interspecies extrapolation factor in the cumulative risk assessment, the carbofuran human study may also inform the interspecies extrapolation factor for the

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53 United States Environmental Protection Agency. Memorandum from Felecia Fort to Sherrie Kinard re: Aldicarb. HED Revised Preliminary Human Health Risk Assessment for Reregistration Eligibility Decision Document (RED) (May 12, 2006), at. 21.

54 Arnold, J.D. (1976) Evaluation of the Safe Exposure Levels to Carbamate, Administered Orally to Healthy Adult Normal Male Volunteers. (Unpublished study received Oct 24, 1979 under 279-2712; prepared by Quincy Research Center, submitted by FMC Corp., Philadelphia, Pa.; CDL:241303-B) Accession no. 241303. MRID 00092826.

55 Arnold (1976) was judged to have met ethical standards in place at the time the study was conducted by Community Review Committee, Inc, an independent, non-profit corporation devoted to the protection of subjects in human research. From Carlson et al. May 2-3, 2006 presentation**.** United States Environmental Protection Agency. Memorandum from John J. Liccione to Tina Levine re: Human Studies Review Board: CARBOFURAN Weight-of-the-Evidence Presentation of Human and Animal Toxicity Studies (April 14, 2006), PC Code: 090601 ("Weight of Evidence Presentation"), available at http://www.epa.gov/osa/hsrb/files/8-Carbofuran-Weight_of_evidence.pdf.

56 United States Environmental Protection Agency. Memorandum from John J. Liccione to Tina Levine re: Human Studies Review Board: CARBOFURAN Weight-of-the-Evidence Presentation of Human and Animal Toxicity Studies (April 14, 2006), PC Code: 090601 ("Weight of Evidence Presentation"), available at http://www.epa.gov/osa/hsrb/files/8-Carbofuran-Weight_of_evidence.pdf.

57 EPA also concluded that these human studies should themselves be used as the POD for the carbofuran risk assessment, while informing the appropriate interspecies UF for the carbamate cumulative risk assessment. FMC agrees that these studies would form an appropriate POD for the carbofuran risk assessment (in which case, there also would be no need for an interspecies UF of greater than 1).

58 *Id.* at 15, Table 9.

59 *Id.* at 16.

> preliminary cumulative risk assessment. The ratio of the rat BMD_{10} to the human BMD_{10} was proposed at the April 2006 HSRB. The Agency is proposing to use the same approach for carbofuran. The Agency is in the process of analyzing both the rat and human BMD_{10} data to determine the central estimate and 95% confidence interval for use as the interspecies extrapolation factor. A rough estimate of the interspecies extrapolation factor for carbofuran may be made by comparing the RBC BMD_{10} values for the rat and human from Table [9] above. *This ratio is approximately 1X*.[60]

Thus, EPA's Weight of Evidence Report for carbofuran concluded that the appropriate interspecies UF for carbofuran is 1X, and not the 10X traditionally used when no such comparative data are available. FMC agrees with EPA's Weight of Evidence determination that a 1X interspecies UF is appropriate for carbofuran and we encourage EPA to re-instate the 1X factor going forward.

In addition, as detailed in the report *Conservation and Consistency of Cholinesterase Function*[61] discussed in FMC's prior comments to the Agency, evolutionary and enzyme kinetic information indicate that the ChE enzyme is highly conserved among mammalian species, including rats, mice, dogs and humans. In particular, the same gene codes for all forms of ChE (e.g., RBC and brain) exist in all mammals, including rats and humans. This common genetic foundation has led to high sequence homology and structural similarity of the ChE molecule among species, and very similar enzyme kinetics (K_i, $V_{max,}$ K_m).[62] The universality of ChE molecular structure and enzyme kinetics among mammals, and in particular, between rats and humans, provides further confidence in the appropriateness of an interspecies UF of 1X.

In the IRED, EPA rejected this analysis and repudiated its prior position that the carbofuran human studies demonstrate that humans are *not* more sensitive than other species to the effects of carbofuran. The Agency based its position on a report issued by the Human Studies Review Board (HSRB) on July 7, 2006, which recommended against use of the carbofuran human studies.[63] As FMC has previously explained to EPA, the HSRB's review of carbofuran was unlawful, due to the Agency's improper recusal of Drs. W. Stephen Brimijoin and Janice Chambers from participating in the Board's consideration of the carbofuran human studies. There was no valid basis for this recusal under the government ethics regulations, and this improper recusal prejudiced FMC Corporation's right to fair consideration of the human studies. Although FMC had objected to any use of the HSRB's report by the Agency in making regulatory determinations regarding the safety of carbofuran unless and until this violation is

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60 *Id.* (Emphasis added.)

61 El Naggar, S.F., Conservation and Consistency of Cholinesterase Function, (May 2006), Report No. P-3851. Sponsored by FMC Corporation.

62 *Id.* at 9.

63 HSRB, May 2-3, 2006 EPA Human Studies Review Board Meeting Report, at 21 (July 7, 2006).

rectified, EPA has nonetheless, in the IRED, used the HSRB report as its sole basis for rejecting FMC's comments with respect to the interspecies UF.

Specifically, the HSRB was asked to consider three carbofuran human studies conducted in 1976-1977, including an oral study. In 1997, EPA requested Drs. Brimijoin and Chambers to be two of the three independent peer reviewers of the carbofuran oral study. In their 1997 peer reviews, Drs. Brimijoin and Chambers concluded that the oral study was the proper study to use as the POD for calculating the reference dose for carbofuran. Based on this independent review, EPA concluded that the oral study was ethical and should be accepted for regulatory purposes. In its April 2006 report to the HSRB, EPA concluded that the oral study was ethical and, consistent with Drs. Brimijoin and Chambers' earlier recommendation, should be used as the POD for setting carbofuran health benchmarks, and for determining the appropriate uncertainty factors for the cumulative assessment of carbamates.

Drs. Brimijoin and Chambers were appointed by EPA to be members of the HSRB; Dr. Brimijoin was appointed to be HSRB Vice-Chair. No one has shown or alleged that they had a financial interest in the carbofuran matter, or that they have any reason not to be completely impartial. At no time did Drs. Brimijoin and Chambers indicate that they could not be impartial. By dint of their knowledge of the carbofuran studies, there was a strong public interest in having their expertise available to the HSRB. Nevertheless, without any public deliberation or opportunity to discuss the matter, or notice to FMC before the May 2-3 HSRB hearing, they were peremptorily recused by the Agency from participating in the Board's deliberations, depriving the other members of the Board of their knowledge and experience with the oral study. Had Drs. Brimijoin and Chambers not been recused, and had their views been made available to the Board, the end result of the HSRB's deliberations might have been totally different. Indeed, the oral study might well have been deemed appropriate for use as the POD for calculating the reference dose, or for reducing the interspecies uncertainty factor for carbofuran.

The recusal of Drs. Brimijoin and Chambers violated the government ethics regulations, published at 5 C.F.R. § 2635.501, *et seq*., and the Federal Advisory Committee Act (FACA). Those regulations are aimed at precluding the participation of government employees in matters in which they have a financial interest or personal or business relationship. There is nothing in those regulations which requires, or allows, the recusal of FACA members such as Drs. Brimijoin and Chambers because of their prior knowledge and experience with the same subject matter. For the Agency to reconstitute the membership of the HSRB on this basis was clearly unlawful, and invalidates the deliberations of the HSRB that took place without those duly appointed members. Persons who are appointed to an advisory committee pursuant to FACA must be permitted to serve and deliberate on matters before the committee unless there are valid ethical reasons for them not to, and no such reasons exist in this situation.

Because EPA improperly recused Drs. Brimijoin and Chambers from participating on the HSRB when it evaluated carbofuran, the Agency acted improperly and unlawfully in using the HSRB's report on carbofuran for purposes of reaching safety determinations in the IRED. Thus, EPA acted improperly in rejecting FMC's comments with respect to the oral human study informing the appropriate application of the interspecies UF, and EPA should either reduce that UF to 1X or defer finalizing the carbofuran RED until a properly-constituted HSRB has the

opportunity to reconsider the carbofuran human studies. As with the 5X database UF, correction of this issue results in all existing carbofuran crop uses fitting within the FQPA risk cup.

V. EPA HAS OVERSTATED THE POTENTIAL RISKS TO WORKERS FROM EXPOSURE TO CARBOFURAN

A. Human Incident Data Show That Current Carbofuran Usage Poses Minimal Risk to Humans

The available human incident data show that current carbofuran usage poses little, if any, risk to humans. Product usage is entirely closed-system, such that the potential for human exposure during mixing, loading and applying the product is very small. Not surprisingly, therefore, very few carbofuran occupational exposure incidents have been reported in the past decade. The few incidents which have occurred involved only mild to minimal effects, and were generally from the result of failures to use protective equipment when performing equipment maintenance. Nor have there been many incidents from general population exposure to carbofuran since 2000 (the majority of this small number of incidents were asymptomatic or minor). It should also be noted that most of the general population incidents were related to misuse or misapplication. The absence of real-world human effects associated with the proper use of carbofuran further supports the conclusion that there is not presently any significant human health risk posed by carbofuran use.

B. EPA Has Adopted an Overly Conservative Methodology To Determine the Human Health Benchmark for Assessing Worker Risk

For a six-year period during its Phase 1 and 2 documentation, from early 2000 until March 2006, EPA had adopted an overly conservative methodology to determine the human health benchmark for assessing worker risk. In March 2006, however, EPA reduced that already excessive health benchmark by almost an order of magnitude, resulting in predicted occupational risks from carbofuran that simply do not comport with reality. FMC has explained in its previous comments why EPA's POD for the occupational risk benchmark was overly conservative.[64] With respect to worker risk, EPA offers no compelling rationale for (a) rejecting FMC's guideline 21-day dermal toxicity study in rabbits, or (b) supporting its retention of a 6% dermal absorption factor from the Shah study, in light of concerns raised by FMC that this value is a significant overestimate because 24 hours of exposure were assumed. As described below, the Shah study is not a worker exposure study; at most, EPA should use the Shah study only to extrapolate an 8-hour dermal absorption factor of 3.5%.

Dermal absorption is one of the most significant potential exposure pathways for workers mixing, loading and applying pesticides or re-entering treated areas. In the Phase 4 HED Risk Assessment, EPA recommended 6% as the dermal absorption factor for route-to-route extrapolation from an oral toxicology endpoint. As described in the document *Rationale for*

[64] As explained above, application of a 10X interspecies UF is highly inappropriate in view of EPA's improper recusals during the HSRB meeting.

Dermal Absorption Factor for Carbofuran Used in Risk Assessments,[65] attached to FMC's prior comments, this value in all likelihood significantly overestimates carbofuran dermal absorption.

At the outset, FMC notes that in the vast majority of organophosphate and carbamate worker risk assessments the Agency determined the dermal risks based on the results of 21 or 28-day dermal toxicity studies in either rats or rabbits. In the case of carbofuran, a valid EPA-guideline, 21-day dermal study in rabbits is available (NOAEL is >1000 mg/kg). EPA declined to use this study to evaluate risks to workers from dermal exposure to carbofuran, based solely on the fact that the Agency believes carbofuran to be more toxic than this study showed.[66] Notwithstanding this belief, EPA accepted this dermal study and classified it as both core and guideline, meaning that the study was properly conducted, deemed acceptable by the Agency, and determined to meet core database requirements. FMC has previously commented to the Agency that carbofuran, with its poor solubility in most organic solvents, is expected to have limited permeability through the lipophilic dermis. This expectation has been borne out in dermal testing of carbofuran. For example, the acute dermal LD_{50} for carbofuran is 2703 mg/kg for males and greater than 2010 mg/kg for females, even in those with abraded skin. Similarly, the 21-day dermal NOAEL is >1000 mg/kg. These toxicity values – which are dramatically lower than carbofuran's oral or inhalation toxicity values – confirm that dermal absorption of carbofuran is extremely low. FMC believes that it was arbitrary and capricious for the Agency to refuse to use this study, which is the most relevant study for assessing dermal risks to workers, based on no more than an unsupported "belief" that the study did not show sufficient toxicity and notwithstanding the fact that the Agency used comparable dermal studies for most other organophosphates and carbamates.

Instead of using FMC's guideline study, EPA's dermal absorption factor value of 6% was determined using data from a rat dermal absorption study in the published literature (Shah *et al.*, 1987).[67] However, both the methods employed in the Shah study itself, and EPA's use of the data in Shah *et al.*, result in an overestimate of real world carbofuran dermal absorption. Additionally, the Shah study was not meant to be a worker exposure study and did not follow EPA worker exposure study guidelines, and therefore should not have been used for regulatory decisions regarding worker exposure.

First, the Shah study likely overestimates the dermal exposure factor because the study was conducted following procedures that artificially enhanced dermal absorption of carbofuran.

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65 McCarty, JD and Nuber D. Rationale for Dermal Absorption Factor for Carbofuran Used in Risk Assessments (May 2006), Sponsored by FMC Corporation, Study No. P-3853. ("Dermal Absorption Report").

66 United States Environmental Protection Agency, Carbofuran HED Revised Risk Assessment for the Reregistration Eligibility Decision (RED) Document (Phase 4) (PC 090601 - DP#D327359) (March 8, 2006) at 30 ("Although a 21-day dermal rabbit study was available, this toxicity study is not appropriate because the endpoint of concern (i.e. cholinesterase activity) was not measured."); United States Environmental Protection Agency, Carbofuran. Revised Toxicology Chapter of the Reregistration Eligibility Decision. Chemical Number 090601. DP#D266568. (August 24, 2000) at 8 and 29.

67 Shah PV, Fisher HL, Month NJ, Sumler MR and Hall LL. (1987) Dermal penetration of carbofuran in young and adult Fischer 344 rats. J. of Toxicology and Environmental Health, 22:207-223.

Specifically, the study: 1) was conducted using technical grade carbofuran, rather than a formulation or dilution that duplicates field exposure conditions as specified by EPA guidelines; 2) used acetone as the vehicle, which enhanced dermal absorption of carbofuran beyond what would reasonably be expected under actual use conditions and is contrary to EPA's own guidelines;[68] and 3) did not conclude with washing the test animal skins as required by EPA guidelines. Combined, these procedures likely resulted in a significant, though unquantifiable, overestimate of carbofuran dermal absorption.

Second, the dermal absorption value chosen by EPA likely overestimates occupational exposure during a typical 8-hour workday. The Shah study measured dermal absorption of carbofuran at 2, 24, 48, 72 and 120 hours.[69] Rather than using the totality of these data points to extrapolate the dermal absorption factor at 8 hours, EPA chose the dermal absorption factor determined at 24 hours (6%), even though a simple linear regression model that incorporates all the measured absorption data in Shah *et al*. could estimate dermal absorption at 8 hours. Applying such a model predicts absorption of 3.5% after 8 hours of exposure, a value 1.7 times below the value used by EPA.[70] Recognizing that the procedures in Shah *et al*. probably enhanced carbofuran dermal absorption, FMC asserts that the 3.5% value it extrapolated from the Shah data is a sufficiently conservative estimate of 8 hour dermal absorption to be relied on for regulatory purposes, and the EPA's selection of the 24-hour factor was overly conservative.[71]

In its response to FMC's comment, EPA acknowledged that "the current 6% value used in the risk assessment may be an overestimate…"[72] The Agency's only justification for relying on this overestimate is that ". . . [t]he dermal absorption study [(Shah *et al*.)] did not provide 8- or 10-hour evaluations."[73] This justification fails to acknowledge FMC's comments, or address the potential that this non-guideline study could have dramatically overstated actual dermal absorption. Moreover, EPA's justification ignores the fact that extrapolations such as the one that FMC calculated are standard scientific procedures that the Agency itself relies on regularly. These failures to respond, in light of the concerns expressed by FMC, make EPA's actions arbitrary and inappropriate.

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68 See United States Environmental Protection Agency. 1998. Health Effects Test Guidelines. OPPTS 870.7600: Dermal Penetration. EPA 712-C-98-350 (stating that EPA recommends that the vehicle used in dermal penetration studies should be the same as that "under which field exposure occurs" and stating that organic solvents "must not be used.").

69 Dermal Absorption Report at 8.

70 *Id.*

71 The suggestion by NRDC that the 24-hour absorption values from Shah, *et al*. potentially underestimate risk during an 8-hour work day is simply unfounded. *See* Comment by J. Sass, Natural Resources Defense Council, at 5 (EPA-HQ-OPP-2005-0162-0385).

72 United States Environmental Protection Agency, "Carbofuran. HED Response to Registrant's Comments Received during Phase 5 of the Reregistration Process." (June 12, 2006).

73 United States Environmental Protection Agency, "Carbofuran. HED Response to Registrant's Comments Received during Phase 5 of the Reregistration Process." (June 12, 2006).

Despite FMC's disagreement with the Agency's refusal to use its previously conducted 21-day rabbit dermal study and its reliance on the Shah study, FMC is conducting a new 21-day dermal study, this time in rats, to confirm the results of the rabbit study and to provide the Agency with guideline dermal toxicity data which can be used to accurately and reliably assess the occupational risks from carbofuran. Given the potential for dermal absorption overestimates using the Shah study and the EPA's dismissal of prior studies, FMC believes that the Agency should defer issuing the RED until FMC's 21-day dermal study in rats is complete and has been reviewed by the EPA. By waiting until this new study is complete, the Agency will have two guideline dermal studies – one in rats and one in rabbits – allowing it to accurately assess worker risk.

VI. EPA'S DRINKING WATER ASSESSMENT FOR CARBOFURAN FAILS TO TAKE INTO ACCOUNT CARBOFURAN'S LIMITED USAGE AS A NICHE PRODUCT, AND PRODUCES ESTIMATED DRINKING WATER EXPOSURES THAT DO NOT COMPORT WITH REALITY

EPA claims that drinking water exposures to carbofuran exceed acceptable risk levels, with modeled exposures exceeding the "risk cup" even with no contribution from dietary exposures.[74] In large part, this conclusion is an artifact of the Agency's overly conservative determination of the human health benchmark for carbofuran, as discussed in Section IV above. Use of more reasonable and appropriate uncertainty factors would result in no exceedance of the risk cup from carbofuran drinking water exposures. Equally importantly, however, the Agency has applied its standard water modeling techniques to carbofuran, even though those techniques lack any mechanism to account for carbofuran's niche usage. This doctrinaire approach has produced drinking water exposure estimates that simply do not comport with reality.

For example, carbofuran is a critical tool in the fight against corn rootworm infestations. While GM corn has reduced the need for conventional treatments, EPA-mandated refuge acreage and other areas where seed or other at-plant treatments are applied experience treatment failures and rootworm infestations that require carbofuran rescue treatments. Thus, although *in theory* carbofuran could be used on the entire corn acreage in the U.S., in reality carbofuran is used on less than 1% of all corn acreage. And this is where EPA's drinking water analysis falls short: the Agency in its modeling *assumes* that carbofuran is used on the default Percent Cropped Area (PCA) of 46% of the corn acreage in the U.S., rather than its actual PCA of less than 1%. By using this flawed assumption, EPA vastly overstates actual carbofuran usage on corn, and as a result, the modeled water concentrations bear no relation to reality.

In its prior comments, FMC had explained that a more appropriate approach for niche pesticides is to account for the percent of the crop that actually is treated with the pesticide. When the percent crop treated ("PCT") is incorporated into EPA's screening level FIRST model, the estimated surface water concentrations are considerably lower (0.5-5.0 ppb) as compared to concentrations modeled using the EPA default PCA (0.6-75 ppb). The reliance of the EPA model on the default PCA is startling given that BEAD had data indicating the actual PCT for carbofuran for the crop types in questions. Indeed, FMC's comments specifically noted that the

[74] IRED at 13.

FIFRA SAP recommended that EPA incorporate PCT in refinements of its water model, especially for products with low usage, as is the case for carbofuran.[75]

A comparison with water monitoring data, however, demonstrates that the modeled concentrations are still conservative, and thus appropriate for predicting potential high-end exposures.[76] Specifically, the modeled concentrations of carbofuran exceed by one to two orders of magnitude the actual monitored concentrations of carbofuran found in the USGS reservoir monitoring study (1999-2000). There, only five carbofuran detections (<1%) were reported out of 551 samples collected in the study. The maximum concentration of carbofuran detected was only 0.050 ppb, with the 95th percentile value below the reporting limit of 0.003 ppb. Additional surface and groundwater monitoring of public water supplies (e.g., the National Contaminant Occurrence Database and the Pesticide Data Program) reflect the low detection frequencies along with the low magnitudes indicated in the reservoir monitoring study.

EPA nonetheless rejected incorporation of PCT, claiming that it "will not capture the localized characteristics" of some watersheds, in which a higher percentage of the crops could be treated with carbofuran.[77] In so doing, however, EPA ignored FMC's corroborating analysis. Specifically, FMC commissioned Waterborne Environmental to estimate concentrations of carbofuran in watersheds in some of the highest usage areas in the country (Illinois, Indiana, Iowa and Nebraska). Waterborne used the Watershed Regressions for Pesticides (WARP) model, which predicts pesticide concentrations based on empirical relations between pesticide concentrations at monitored stations and a select group of nationally available watershed characteristics, including pesticide usage and soil characteristics. The major advantage of a WARP assessment is its ability to combine soil type vulnerability with county-level product usage data. WARP information from other key corn-growing states confirms that Illinois is a highly vulnerable state in terms of surface water runoff and is on the upper end of overall carbofuran usage on corn. Hence, WARP data are reasonably conservative and account for potentially higher EECs than the national average in some areas. The WARP data confirm that EPA's modeling dramatically overstates real-world carbofuran concentrations, and further confirms that use of the PCT approach, even at the screening level, results in appropriately conservative, but more realistic results than EPA's modeling showed.[78]

EPA nonetheless rejected the WARP modeling without providing any meaningful consideration of its results. Specifically, in response to EPA's concerns about the WARP

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[75] United States Environmental Protection Agency, "The Agency's Responses to Public Comments on the Draft FQPA Science Policy Document" on "Estimating the Drinking Water Component of a Dietary Exposure Assessment" October 19, 1999.

[76] FMC's methodology and conclusions were described in detail in Morris, "Percent Crop Treated Refinement and its Impact on the Acute Drinking Water Dietary Assessment for Carbofuran," (November 10, 2005).

[77] United States Environmental Protection Agency, "Response to Phase 3 Comments on Carbofuran Environmental Risk Assessment and Human Drinking Water Exposure Assessment," at 78 (February 17, 2006).

[78] FMC's WARP modeling found maximum estimated 90th percentile concentrations of 0.18, 0.24, 0.17 and 0.37 ppb for Indiana, Iowa, Nebraska and Illinois, respectively.

approach, FMC submitted extensive supplemental information and analysis responding to EPA's comments. In reply, EPA offered only that it would not use the WARP results because the model had not yet completed a peer review process.[79] Indeed, the Agency refused to respond to any of FMC's substantive points, stating only, "[b]ecause WARP has not undergone a thorough peer review to determine its appropriateness in Agency risk assessments, the Agency cannot address the specifics of the model at this time."[80] It is inherently arbitrary for EPA to refuse to comment on any of FMC's substantive points, while instead relying inflexibly on a model which provides grossly inaccurate results for a product like carbofuran. Moreover, even if it were reasonable for EPA not to use WARP as its basis for determining modeled carbofuran exposures, the WARP data nonetheless *confirms* the propriety of using PCT in assessing carbofuran under the screening level FIRST model, and that fact remains unrebutted – as does the fact that WARP clearly illustrates how overstated EPA's modeled concentrations are.

In the IRED, EPA seeks to bolster the validity of its overly conservative modeling, based on the fact that, in the 1980s, groundwater monitoring reported peak concentrations ranging from 1.4 to 176 ppb. What EPA fails to acknowledge, however, is that these concentrations were in highly vulnerable watersheds (loamy sand) designed to leach, and in response to concerns about groundwater contamination in these types of vulnerable watersheds, FMC modified its labels to disallow carbofuran use in such areas.[81] Also, the Agency's analysis fails to acknowledge actual carbofuran use – since the 1980's, the number of carbofuran-treated acres have declined significantly. The Agency's failure to acknowledge these product stewardship actions and the fact that they resulted in dramatic decreases in carbofuran detections and concentrations in groundwater is improper and arbitrary.

Of particular note, the IRED recognizes that widespread and extensive monitoring over the past decade has shown very few locations with detections, and where there were detections, the levels of carbofuran have been extremely low. These facts vividly demonstrate that potential exposure to carbofuran has declined markedly:

- "Over the last decade, non-targeted ground water monitoring reports indicate fewer locations with detections."[82]

- For surface water, "Few detections exceeding 1 ppb have been found since the mid-1990s."[83]

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79 United States Environmental Protection Agency, "Response to Phase 5 Comments on Carbofuran Environmental Risk Assessment and Human Drinking Water Exposure Assessment," at 3 (July 27, 2006).

80 *Id.* at 4.

81 *See* Furadan® 4F Label, EPA Reg. No. 279-2876 (stating that "Users are advised not to apply carbofuran where the water table (ground-water) is close to the surface and where the soils are very permeable, i.e., well-drained soils such as loamy sands.").

82 IRED at 11.

83 *Id.* at 12.

- "Detectable residues of carbofuran (no 3-hydroxycarbofuran found) were found in 14 out of 1418 PDP water samples (data from 2001-2003). Carbofuran residues ranged from 0.001 ppb to 0.079 ppb."[84]

In sum, the data EPA cites does not confirm the results of its modeling; to the contrary, it demonstrates that EPA's modeling vastly overstates what is seen in the real world, and that incorporating the PCT approach, as FMC recommended, results in modeled carbofuran concentrations that are both conservative and realistic.

EPA also relied on a 1981-1983 prospective groundwater study in Maryland, to support its rejection of FMC's groundwater modeling assessment (Probabilistic Leaching Exposure Assessment). As previously indicated by FMC, this corn plot study is not an appropriate surrogate for predicting groundwater concentrations in other geographic areas, especially in light of current carbofuran use patterns. The Maryland study was on highly vulnerable, acidic soils (low pH), where leaching was maximized and carbofuran hydrolysis was minimized. Indeed, precisely *because* of the potential for groundwater contamination in these types of soil conditions, FMC has undertaken significant mitigation measures to ensure that carbofuran cannot be used on such soils, as indicated on the label.[85] Therefore, while the Maryland study shows that carbofuran has the *potential* to impact groundwater under certain soil conditions, these results are not an appropriate indicator of carbofuran groundwater contamination potential. Because FMC has implemented appropriate label mitigation measures, carbofuran cannot be used on these soils, and therefore the EPA's point is moot. Additionally, use patterns for carbofuran, such as for corn rootworm rescue treatments which occur nearly exclusively in the Midwest Region, indicate that carbofuran is applied to soils with significantly different characteristics from the Maryland Study.

While carbofuran use is geographically widespread, the areas treated are relatively discrete and the use quantities are low. FMC therefore submits that the basic assumptions underlying EPA's modeling inputs (e.g., default PCA of 46% in a given watershed is assumed to be treated) are not representative for evaluating actual carbofuran-treated acres. Accordingly, a PCT approach is more appropriate, and when combined with a more appropriate human health benchmark and uncertainty factors for carbofuran will show no exceedance of the risk cup from carbofuran drinking water exposures.

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84 *Id.*

85 *See* Furadan® 4F Label, EPA Reg. No. 279-2876 (stating that "Users are advised not to apply carbofuran where the water table (ground-water) is close to the surface and where the soils are very permeable, i.e., well-drained soils such as loamy sands.").

VII. EPA HAS OVERSTATED THE ENVIRONMENTAL RISKS OF CARBOFURAN[86]

A. EPA Has Overstated the Avian Risks Associated With Current Uses of Carbofuran

1. Wildlife-Monitoring Program Data Strongly Suggest That There Is No Significant Risk to Birds Posed by Flowable Carbofuran Use

Because carbofuran use is limited, very few animals come into contact with the insecticide, thereby significantly limiting carbofuran's potential risk profile. Indeed, the fact that carbofuran's limited use results in limited exposure, and therefore limited risk, is confirmed by a review of the extensive wildlife monitoring programs for carbofuran that have been conducted over the past decade to ascertain potential harm to wildlife from carbofuran. None of these monitoring programs found that carbofuran caused the death of any animals observed during the studies. Wildlife-monitoring programs were conducted in Texas, Oklahoma, California, Mississippi, Arkansas, Tennessee, and Louisiana.[87] Two years of surveying across seven states resulted in *not a single bird's death* being attributed to flowable carbofuran use on cotton fields. These surveys include:

> ***Texas 1996.*** 37 surveys were conducted in and around 20,092 acres, and over 154 linear miles were surveyed on foot in 11 counties.[88] Texas officials walked every row of the fields at a rate of two miles per hour or less, while intensively searching the ground and habitat for wildlife mortality. A mourning dove nest was identified and tracked through post-treatment without any

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86 Although the comments in this section focus primarily on the avian, mammalian, and aquatic risks associated with carbofuran, FMC acknowledges that, like many other insecticides, carbofuran can pose a risk to bees under certain circumstances. FMC is aware of the concerns raised by beekeepers in comments posted to the carbofuran docket. However, FMC believes these comments overstate the real risks carbofuran poses to bees. FMC has taken a number of stewardship steps to mitigate carbofuran's potential impact on bee colonies. These mitigation measures are reinforced by explicit warnings on the Furadan® 4F Label regarding the use of carbofuran on blooming crops or in areas where bees are visiting. See Furadan® 4F Label, EPA Reg. No. 279-2876 (stating that "This product is highly toxic to bees exposed to direct treatment or residues on crops. Do not apply this product or allow it to drift to blooming crops or weeds if bees are visiting the treatment area."). In addition, the label also contains explicit warnings for alfalfa (See Id., stating "Do not move bees to alfalfa fields within 7 days of application."), and sunflower applications (See Id., requiring foliar treatments be conducted "prior to bloom."). FMC believes that these mitigation measures have reduced the potential for honeybees to be exposed to carbofuran, thereby minimizing the risks posed by carbofuran to beneficial insects such as honeybees.

87 William W. Smith, *Avian Monitoring in Furadan 4F Treated Cotton Fields: 1995 – Texas, Oklahoma, California, Mississippi; 1996 – Arkansas, California, Louisiana, Mississippi, Oklahoma, Tennessee, Texas* (May 13, 1997).

88 *Id.* at Appendix 10.

> apparent effects to the hatchlings. *No wildlife mortality attributed to carbofuran was found*.[89]
>
> ***California 1995.*** 43 post-application surveys were conducted on 6,191 acres of cotton across five counties. Carcass searching activity occurred on the same day of application and up to three days post-application. Although wildlife kills included seven sparrows, fish, and a squirrel, laboratory necropsy and pesticide residue analysis found that *carbofuran exposure was not the causal agent for any of these losses*.[90]
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> ***Oklahoma 1995.*** The Oklahoma Department of Agriculture and the USDA trained individuals to survey 46 acres at eight sites, both the day before application and the second day following application of carbofuran.[91] The individuals searched both field perimeters and field interiors and performed carcass search efficiency trials. *No wildlife or avian moralities were detected as a result of carbofuran application*.[92]
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> ***Texas 1995.*** The Texas Department of Agriculture surveyed 66 treated fields (approximately 10,481 acres) on foot over a three-month span. While over 30 different avian species were sighted, *no mortality of avian species or wildlife was found attributable to carbofuran*.[93]

Additionally, reports of incidents connected to carbofuran exposure have dropped dramatically since the early 1990s, demonstrating that mitigation measures previously taken by FMC have proven effective in reducing and virtually eliminating the risks associated with proper carbofuran use. Real world experience with carbofuran strongly suggests that there is not presently a significant risk posed by carbofuran use.

2. EPA Employed Excessively Conservative Assumptions in its Avian Risk Assessment

EPA has dramatically overstated the risks that carbofuran poses to avian species. Although FMC acknowledges that carbofuran is highly toxic to birds, the simple fact is that carbofuran's low application rates, coupled with its niche usage and prior label mitigation measures (e.g., restriction regarding application near waterfowl), mean that *actual risks* to birds

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89 *Id.* at 11-12.

90 *Id.* at 8.

91 FMC Response to Draft EFED Chapter at 30.

92 Smith at 8.

93 One finch mortality was found, but its death was determined to have occurred pre-planting, precluding carbofuran from being the causal agent. *Id.* at 6-7.

– as opposed to hazards – are low. Consistent with its standard approach, EPA initially conducted a highly conservative screening level assessment (the "RQ methodology") and, when the screening assessment showed potential risks, EPA then conducted a more refined "probabilistic risk assessment" (PRA). Notwithstanding EPA's claims, however, the Agency employed such overly conservative assumptions, that it is not a surprise (and it is in fact expected) that the resultant "risks" would not differ significantly from those identified in the RQ methodology and would be deemed unacceptable.

For example, the Agency assumed that all of a bird's diet consisted of pesticide-treated food items *and* that all of its water contained carbofuran. Moreover, EPA assumed that *all* of this food and drink contained pesticide residues at elevated levels. Additionally, EPA's model relied on generic pesticide residue data, as opposed to carbofuran specific data. This combination of overly conservative compounded assumptions and unrepresentative generic residue data is highly unlikely ever to occur in the real world. As such, EPA's PRA is highly unrealistic, inaccurate, and therefore not the refined probabilistic assessment the Agency claims. Indeed, the assumption that all food and drink contain maximum residue levels of carbofuran clearly and obviously biases the assessment towards maximum mortality, which is not observed in the field.

EPA employed other overly conservative assumptions in its PRA. For example, EPA assumed that every avian species potentially consuming carbofuran could be as sensitive as the most sensitive species in any test, notwithstanding the fact that the available database shows a significant range in sensitivities (a range skewed low by the Agency's utilization of the whistling duck LD_{50}). In addition, EPA used the LD_{50} rather than the LC_{50} in this assessment, even though an LC_{50} is far more appropriate for a liquid formulation and far more representative of actual avian feeding behavior, and therefore carbofuran exposure.[94] In an LD_{50} analysis, a large bolus dose of pesticide, usually mixed in corn oil, is shoved down the throat of a starving bird. An LC50 study, in contrast, involves treatment of bird food items with carbofuran, such that the birds consume the pesticide in the normal course of feeding behavior.

EPA's reliance on LD_{50} data, rather than LC_{50} data, is inappropriate because it is not representative of what actually occurs in nature. Carbofuran is applied either foliarly or in-furrow, such that the oral exposure of birds or small mammals to carbofuran results from dietary ingestion of residues associated with feed items, with some possible exposure through water. However, for treated feed items, EPA has ignored the short-term dietary LC_{50} data, which provides a more appropriate index of toxicity for carbofuran, and instead used LD_{50} data, which represents an exposure scenario that does not translate into real world feeding habits and certainly is not analogous to birds feeding on or near a crop field. LD50 studies are appropriate for granular not flowable formulations. Additionally, acute oral toxicity data for mammals has indicated that these results can vary significantly, depending on the vehicle used to administer the dose (e.g., corn oil), because of the vehicle effect on the absorption of the test material through the gastrointestinal tract. None of these dose vehicles are present under natural

[94] FMC acknowledges that the ChemX SAP made statements regarding the use of LC_{50} versus LD_{50}; however, FMC disagrees with those statements, and further asserts that EPA has misapplied them to justify its analysis of carbofuran.

conditions, where pesticide residues are only present in or on feed items. Exposure via feed residues is analogous and therefore better represented by the exposure scenario that occurs in a dietary (LC_{50}) study.

Many of EPA's criticisms of the LC_{50} data represent deficiencies in its own testing guidelines and methods. Rather than upgrade its testing guidelines (as many laboratories have done independently), EPA chooses to ignore FMC's LC_{50} data and instead relies on LD_{50} data that plainly does not mimic what happens in the field. Indeed, EPA's whole avian risk analysis is based on an assumption of equivalence between LD_{50} and LC_{50} toxicity data, and estimates of daily food consumption – even though numerous short-term to subchronic dietary studies on animals for a variety of different pesticides indicate that this conversion and estimated dose or estimated LC_{50} procedure results in highly erroneous estimates of dietary toxicity when based on acute oral toxicity data. Indeed, it is well-documented that carbofuran is substantially less toxic via the dietary route than via the acute oral route.

Of significance, LC_{50} studies are conducted with very young, rapidly growing birds, so that daily feed ingestion as a percentage of body weight is high. Moreover, use of young birds may reflect an increase in sensitivity compared to adults. While not always proved the EPA always assumes the young birds are more sensitive. For the same species, LC_{50} values for the young birds used in short-term dietary testing are commonly lower (young birds are more sensitive) than LC_{50} values for older birds (juveniles, adults) used in other tests. EPA, however, maintains that the carbofuran LC_{50} values should not be used because feed ingestion rates for birds used in laboratory testing are not equivalent to feed ingestion rates for birds in the wild. As such, the Agency concludes that birds in the wild would ingest more feed daily based on theoretical calculations. This position, however, is nothing more than a theoretical assumption by EPA; it is not supported by any empirical data.

EPA also claims that the LC_{50} data are not reliable because of palatability or food avoidance reactions, and the data therefore must be disregarded. In fact, palatability and food avoidance are very real biological reactions of animals to treated feed. These reactions should be considered and included in any refined assessment, because they can significantly reduce potential exposure, and therefore, decrease risk. Thus, in the wild, where a bird has a choice for feeding, a bird may choose not to feed in a treated field because of pesticide residues. EPA, however, selectively ignores this important point when it chooses to use the LD_{50} data. LD_{50} data, however, are much more likely to result in an unrealistically conservative result that has no foundation in real bird behavior, and thus, cannot be sustained under scientific scrutiny. In sum, EPA's use of the LD_{50} data in lieu of LC_{50} data is not scientifically sound and results in risk estimates that are vastly overstated.

EPA's PRA also employs other assumptions that are both unlikely and overly conservative, further rendering suspect its conclusions about carbofuran. For example, EPA assumes only two very short feeding windows (one in the morning, the other in the afternoon) for all birds in its assessment. Again, this approach focuses only on the rare birds that may gorge themselves and ingest a large dose in a short time period, a scenario that does not represent the actual feeding patterns of the majority of species that may be found in and around agricultural fields where carbofuran might be applied. Of course, for an acutely toxic compound such as

carbofuran, this assumption strongly biases the assessment against carbofuran and towards an outcome predicting very high avian mortality.[95]

Moreover, FMC believes that EPA's model is biologically inaccurate concerning repeated feeding by birds that initially ingest a sublethal dose. EPA assumes that birds exposed to sublethal doses of carbofuran will return to feed again in the afternoon. In reality, however, numerous toxicity studies on birds exposed to cholinesterase-inhibiting compounds show that once a bird ingests a sufficient dose to elicit sublethal toxicity, those birds are unlikely to continue to feed until they recover from that dose. One of the earliest and most common signs of toxicity in birds exposed to cholinesterase inhibitors is that they display lethargy and stop feeding. This has been well-documented in the literature, rending it utterly unrealistic to assume – as EPA does – that a bird receiving a sublethal dose of carbofuran and experiencing signs of toxicity will return to ingest additional doses that result in mortality.

In its avian risk assessment, EPA has made other scientifically questionable assumptions that appear to drive the PRA avian model and result in scientifically flawed predictions. For example, EPA claims that census data of unmarked birds can be used to represent how much time individual birds spend on treated fields. This assumption, however, is not scientifically defensible because census results provide no information on how much time individual birds spend on the fields, and therefore cannot be used to predict what proportion of daily food and water intake of individual birds is obtained on the treated fields. EPA also appears to be using inaccurate assumptions about the half-life and physical characteristics of carbofuran in soil and water, further compounding the overly conservative nature of its assessment.

In addition, a key driver of the risk analyses is the assumption that all birds obtain all of their feed from the field interior, which is assumed to contain carbofuran residues. Numerous avian species are known not to use agricultural fields at all, or to use fields only sparsely, instead feeding primarily or only on the outer edges of the field. For example, research by Best *et al.* (1991) indicates that a majority of birds found feeding in crop fields use the edge area, rather than the field interior. EPA's assessment does not provide a good accounting as to what proportion within and among species may be found in proximity to the crop; what proportion may actually use the crop a substantial amount of time; and, what proportion of time those species using the crop may actually use the crop of interest. For example, avian field studies on several crops have shown that while a large number of species are observed around a crop, only a small percentage (10-15%) of those species actually use the crop; the remaining species use the surrounding area or fly over the crop.

[95] While some species may at some times feed extensively in a short time period (gorging), this scenario is not applicable to the majority of species that may be found in or around fields treated with flowable carbofuran. As such, EPA's PRA, which relies entirely on presumed gorging behavior, does not comport with the reality of exposure for the vast majority of species, rendering its conclusions enormously overly conservative and inherently suspect. Indeed, because EPA has relied exclusively on a feeding scenario that is known to be inaccurate in most cases, its PRA cannot in any meaningful sense be considered a "refined" assessment – or even a "probabilistic risk assessment" – as it never assesses what is most likely to happen in the real world.

Finally, EPA has not attempted to correlate how its modeled results, which are based on species that use the crops selected by the Agency,[96] relate to the majority of species that do not make such extensive use of these types of crop fields. Moreover, EPA does not explain how its analysis for selected crops applies to other crops. The Agency appears to be extrapolating its conclusions to all avian species and all crops, which is clearly an inaccurate assumption – and an important one, as the proportion of feed obtained from a treated area is a key driver in the Agency's risk assessment.

In sum, all of the most important assumptions contained in EPA's "probabilistic" risk assessment – 1) LD_{50} vs. LC_{50}; 2) all food and drink contains carbofuran at maximum residue levels; 3) gorging feeding behavior; 4) all species are potentially as sensitive as the most sensitive species; 5) birds in the wild do not experience food palatability or food avoidance reactions in treated feed; 6) birds exposed to sublethal doses of carbofuran will return to feed again; 7) all feed is treated with carbofuran; 8) census data of unmarked birds as representative of how much time individual birds spend on treated fields; and, 9) birds obtain all of their feed from the field interior – bias the assessment towards predicting maximum avian mortality. Taken together, these assumptions render the assessment unrealistic and overly conservative.

Indeed, the most that can be said from reviewing the results of EPA's PRA is that *if* a bird lands on a carbofuran treated field *and if* all of the feed and water located in or near that field is contaminated with carbofuran at maximum levels *and if* that bird is as sensitive as the most sensitive species *and if* that bird engages in gorging behavior – and does not find the food unpalatable and continues gorging notwithstanding initial signs of cholinesterase inhibition – that bird will likely die if, in fact, the LD_{50} is representative of toxicity in the wild, which it likely is not. Noticeably absent from EPA's assessment are any statements about how likely such a scenario might be. Moreover, all available evidence (which has been confirmed by available avian incident data) – including evidence on bird feeding behavior and on carbofuran's limited usage in niche markets – demonstrates that the mortality predicted by EPA's model will occur extremely rarely. As discussed above, the carbofuran field studies, as well as, well-designed monitoring programs in cotton fields in California, Oklahoma, Mississippi, Tennessee, Louisiana, Arkansas and Texas (conducted in 1995 and 1996) provide further support for the conclusion that the EPA's PRA seriously overestimates the potential avian mortality associated with the use of carbofuran on field crops.

In order to provide a more realistic assessment of potential avian exposure, and therefore risk, FMC conducted an alternative probabilistic assessment that modified some of EPA's more conservative assumptions (while retaining others). EPA, however, rejected FMC's approach as being insufficiently conservative, because not all of its assumptions were the most conservative

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[96] The 2001 ChemX SAP questioned the EPA's identification of species that use specific crop fields. *See* United States Environmental Protection Agency: FIFRA Scientific Advisory Panel Meeting, *Probabilistic Models and Methodologies: Advancing the Ecological Risk Assessment Process in the EPA Office of Pesticide* Programs, at 15, available *at* http://www.epa.gov/scipoly/sap/meetings/2001/march/march132001.pdf.

ones.[97] Yet EPA's practice of compiling overly conservative assumptions on top of overly conservative assumptions has the effect, in the words of the Presidential / Congressional Commission on Risk Assessment and Risk Management, of rendering the resultant assessments "so unrealistic [as to] impair. . . the scientific credibility of . . . risk assessment."[98] That is exactly what has happened here. FMC sought to approach the assessment in a way that maintained conservatism, but not the unscientific conservatism that was applied to EPA's PRA. The Agency's rejection of FMC's alternative probabilistic assessment and its retention of multiple excessively conservative assumptions render the overall avian assessment highly suspect and scientifically unsound.

EPA claims that FMC's model was not probabilistic, but the Agency is incorrect. In fact, FMC's assessment is probabilistic because modeled exposure distributions are divided by a distribution of toxicity values and, for certain analyses, distributions for additional factors impacting the risk assessment were included in the analyses. This assessment allows for the uncertainty and variability in the inputs to be addressed, in contrast to a deterministic approach. Moreover, FMC's assessment is more appropriately probabilistic than EPA's because it allows for distributions in the proportions of food items. That is, EPA appears to be extrapolating its highly conservative conclusions to all avian species and crops, but the Agency assumed (as noted above) that all food and drink consumed by the birds were treated with carbofuran at a variety of label rates; this assumption would be applicable only to a small fraction – if any – of all avian species. FMC, in contrast, determined that the proportion of feed obtained from a treated area is a key determinant for risk assessment, and therefore incorporated this variable into its model.[99]

Moreover, FMC's probabilistic model results are consistent with observed results from field data, whereas EPA's PRA predicts much more extensive mortality than has been observed with the use of flowable carbofuran (notwithstanding the limitations of the field data that EPA has identified). There is a substantial disconnect between reported field results and the level of mortality predicted by EPA's modeling scenarios. EPA's theoretical assessment predicts that high levels of avian mortality will occur frequently. Under such circumstances, both incident reports associated with labeled uses and monitoring programs would be expected to show much greater mortality than they do. On one hand, EPA discounts both the state monitoring programs and the available incident data, claiming that these programs miss the vast majority of mortalities that EPA believes are occurring, and on the other hand, EPA cites the incident data (but not the state programs) in particular as supporting its conclusions concerning avian mortality from carbofuran.[100] Yet if avian mortalities were occurring at anywhere near the level and frequency

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97 United States Environmental Protection Agency, "Response to Phase 3 Comments on Carbofuran Environmental Risk Assessment and Human Drinking Water Exposure Assessment," (February 17, 2006) ("Response to Phase 3 Comments") at 2.

98 Congressional Commission on Risk Assessment and Risk Management, *Risk Assessment and Risk Management In Regulatory Decision-Making*, 1997, Vol. 2 at 74.

99 EPA also criticized FMC for using point estimates for some model inputs rather than using distributions. FMC used point estimates because the full data sets used by EPA were not (and are not) available to FMC, such that FMC had to rely on the summary mean values provided by the Agency.

100 IRED at 23-4.

predicted by EPA, the incident record for carbofuran would be far more extensive. Moreover, in terms of reliability, other federal agencies, including USDA and the CDC, routinely rely on similar monitoring programs and the incident reporting system to track both avian diseases and the spread of human diseases by birds (e.g., West Nile virus). EPA offers no explanation as to why avian field programs that are suitable for use by human health and other agencies are insufficient for its assessment of avian hazard.

FMC extensively explained the basis and assumptions in FMC's probabilistic risk assessment, and responded to EPA's critiques of that assessment. The Agency, however, continues to disregard those results and rely on a cascading series of conservative assumptions that, taken together, impair the scientific credibility of the risk assessment. EPA's claim that current usage patterns of carbofuran are likely to cause significant avian mortality is not supportable in theory or empirically.

B. EPA's Excessively Conservative Assumptions Overstate the Mammalian Risks Associated with the Current Uses of Carbofuran

EPA's standard deterministic risk assessment (DRA) dramatically overstates the risks carbofuran poses to mammalian species. Although FMC acknowledges that carbofuran is toxic to mammals, its niche use patterns coupled with the limited quantity of active ingredient applied annually, mean that the actual risks – as opposed to hazards – from carbofuran to mammals are low. The DRA overstates mammalian risks because it contains a number of overly conservative assumptions, which include assuming that: 1) small mammals consume a diet that consists entirely of feed items containing maximum estimated pesticide residues over the duration of the short-term and long-term exposure periods; 2) small mammals ingest only the types of feed items (primarily plant feed items) included in the modified Hoerger and Kenaga nomogram; 3) small mammals consume a diet consisting entirely of a single type of feed item; 4) small and large insects contain initial pesticide residues equivalent to those found on leaf foliage and forage, or seed and fruits, respectively;[101] 5) no degradation of applied pesticide occurs over the short-term exposure period; and, 6) carbofuran is applied at the maximum label rate, over multiple application scenarios, at the maximum number of applications permitted with the minimum interval in between applications. As stated previously, FMC acknowledges that EPA's assessment should employ conservative assumptions based on good science; however, defaulting to overly conservative assumptions, as it has here, is *not required or contemplated* by FIFRA. Reliance on overly conservative assumptions causes the DRA to identify unacceptable mammalian risks that do not represent the real world risks associated with the use of carbofuran.

For example, EPA makes four unrealistic and overly conservative assumptions regarding mammalian diet. The first is that small mammals consume a diet that consists entirely of feed items containing maximum estimated pesticide residues over the duration of the short-term and long-term exposure periods – a severe and unrealistic assumption for chronic and acute risks that involve multiple feeding events. EPA acknowledged in its response to comments by FMC that

[101] Fletcher JS, Nellessen JE and Pfleeger TG (1994): Literature review and evaluation of the EPA food-chain (Kenaga) nomogram, in instrument for estimating pesticide residues on plants. Environ Toxicol Chem 9, 1383-1391.

more realistic estimates of percentage of diet contaminated with carbofuran could have been employed.[102] EPA dismissed the application of these "realistic estimates" based on an unsupported assertion that they "…would not result in any change regarding the conclusions" about mammalian risk.[103] To ensure reliability and validity, the EPA should have employed more realistic estimates to enhance the accuracy of carbofuran's risk picture.

The second assumption is that small mammals ingest only the types of feed items (mostly plant feed items) found in the modified Hoerger and Kenaga nomogram (e.g., only short grass, seeds, and small insects) over the duration of the acute and chronic exposure periods. While this assumption may simplify exposure estimation for purposes of the DRA, it ignores the fact that a number of key mammalian feed items are not captured by the nomogram (e.g., aquatic and soil invertebrates). EPA acknowledges that uncertainty exists regarding the overall diet of mammals in treated agricultural fields.[104] However, it responded to this uncertainty by defaulting to an assumption that greatly oversimplifies mammalian diet, producing unrealistic estimates of the risks posed by carbofuran to mammals.

Third, EPA estimates of the daily feed ingestion rates for various size small mammals overestimates their actual feed intake. The EPA's daily feed ingestion rates were estimated using the Nagy equation; however, actual empirical data on small mammals (shrews, voles, mice) indicate that these estimated daily feed ingestion rates substantially overestimate the actual daily feed intake.[105] This overestimate is significant because feed ingestion rate is a key factor in the outcome of the DRA – often driving the results. By overestimating a factor that drives the modeling outcome, the DRA necessarily produces an overly conservative and unrealistic assessment of risk.

Finally, the DRA assumes that small and large insects have pesticide residues similar to those found on leafy foliage and forage, or seeds and fruits, respectively, based on the Fletcher, *et. a1*, modifications to the Hoerger and Kenaga nomogram.[106] However, the Uptake,

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102 United States Environmental Protection Agency, "Response to Phase 3 Comments on Carbofuran Environmental Risk Assessment and Human Drinking Water Exposure Assessment," at 38-39 (February 17, 2006) ("EPA's Response to Phase 3 Comments") ("In the case of chronic effects, percentage of the diet contaminated could make a difference for single application scenarios…[multiple application scenarios] would require assumptions on the order of less then 20% [contaminated feed] for the risk picture to change.").

103 EPA's Response to Phase 3 Comments at 39.

104 *Id.*

105 For very small mammals (i.e., 15 gram and 35 gram animals), the estimated LC_{50} values based on these feed ingestion calculations are similar to the LD_{50} values. Published literature has shown that the LD_{50} is a poor predictor of the short-term dietary LC_{50}. *See* McCann, J.A., W. Teeters, D.J. Urban, and N. Cook, 1981. A short-term dietary toxicity test on small mammals. In: Avian and Mammalian Wildlife Toxicology: Second Conference, ASTM STP 757 (D.W. Lamb and E.E. Kenaga, eds.). American Society for Testing and Materials, Philadelphia, at 132-142. –.

106 Fletcher JS, Nellessen JE and Pfleeger TG, 1994. Literature review and evaluation of the EPA food-chain (Kenaga) nomogram, in instrument for estimating pesticide residues on plants. Environ Toxicol Chem 9, at 1383-1391.

Translocation, Accumulation, and Biotransformation database (UTAB) used to revise the original Hoerger and Kenaga nomogram does not contain any insect residue data.[107] Yet, the EPA offers no scientific rationale for extrapolating residues on plant-type feed items to insect and other invertebrate type feed items.[108] This failure is particularly pronounced in this instance, because the EPA relied on insect residue data in the avian probabilistic assessment. Use of this insect residue data in the DRA would increase the consistency of EPA's overall risk modeling efforts.[109] The significance of this inconsistency is apparent in EPA's response to FMC's prior comments regarding this issue. In its response, EPA suggested that using the insect residue data would reduce the DRA's risk estimates.[110] As noted by the EPA, this reduction in risk alone would not be sufficient to ensure that mammalian risk quotients were below the applicable levels of concern; however, correcting this assumption along with the other overly conservative risk assumptions noted above would change the mammalian risk picture significantly.

Another example of EPA's excessive conservatism can be found in the standard maximum estimated residues used by EPA in its deterministic avian and mammalian risk assessments. EPA used standard maximum estimated residues that represent the upper-end tail of residues in the UTAB database for each category of feed items. The standard maximum residue for short grass / long grass, forage / leafy foliage and seeds / fruits represent values greater than the 99th, 94th, and 98th percentile for each of those feed item categories, respectively. Using residue values on the outer edge of available data goes beyond making protective assumptions, and biases any modeling efforts against the compound being analyzed.

Disregarding FMC's critiques of EPA's mammalian risk assessment, the IRED concludes that the current usage patterns of carbofuran pose significant acute and chronic risks to mammals. However, as discussed above, this conclusion is the result of a cascading series of overly conservative assumptions that, when aggregated, produce a scientifically unsound and unrealistic estimate of the risks posed by carbofuran to mammals. This result is not supported by theory or by data from the carbofuran field studies which do not indicate significantly greater mortality of small mammals in carbofuran treated fields compared to controls, or post-application fields compared to pre-application fields.[111]

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107 Baehr, C.H. and C. Habig. 2000. Statistical evaluation of the UTAB database for use in terrestrial nontarget organism probabilistic risk assessments. In: Environmental Toxicology and Risk Assessment: Science, Policy, and Standardization – Implications for Environmental Decisions, ASTM STP 1403 (Greenberg, B.M., R.N. Hull, M.H. Roberts, and R.W. Gensemer, eds.). American Society for Testing and Materials, West Conshohocken, at 96-110.

108 EPA's Response to Phase 3 Comments at 40-41 (Rejecting alternative residue data because it had not been through QA/QC procedures).

109 EPA's Response to Phase 3 Comments at 40 (February 17, 2006). "Reliance on the referenced alternative insect residue data…would certainly result in more comparable risk estimates."

110 EPA's Response to Phase 3 Comments at 40-41 (February 17, 2006).

111 Booth, GM, LB Best, MW Carter and CD Jorgensen. (1989) Effects of Furadan® 4F on birds associated with Kansas and Oklahoma alfalfa fields (FMC Report NO. A87-2306/2307; EPA MRID Number 411107-01); Jorgensen, CD, RC Whitmore, GM Booth, MW Carter, and HD Smith. (1989) Effects of Furadan® 4F on birds associated with Nebraska and Texas/New Mexico corn fields (FMC Report NO. A87-2308/2309; EPA MRID Number 411106-01); Smith, W. (1997) Avian Monitoring in Furadan® 4F

C. EPA's Aquatic Assessment Is Unrepresentative Of The Vast Majority Of Water Bodies And Greatly Overstates Potential Aquatic Risks From Carbofuran

EPA's aquatic risk assessment employed cascading tiers of overly conservative assumptions that, taken together, result in implausible estimated carbofuran concentrations for the vast majority of water bodies. Moreover, although the Agency claims to have done a refined, probabilistic assessment for aquatic organisms, as far as FMC can tell, EPA *did not modify any of its conservative assumptions in the refined assessment.* The only modification the Agency made was to use the whole PRZM/EXAMS output to estimate potential exposure, rather than simply calculating the upper 90th percentile of potential exposure.

Incredibly, EPA claims that its PRZM/EXAMS modeling was not conservative – notwithstanding the clear evidence to the contrary.[112] As FMC has previously commented, the Agency made the following exceptionally conservative assumptions in its modeling for carbofuran:

- The receiving water directly abuts the treated field (no buffer at all), notwithstanding the fact that a GIS study that was conducted in the area of Mississippi where EPA's standard cotton scenario is located, determined that very few, if any, small farm ponds (or other water bodies) actually meet this key model assumption. EPA did not even evaluate the significant impact of this assumption on its aquatic EECs and resulting aquatic organism risk calculations.

- Carbofuran is applied at the maximum label rate to the entire watershed, which is 10 times the area of the pond. (The pond is assumed to be 1 ha in area and 6 feet deep.) EPA also assumes the maximum number of applications per season and the minimum interval between applications.

- The soil type and field slope are such that "site vulnerability was at the high end for the crop and carbofuran use scenario . . . to produce runoff greater than would be expected at 90% of the sites for a given crop/use."

- There is no inflow to or outflow from the pond, no precipitation input, and no water loss by evaporation – an essentially impossible scenario that results in overstated EECs.

- The pond receives all the carbofuran contained in runoff from the treated field. This assumption is implausible and overly conservative in that it

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Treated Cotton Fields 1995-Texas, Oklahoma, California, Mississippi 1996-Arkansas, California, Louisiana, Mississippi, Oklahoma, Tennessee, Texas (FMC Study No. A97-4624; EPA MRID No. 445002-01).

112 *See generally*, EPA's Response to Phase 3 Comments at 4-5 and 48-66.

assumes maximum runoff, but no dilution from an increase in water flow to the pond – even though the pesticide would not reach the pond, except via that water flow.

- The pesticide instantaneously and homogenously mixes throughout the entire pond. The result of this assumption is that there is no "safe zone" in the pond with lower pesticide concentrations.

- Runoff from the entire treated field reaches the pond; in other words, *all* of the pesticide from the treated field reaches the pond although, as noted above, none of the water actually does.

- All water bodies – no matter where located – have a pH of 7. As EPA is well aware, the hydrolysis rate for carbofuran varies significantly with pH, with faster hydrolysis occurring at higher pHs. Marine, estuarine and hard freshwater bodies typically will have pHs in the 7.7 to 8.4 range where carbofuran degrades far more rapidly. Such pH ranges are not considered in the modeling, even though many water bodies have pHs at this level.[113]

All of these independent assumptions (and several others) bias the model output towards very high-end estimates of potential concentrations of carbofuran in the water column. EPA then added additional layers of conservatism into its RQ calculations, by dividing instantaneous peak estimated water concentrations by 48- or 96-hour toxicity values, and calculating RQs based on upper end (upper 90th percentile) EECs derived from the modeling.

In addition to the foregoing highly conservative and compounded assumptions, EPA rejected FMC's data for several model input parameters (water solubility, aerobic and anaerobic aquatic metabolism) and instead either assumed a very conservative value for that parameter based on its input parameter guidance or assumed that carbofuran was stable for that parameter. But the aerobic and anaerobic metabolism studies provided by FMC were conducted according to EPA's testing guidelines, met the guideline criteria and provided valid data that should be used for environmental modeling. EPA's rationale for not using these data (i.e., that some abiotic hydrolysis may have occurred during the test in addition to microbial metabolism), to our knowledge, has never been applied to any other compound despite numerous examples of other compounds that have similar characteristics. Similar model inputs, as those suggested by FMC, are routinely used by EPA for environmental surface water modeling.

Moreover, even in EPA's supposedly "refined" probabilistic assessment, variability in carbofuran application rates, application dates, physical-chemical properties, degradation rates, soil, slope, proximity of the field to the pond, watershed area, PCA treated with carbofuran, pond dimensions, hydrology and water quality were not considered in the exposure analysis for each scenario. EPA failed even to consider the uncertainty surrounding each of these parameters – let

[113] Although EPA claims that its revised assessment provided some limited modeling of pHs at 8.0 and 6.2, the results of that modeling were not provided in the Agency's documentation and do not appear to have been incorporated into the aquatic organism risk assessment.

alone uncertainty about the model itself. The sole source of uncertainty about exposure addressed in the refined assessment was associated with the distribution of model parameters that were fit to the 30 annual maximum concentrations generated by each PRZM/EXAMS simulation. Thus, EPA's claim that, "[f]or the remaining 5% of fish species, 5% of the time (1 out of 20 years) acute mortality on the order of 0.4% or higher . . . has the potential to occur,"[114] is applicable only to the tiny subset of aquatic habitats represented by the exposure simulation – which otherwise vastly overstates the potential risk in the broad range of natural aquatic environments.

The unrealistic nature of EPA's modeling results, due to overly conservative parameterization, is confirmed by the fact that they produce results that are contrary to what is seen in the real world. For example, EPA predicts significant risks to aquatic organisms notwithstanding the fact that there has not been a single aquatic incident report attributable to carbofuran since 1991. Equally significantly, EPA's model predicts that marine and estuarine aquatic invertebrates will have the greatest potential risk from carbofuran use, but this result simply cannot be correct. First, marine and estuarine waters typically have a pH of greater than 7.0, and as EPA is well aware, carbofuran degrades rapidly at higher pHs – such that any realistic model should have predicted lower carbofuran concentrations for these waters. Moreover, marine and estuarine systems have large water inflows that would facilitate rapid mixing and dilution – again lowering carbofuran concentrations. The fact is that EPA's static pond scenario – the only scenario included in its model – does not and cannot accurately predict pesticide concentrations in marine and estuarine systems (or in rivers or many other types of water bodies), and EPA's assumption that it does results in implausible conclusions about aquatic risk.[115]

EPA attempts to support its application of the static pond modeling results to marine and estuarine organisms by claiming that use of the static farm pond scenario to estimate exposure to pink shrimp and Atlantic silverside relies on the appropriate assumption that runoff from a corn field is independent of a freshwater or saltwater system adjacent to the field.[116] Yet even if runoff is "independent" of the receiving water, the EEC is clearly a function of the volume and hydrology of the water body into which the pesticide is deposited and it is simply not credible to claim that marine and estuarine systems in any way resemble the static farm pond on which EPA's probabilistic assessment is based.[117] Moreover, runoff is *not* independent of soil and climate, which are likely to differ considerably between Indiana and most coastal locations.

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114 EFED at 160.

115 Indeed, EPA even acknowledges that the EECs used in *chronic* frequency-of-exceedance analysis are not applicable to saltwater habitats. EFED at 157. Yet there is simply no reason why this conclusion would not apply to all other aspects of the assessment for saltwater organisms, including RQs, probabilistic assessment of acute effects, and so on. As noted above, saltwater habitats have higher volumes and greater mixing than the standard pond scenario (as well as a higher pH than EPA assumed), such that saltwater organisms would have lower exposure to carbofuran than freshwater organisms.

116 EFED at 161.

117 Response to Phase 3 Comments at 65 ("EPA agrees that EECs are clearly a function of the volume and hydrology of the water body and that runoff is not independent of soil and climate.").

In the face of a multitude of overly conservative assumptions, the Agency nonetheless claims that variability in the modeled factors would be expected to "intensify the response" under field conditions – *i.e.*, that in the real world, effects from carbofuran would be expected to be worse.[118] The Agency provides no factual support for this statement which, in light of the overly conservative assumptions outlined above, simply defies reality. Similarly, EPA notes that smaller water bodies adjacent to heavily treated fields could have higher concentrations than the simulated ones – but does not mention that larger water bodies (*i.e.*, most water bodies), or flowing water, or water bodies separated from fields by vegetated strips, or water bodies with inflow or outflow, would have lower concentrations. Had EPA actually analyzed incorporation of buffer zones, watershed hydrology, and other more realistic assumptions than those employed, the estimated risks would be far lower.

Indeed, the available carbofuran monitoring data – discussed above in Section VI – suggest that EPA's "refined" PRZM-EXAMS modeling overstates what is seen in the real world by one to five orders of magnitude. EPA, however, criticized FMC for using WARP modeling and NAWQA monitoring data to calculate potential risks to organisms found in streams, lakes, reservoirs and other types of water bodies – claiming that its assessment was focused towards highly vulnerable areas. This argument is without basis. Although EPA obviously assessed only a maximally vulnerable scenario as part of its "probabilistic" assessment, the Agency extrapolates its estimated exposures and risks for aquatic organisms from its pond scenario to all other types of water bodies, and implies that its estimated risks based on its small, shallow pond scenario are applicable to all other types of water bodies (*e.g.*, marine and estuarine systems). This is simply and obviously inaccurate – the most that can be said about EPA's modeling is that it represents the upper end of potential risks for organisms in small, vulnerable water bodies with no flow, but that hardly translates – as EPA suggests it does – to significant risks to aquatic organisms in the majority of water bodies.

EPA also indicated that it does not expect the PRZM/EXAMS EECs to change dramatically for the granular formulation. FMC submits that EPA's effort to extrapolate modeling for flowable carbofuran to the granular formulation is scientifically invalid. The granular formulation is applied differently in ways that alter runoff exposure and eliminate exposure due to spray drift entirely. Therefore, the exposure from granular carbofuran to an adjacent body of water is sufficiently different from the flowable formulation to make EPA's extrapolation inappropriate.

Because the assumptions of the refined risk assessment are the same as the ones used in EPA's overly conservative screening level assessment, it is not surprising that the Agency reached the same broad conclusions under both assessments. Had EPA actually conducted a meaningful probabilistic assessment that incorporated ranges of parameters for the most important inputs, the Agency could have developed a more realistic analysis of actual watersheds and agricultural practices. Under assumptions more representative of the range of real-world exposure scenarios (including flowing water and saltwater habitats), risk estimates would be much lower than EPA's results. And although EPA's assessment may be acceptable as an initial

[118] EFED at 181-182.

screening approach, it is inappropriate to use such an assessment for any kind of regulatory decision-making, as the Agency appears to be doing here. A more realistic refined assessment would confirm what real world use shows – that under current use conditions, carbofuran does not pose a risk to aquatic organisms.

VIII. EPA'S UNSUPPORTED ASSERTIONS ABOUT THE RISKS ASSOCIATED WITH THE REMAINING USES OF GRANULAR CARBOFURAN DO NOT ACCURATELY REPRESENT THE RISKS

EPA's carbofuran EFED Science Chapter does not contain a new risk assessment for granular carbofuran to support the IRED's conclusions about the risks associated with the granular formulation.[119] Instead, EPA extrapolated from prior risk assessments, conducted on granular uses that are no longer permitted under the carbofuran label, to conclude that the granular formulation continues to pose an unreasonable risk to birds and mammals.[120] EPA made no effort to analyze the current risks, and it only describes, in passing, the current limited usage pattern of the granular formulation.

In 1991, FMC and EPA reached an agreement capping the annual sales of granular carbofuran at 2,500 pounds per year in order to address EPA's concerns about the avian risks associated with the granular formulation. This settlement not only dramatically reduced the quantity of granular carbofuran sold annually; it also drastically reduced the crop types where granulars are applied (applications limited to spinach grown for seed, pine progeny, bananas (Hawaii only), cucurbits, and cranberries[121]). The purpose of the granulars settlement was twofold: 1) to address avian risks, and 2) to retain uses of the granular formation that have substantial benefits.

In spite of these significant changes, to both the scope and scale of granular use patterns, EPA made no effort to update its granular risk assessment to capture current use patterns, or, more importantly, what species of birds are found in and around fields currently treated with the granular formulation, and among those species, which are at high risk due to their feeding behavior and use of treated fields. By presuming that the existence of unacceptable risks associated with prior granular use patterns means that existing uses pose unacceptable risks, the EPA is making an unsupported conclusion about hazard – *not* risk. Risk assessments necessarily change as usage patterns and quantities change. By ignoring changing use patterns and the dramatic reduction in the quantity of active ingredient applied, the EPA ignores the fact that the low quantity and niche use of granular carbofuran poses very low actual risk to birds. For example, the EFED Chapter does not consider the fact that the bird kill incidents it points to as an example of avian risk occurred almost exclusively at crops and for use patterns no longer permitted under the carbofuran label, except to say that the incidents related to prior uses are still

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119 EFED at xiii and 189.

120 *Id.*

121 FMC has since voluntarily cancelled the use of granular carbofuran on cranberries.

relevant because the use rates and methods are comparable.[122] However, nowhere in the EFED Chapter is it actually explained how those prior uses are comparable to current uses. Additionally, the assertion that current uses pose a risk is contrary to the EPA's prior conclusion that the current use patterns do not pose a risk, in part, because of the way in which the chemical is applied.

Additionally, previous granular carbofuran assessments have indicated widely varying potential exposures to the granular formulation.[123] Widely varying exposures necessarily create widely varying risk. This variation is based on differing application rates, application methods, and incorporation techniques. The EPA ignores this risk variation by: 1) failing to conduct new risk assessments that reflect the small number of uses and limited quantity of granular carbofuran applied annually; and, 2) relying on risk assessments for crops no longer on the carbofuran label. Furthermore, field data does not support the linear relationship between application rate and theoretical risk hypothesized by EPA. Actual data indicates that the risks associated with the granular formulation bear no clear relationship to the EPA's LD_{50} per square foot calculation, but that other crop-specific factors, not considered by the EPA's simplistic risk index, are much more significant determinants of the potential risks associated with the use of the granular formulation. The significance of these other crop-specific factors means that a risk assessment of the granular formulation for one crop cannot simply be substituted, as equally applicable, to other crops. By not capturing the variation in risks associated with different uses, or considering the current limited usage patterns along with improvement in agronomic techniques (e.g. more precise application), the EPA reaches a scientifically unsupported conclusion about the risks associated with the current use patterns of the granular formulation. To reach a scientifically sound conclusion, EPA must conduct a new risk assessment that accurately reflects current use patterns, application rates, and the limited quantity applied annually.

In addition to overstating the avian risks associated with the remaining granular uses, the IRED and EPA's human health analysis fail to acknowledge that the remaining uses of the granular formulation are within the FQPA risk cup for carbofuran. Therefore, the remaining granular uses do not pose a risk to human health. Similarly, the EPA's analysis fails to acknowledge the fact that granular carbofuran does not present a significant exposure risk to workers because of the physical characteristics of the formulation. These failures, combined with EPA's overstatement of avian risk, mean that the IRED presents an inaccurate and unrealistic assessment of the human health and environmental risks associated with the granular formulation of carbofuran.

While the EPA's analysis ignores the changed risk picture with respect to the granular formulation, the IRED continues to highlight the significance of the granular formulation for those crops where it is used by asserting that: 1) only limited alternatives are available for control

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[122] EFED at xiii ("A large number of these bird kill incidents have been attributed to secondary exposure following the normal application of granular carbofuran…The majority of these incidents attributed to granular carbofuran have occurred at crop sites where the granular form is no longer registered for use.").

[123] United States Environmental Protection Agency, Office of Pesticides and Toxic Substances, "Carbofuran Special Review Technical Support Document," (January 1989) at Section II-13.

of pales and pitch weevil in pine seedlings;[124] 2) granular carbofuran is the only pesticide available for control of springtails and European crane flies in spinach grown for seed;[125] and, 3) cucurbit growers would face higher production costs if carbofuran were no longer available.[126] Balancing these continuing benefits against a realistic assessment of the limited risks associated with the remaining uses of the granular formulation clearly justify its continued registration.

By ignoring the variation in risks associated with different uses, and failing to consider the current limited uses and application patterns, the IRED reaches a scientifically unsupported conclusion about the risks associated with the granular formulation. This error is compound by the fact that the agency ignores the clear and demonstrated benefits associated with present use patterns. By overstating risks and understating benefits, the IRED reaches inaccurate conclusions about the risks and benefits of granular carbofuran, and thereby its eligibility for reregistration.

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124 IRED at 35; *see also* Carbofuran Response to Comments and Alternatives Analysis for Crops with Low Usage at 19 ("For spinach grown for seed, there appears to be a need for carbofuran.").

125 IRED at 35; *see also* Carbofuran Response to Comments and Alternatives Analysis for Crops with Low Usage at 13-14 ("Based on currently available information, BEAD believes that there may be benefits to growers from this use of carbofuran, but were are unable to estimate the magnitude of such benefits at this time.").

126 *See e.g.*, Impact Assessment for Carbofuran on Cucurbits (Cucumbers, Pumpkins, Squash, and Watermelon) at 9.

IX. CONCLUSION

As explained above, EPA's assessment of carbofuran is not supported by legitimate scientific analysis or data. In addition, the default overly conservative and compounded assumptions applied by EPA are without foundation and are inconsistent with FIFRA and the FFDCA, and, EPA's modeled conclusions are completely at odds with real-world usage or experience with this product. For the foregoing reasons, FMC believes that carbofuran, a limited-use, but critically important pesticide, can be used safely, and should be reregistered. FMC encourages EPA to reconsider its proposed cancellation and instead approve the reregistration of carbofuran in the final RED.