Department of Pesticide Regulation

Brian R. Leahy
Director

Edmund G. Brown Jr.
Governor

MEMORANDUM

TO: David Duncan
Environmental Program Manager II
Environmental Monitoring Branch

FROM: Terrell Barry, Ph.D.
Research Scientist IV
Environmental Monitoring Branch
916-324-4140

Original Signed By

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SUBJECT: RESPONSES TO PEER REVIEW COMMENTS

The peer reviewers were presented 5 questions. Summarized peer reviewer responses and specific peer reviewer comment that require more detailed DPR response are listed, following the statement of each question.

1. *DPR used data from 28 of the 47 fumigations available to determine buffer zones and correctly excluded, for scientific and policy reasons, data from 19 of the fumigations*

All three reviewers agree that DPR used valid methods to exclude the 19 fumigations. Of the 19 fumigations removed, the exclusion of the four Arizona fumigations from data volume 0199-0072 was noted by Dr. Seiber and Dr. Miller as being the least well supported. Both of these reviewers stated that the basis for removal should be better described. Dr. Guo stated that excluding those four fumigations as outliers was reasonable. The four fumigations from data volume 0199-0072 showed very large flux values relative to the remainder of the chloropicrin flux database. Examination of the conditions under which those four applications were made showed that the applications did not satisfy the current good agricultural practices (GAPs) required on the federal chloropicrin labels. In addition, outlier analysis indicated that those four flux values were, indeed, statistical outliers. Thus, a decision was made to remove those four applications from the flux analysis and buffer zone development (Reardon, 2013). These removal criteria will be described in more detail in the revised document.

Dr. Seiber also stated that it seemed arbitrary to remove the three Symmetry method fumigations on the basis that the method is not practiced in California. For the purposes of mitigation method development, DPR focused on the methods used in California. The Symmetry method fumigations are significantly different from the methods used in California. That does not preclude the use of the Symmetry method but the buffer zone assigned to that method would be, by default, the buffer zone for the tarp/application method/application rate combination used in the application rather than the Symmetry method specifically. The potentially flux reducing feature of the Symmetry method can be accounted for by the reduction in application rate.

2. DPR classified chloropicrin fumigation methods into only three groups, based on tarp type, and correctly excluded other tarp and application type.

All three reviewers agreed in general principle and also stated that the statistical analysis is appropriate. Dr. Miller agreed in its entirety and pointed out that having only three groups streamlined enforcement and reduced the likelihood of misapplication. Dr. Seiber agreed with the division into three tarp types but also commented that other factors such as depth of injection, soil temperature, and soil moisture, among other factors, be considered. Dr. Guo also noted that the applications were made under widely differing conditions of soil moisture, temperature, weather conditions and locations. He suggested that these varying conditions might confound the ANOVA. He also advised that "…DPR use published research findings to provide additional support for the ANOVA inferences."

Since receiving the Peer Reviewer Comments DPR has elected to employ a division of application method and tarp combinations that is consistent with the divisions used on current federal chloropicrin labels. Thus, the following application method/tarp type groupings will each have its own buffer zone table:

1. TIF tarp broadcast shank injection
2. TIF tarp broadcast bed injection
3. TIF tarp broadcast strip deep injection
4. TIF tarp drip
5. Non-TIF tarp broadcast shank injection
6. Non-TIF tarp broadcast bed injection
7. Non-TIF tarp strip injection
8. Non-TIF tarp drip
9. Untarped broadcast shallow shank injection
10. Untarped broadcast deep shank injection
11. Untarped broadcast bed injection
12. Untarped drip

Dr. Guo further questioned whether the assumption of flux being proportional to application rate was valid. It is true that the flux of chloropicrin from a particular fumigation is the result of the totality of the conditions listed by Dr. Seiber and Dr. Guo. However, DPR has conducted an analysis to validate that flux is a linear function of application rate. That analysis and discussion will be added to the updated technical document. The DPR analysis results mean that application rate does not have to be specifically accounted for beyond standardizing all application flux to a uniform application rate. All fumigations in the DPR analysis were standardized to a uniform application rate of 200 lbs/ac for the statistical analysis.

The fact that the applications in the chloropicrin flux database were conducted over widely varying conditions and that the statistical analysis still detects differences in maximum flux associated with tarp type shows the strength of these results. DPR is seeking to develop statewide applicable mitigation measures. While it is likely that soil type, soil moisture and soil temperature influence flux, the difference that influence might produce has not been reliably measured in field collected flux data. For example, the DPR analysis in Appendix 3 of the document in review shows the difficulty in detecting the effects of soil water availability in field data.

Dr. Guo also commented that the strip application method fumigations are practiced in California (e.g., in orchards) and therefore, cannot be neglected in the buffer zone development. As discussed above, although it was not specifically stated in the document under review, the TIF strip application method will be addressed in the mitigation document.

Dr Seiber suggested examining the references in Woodrow et al. Correlation to estimate emission rates for soil-applied fumigants, J. Agricultural and Food Chemistry, 59, 939-943 (2011). This paper will be valuable for focusing both field research and HYDRUS research on potential flux reducing factors. The references will be reviewed in that context.

3. *Peak flux sometimes occurred during the day and sometimes during the night, and the DPR correctly and completely accounted for these time periods.*

All three reviewers agree that the DPR did correctly and completely account the day/night maximum flux in an appropriate manner.

4. DPR concludes insufficient evidence exists to support most buffer zone reduction credits, contrary to the U.S. Environmental Protection Agency's (U.S. EPA's) conclusion.

Dr. Miller agrees with the DPR approach to using only field level studies to develop emission factor credits. He further agrees with the DPR proposal of only allowing tarp type credits.

Dr. Guo concludes that, even though USEPA has confidence that the allowed emission factors change the chloropicrin flux profile, it is reasonable for DPR to award only tarp credits. But he also states that the statistical analysis of the 28 field experiments cannot be used to support the DPR approach. This conclusion about the ANOVA is correct. In fact, DPR did not use statistical analysis directly to arrive at the conclusion to not use credits. Instead, a simple numerical value comparison was employed because there were not enough observations of the KTS, water seal following application, and injection depth to perform statistical analysis. Those simple numerical value comparisons showed that the maximum flux for those three emission factors were similar (or in some cases greater) than the mean maximum flux of the appropriate application method groups (see pp6-8 and figure 2 and 3 of Barry, 2013b). This simple comparison indicates that there is not enough confidence to award shorter buffer zones for the proposed emission factors of

KTS, water seal following application, and injection depth.

Dr. Seiber encourages DPR to accept GLP lab chamber and related data but he also stated that use of that data to develop buffer zone credits is not necessary. He further encouraged DPR to confer with EPA on using model generated or lab chamber data for fumigants. This is a good suggestion. And, in fact, DPR has conferred with EPA on their Factors document that was used to develop the EPA buffer zone credits and DPR continues to confer with EPA on various aspects of the fumigant exposure mitigation measure development.

5. DPR utilized 1.25 m/s as the definition of a calm hour for wind speed and direction data from the California Irrigation Management Information System (CIMIS). Speeds at or below 1.25 m/s are considered calm hours for purposes of modeling and speeds above 1.25 are considered non-calm hours.

Dr, Guo and Dr. Seiber both agree that the wind speed threshold of 1.25 m/s is scientifically acceptable. Dr. Seiber suggests adding the analysis to the revised memorandum. That section will be added to the revised memorandum.

Dr. Miller did not provide a response to this question.

The Big Picture

In this section the following questions were proposed:

(a) Are there any scientific issues not mentioned above that are part of the scientific basis of the proposed rule? If so, please comment on whether these are based on sound scientific knowledge, methods, and practices.

(b) Taken as a whole, is the scientific portion of this proposal based upon sound scientific knowledge, methods, and practices?

Dr. Guo commented: “Overall, the methodology used by DPR to develop buffer zone and mitigation measures for chloropicrin is scientifically sound and practically applicable. However, data from the selected 28 field chloropicrin applications are not adequate to support essential statistical analyses for concluding buffer zone reduction credit programs. The reviewer suggests that published research findings (i.e., from field plot experiments) be combined with the field application data to develop chloropicrin fumigation buffer zones.” This comment is similar to an earlier comment by Dr. Guo and was addressed above.

Dr. Guo also presented a list of 9 suggested editorial changes to the main memorandum. Those changes will be incorporated into the revised document where appropriate.

Dr. Guo and Dr. Seiber provided specific comments on the memorandums included as appendices of the main document. The documents in the appendices were provided only for easy reference as supporting materials. All of the appendices documents are finalized memoranda so no changes will be made to those documents.

Dr. Miller states, with regard to the Big Picture: "The scientific validity of the California DPR's methods for determining the variables for establishing buffer zones appears sound." He presents 5 additional review points. The first relates to adding discussion on the environmental fate of chloropicrin related to chloropicrin concentrations in soils or air. DPR has previously issued a document documenting chloropicrin environmental fate (Beauvais, 2010). That document can be cited as reference in the revised document. The second point asks for additional, more detailed discussion on the variety of tarps used in the studies. DPR grouped the tarps according the U.S. EPA tarp grouping guidelines so more detailed discussion would not change the grouping. However, this is an area where further field research could be valuable. The third point is related to how well the modeled air concentrations would match the concentrations measured in the studies. The PERFUM model uses the ISCST3 air dispersion model to estimate the chloropicrin air concentrations. The ISCST3 model has been previously vetted by DPR for simulating air concentrations associated with fumigant soil applications (Ross, et al., 1995 and Johnson, 2001). In addition, the ISCST3 model is a U.S. EPA Office of Air approved regulatory model. The fourth point confirms the use of the maximum direction buffer zone as reasonable and the best choice for DPR's mitigation methods. Point five reiterates that the decision by DPR to not allow buffer zone credits is reasonable and well supported by the DPR analysis.

Dr. Seiber suggests that the memorandum be designated as open to updates so that new information can be incorporated. This new information could include data from Hydrus runs as that method of analysis is developed or new mitigation measures to reduce chloropicrin flux from the soil. This is a good suggestion and will be considered going forward.

Dr. Seiber comments that uncertainty of the results is not adequately specified, specifically for buffer zone distances in the buffer zone table. Because the buffer zone tables are regulatory in nature, neither DPR nor U.S. EPA, includes an uncertainty factor along with the buffer zone distance.

Dr. Seiber comments, similar to Dr. Guo, that there is no discussion about the environmental fate of chloropicrin, specifically reactions that may degrade chloropicrin in the air. DPR has previously published an environmental fate document on chloropicrin. Dr. Seiber asks if DPR assumed chloropicrin in air is stable to reactions that might degrade the chemical. That is correct; under the 8 hour averaging time it is assumed that there is no chloropicrin degradation. Chloropicrin is degraded in the soil by various routes but that degradation is taken into account implicitly as part of the flux profile. The maximum flux value characterizes the flux of chloropicrin present in the soil during that sampling interval only, and a proportion of that mass

is lost from the soil into the air. Once that chloropicrin is lost to the air, estimates of the half-life of chloropicrin in closed chambers due to photolysis by sunlight range from 3 hrs to 18 hrs. One author predicted that the half-life under ambient sunlight conditions might be between 3.4 and 7.6 hours. There are only a few studies available and it is most conservative from a human exposure perspective to assume there is no degradation of chloropicrin during the 8 hour averaging time used to develop the buffer zones.

Dr. Seiber asked why the 6 hr flux was directly used as an 8 hr flux without adjustment to the longer averaging period. A longer averaging period, all other factors held constant, would yield a lower flux. A peak-to-mean adjustment to 8 hrs could have been made but it was deemed preferable to use the measured flux directly because the peak-to-mean adjustment would introduce additional uncertainty. Using the 6 hr flux directly as an 8 hr flux produces more health protective buffer zones.

Dr. Seiber comments that a discussion of the effect of soil water on the flux should be included in the section of the memorandum that includes Table 1. This will be included in the revised document.

Dr. Seiber comments that injection depth should be further explored as a factor in the magnitude of flux. It is agreed that depth is likely a factor, together with other factors, in determining the magnitude of chloropicrin flux. The current chloropicrin flux database does not show a distinct difference due to depth. However, DPR has elected to separate out deep application methods from shallow application methods on an operational basis. The flux data for the deep applications is used to develop buffer zones for those application scenarios.

Dr. Seiber comments that the addition of KTS following application appears beneficial in lab, chamber, and field studies. He further suggests that results from those studies should be presented in the memorandum in footnote format. As discussed above, DPR only uses field data to develop mitigation measures. The available field studies were included in the DPR database and the KTS application flux estimates were not different in magnitude from the same application types without KTS applied.

Dr. Seiber comments that there is periodicity of the flux evident in Figure 8 on page 18. That is a correct observation and will be more fully explored in the revised document

Dr. Seiber comments that Figure 10 on page 19 is difficult to decipher, he indicated that Figure 10 is not called in the text, and asks what purpose Figure 10 serves. On page 16 the text states: “Figures 8 to 11 give a visual step by step guide to how the buffer zones shown in Tables 5 were developed.” This figure was included to illustrate the wide variety of the buffer zone distributions within the same application scenario. This wide variation must be captured in the buffer zone development process which is why DPR used the method presented in the document

under review. A clearer discussion will be included in the revised document.

Dr. Seiber comments that head-space analysis under the tarp instead of full flux determination would be a preferred method to determine the required tarp cutting delay. He asked if that method was considered. This method was considered and attempted. Unfortunately, the instrument used to measure the real-time headspace concentration was highly variable and the data could not be used to determine the appropriate days for tarp cutting.

Dr. Seiber comments that the discussion on page 25 concerning the whole field buffer zone method compared to the maximum direction buffer zone method should be simplified and clarified. This comment will be incorporated into the revised document.

References

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