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Clomazone Damage to Off-Site Vegetation: Test Results Are Negative But Plants Are Wither and Die

by

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CLOMAZONE DAMAGE TO OFF-SITE VEGETATION: TEST RESULTS ARE NEGATIVE BUT PLANTS WITHER AND DIE

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I. BACKGROUND

Command is a pesticide commonly used in the upper Midwest to inhibit undesirable growth in soybean fields. Its active ingredient is the chemical "clomazone."

On May 30, 1989, Maria Romanski, a grower of organic herbs and vegetables, observed a plume of dust spewing from behind farm equipment that was spraying a planted soybean field adjacent to her commercial nursery in southern Wisconsin. The plume drifted off of the soybean field, and drifted onto her property and the herbs and vegetables she and her husband were growing for market. Because she was unable to persuade the sprayer to stop, Mrs. Romanski reported the incident to the Wisconsin Department of Agriculture. Inspectors arrived at the property the same day, took vegetation and soil samples of the exposed vegetation, and advised the Romanskis that it would violate state law for them to sell the herbs and vegetables to the public if they contained pesticide residues. In the weeks that followed, plants on the Romanski property developed extensive whitening—a characteristic sign of exposure to clomazone. The Romanskis brought legal

* Professor of Law, University of Wisconsin. Mr. Tuerkheimer represented the Romanskis in the litigation referred to in the second paragraph of this article. A settlement was reached as to compensatory damages, and a jury awarded plaintiffs $75,000 in punitive damages against the pesticide sprayer.

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action against the pesticide sprayer and others for damages caused by the sprayer's tortious conduct resulting in the exposure of their organic herbs and vegetables to clomazone.

Almost all two and one-half acres of crops were destroyed. Yet, the analyses of vegetation and soil samples, taken almost immediately after the drift by state officials, failed to detect clomazone residues. Clearly, the testing methods used by the state were inadequate.

The anomaly of negative test results with almost total destruction of the crops has resulted in an investigation of other Midwestern, pesticide-residue-analysis laboratories' experiences with clomazone. This investigation showed that the failure of the Wisconsin laboratory to detect clomazone residues from environmental samples is not exceptional.[1] Furthermore, it appears that the analytical methods developed under laboratory conditions are unreliable when applied to plants that have been exposed to clomazone under environmental conditions.[2] These analytical methods appear to be inadequate to reasonably ensure that any residues existing on raw agricultural commodities are below specific tolerances established by Environmental Protection Agency.[3]

A weed is a plant that is out of place. Pesticides are designed to kill weeds while not destroying desirable vegetation in the vicinity. Command, the registered trademark for the pesticide whose active ingredient is clomazone, is manufactured by FMC Corporation for use with soybeans.[4] In experimental field trials, soybeans demonstrated

1. Telephone interviews with: Abul Anisuzzaman, Supervisor, Consumer Analytical Laboratory, Ohio Department of Agriculture (Aug. 29, 1991); Roger Bishop, Supervisor, IDALS Pesticide Laboratory, Iowa Department of Agriculture and Land Stewardship (Aug. 29, 1991); Bill Bulmer, Supervisor, Toxic Substances Section, Michigan Department of Agriculture (Sept. 24, 1991); Heidi Fischer, Enforcement Supervisor, Minnesota Department of Agriculture; Wayne Pask, Supervisor, Pesticide Residue Section, Office of the Indiana State Chemist (Aug. 28, Sept. 5, 1991); Jim Stedelin, State Diagnostic Laboratory, Illinois Department of Agriculture (May 31, 1991); Steve Hutson, Pesticide Residue Analysis Laboratory, Wisconsin Department of Agriculture (Oct. 1, 1991).

2. Despite uncertainties regarding analytical methods for testing for residues of Command on crops, the EPA recently granted a specific tolerance for Command on pepper, claiming that "[t]he nature of the residue is adequately understood, and an adequate analytical method . . . is available for enforcement purposes." 55 Fed. Reg. 49,646 (1990). It has also proposed a rule granting a specific tolerance for Command on winter squash. 56 Fed. Reg. 42,574 (1990).

3. *See* EPA Tolerances and Exemptions from Tolerances for Pesticide Chemicals in or on Raw Agricultural Commodities, 40 C.F.R. §§ 180.01, 180.425 (1991).

4. FMC Corporation, Agricultural Chemical Group, Command Herbicide, Technical Data (1986). Clomazone, is the chemical name for 2-[2(2-chlorophenol)methyl]-4, 4-dimethyl-3-isoxazolidinone. The herbicidal activity of clomazone was discovered in the early 1980's, when researchers for FMC discovered that sensitive plants displayed chlorosis, or bleaching, upon exposure. Grasses and broadleaf weeds were affected at very low application rates. *See* Chang &

excellent tolerance to clomazone, while a wide variety of grasses and broadleaf weeds were sensitive to it even at low levels.[5] The problem with clomazone is that many desirable plants, as well as weeds, are susceptible to its pesticidal action. Compounding the problem is the pesticide's proclivity to drift, thereby causing damage to crops and other desirable plants in adjacent areas.[6]

II. THE PROBLEM: TEST METHODS AND VEGETATION DAMAGE

First marketed in 1986, clomazone was intended for pre-plant or pre-emergent use on soybeans.[7] Although 1985 field trials proved uneventful,[8] numerous problems with drifting were reported in 1986, when clomazone first became commercially available.[9] Early in the 1986 planting season, the same growers who had used it uneventfully the previous year in experimental trials reported numerous incidents of pesticide drift during application, causing damage to nearby vegetation.[10] After application, clomazone showed a tendency to volatilize from moist soils, and then drift off-site. Even minuscule quantities of clomazone caused bleaching, and sometimes permanent damage, to

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Konz, FMC Corporation, *Synthesis and Herbicidal Activity of 3, 5-Isoxazolidinones*, 187th A.C.S. Nat'l Meeting, Am. Chemicals Soc'y (Apr. 8-13, 1984); Chang & Konz, FMC Corporation, *3-Isoxazolidinones: A New Class of Herbicides*, 187th ACS National Meeting Am. Chemical Soc'y (Apr. 8-13, 1984).

Command was first registered with EPA as a new chemical in 1986, and is marketed as two end-use products: Command 4 EC (Reg. No. 279-3053) and Command 6 EC (Reg. No. 279-3054). *See* EPA Pesticide Fact Handbook, *Command Herbicide*, Fact Sheet Number 90.1 (June 20, 1986).

5. Palmquist & Hopper, FMC-570260-1985 EUP/TT Results, 1986 Proceedings, S. Weed Sci. Soc'y, 39th Annual Meeting 522 (abstract).

6. Poster, *Command Herbicide: The Rookie Battles Controversy*, CROPS AND SOILS MAG, Oct. 1986, at 9.

7. FMC Corporation, *Command 4 EC*, 1989 Crop Protection Chemicals Reference 1185, 1187; FMC Corporation, Agricultural Chemical Group, Technical Data, Command Herbicide (1/15/86).

8. The EPA reviews data derived from field trials in order to assess "Hazards to non-target organisms" from pesticidal action. Additional testing, precautionary label statements, or other action may be ordered by the EPA when data so requires. 40 C.F.R. 158.202(h) (1991).

9. The EPA addressed in a pesticide fact sheet reports of the damage to off-site plants from Command, Fact Sheet Number: 90.1, issued June 20, 1986. The Agency noted that "some desirable plants, including ornamentals (e.g., roses), trees (e.g., flowering and edible cherries), agronomic crops (e.g., small grains, alfalfa, sunflowers), and vegetables (e.g., lettuce, cole crops, radish) are sensitive to Command herbicide." However, the Agency believed that most of the effects were visual and temporary. As we have seen, Command can produce permanent damage and economic loss to sensitive desirable plants. *See infra* notes 14-16 and accompanying text.

10. Poster, *supra* note 6, at 9.

sensitive off-site plants which resulted in economic loss for the owners.[11]

To reduce the incidence of damage to non-target vegetation, the Environmental Protection Agency required FMC to change the pesticide label, significantly restricting the conditions under which it could be used.[12] Under these constraints, clomazone may only be applied before a field has been planted, and must be incorporated within a few hours of application. Incorporation is a process which uses field equipment to mix the pesticide into the top few inches of soil[13] to prevent the post-application volatization, and subsequent off-site drift, of the pesticide.[14] Since such incorporation would disrupt planted soybean seeds, clomazone can no longer be used once a field is planted. Also, clomazone cannot be applied when wind conditions exceed ten miles per hour, and in addition, cannot be applied within a thousand feet of commercial vegetation areas and nurseries.[15] Despite these label constraints, each year there are numerous incidents of damage through the use of clomazone to sensitive, non-target plants.[16] Often in these cases, where state officials have been called to investigate, state laboratories have not been able to confirm the presence of clomazone residues in the vegetation or soil samples obtained.[17]

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11. EPA, Office of Pesticide Programs, Command Herbicide, Fact Sheet Number: 90.1 (June 20, 1986); EPA, Region 5, Memorandum from John L. Ward, Chief, Pesticides Section, regarding Office of Compliance Monitoring's Response to Two Pesticide Misuse Incidents in Indiana, 5SPT-7, (March 2, 1990); and Ronald Doersch, University of Wisconsin Extension Agronomist, undated memorandum regarding Command carryover.

12. Federal law requires that registered pesticides be used only in a manner permitted by the labelling. That law is commonly known by its acronym FIFRA. *See* 7 U.S.C. § 136 (1986) and Pesticide Spray Drift Evaluation 40 C.F.R. § 158.202(g) (1991).

13. FMC, Command 4 EC, Crop Protection Chemicals Reference, (5th ed. 1989).

14. Thellen et al., *Comparison of Application Methods and Tillage Practices on Volatization of Clomazone*, 2 WEED TECH. 323, 326 (1988).

15. FMC, Command 4 EC, Crop Protection Chemicals Reference, (5th ed. 1989).

16. Telephone interviews with: Katherine Fedder, Plant Pest Management Services, Michigan Department of Agriculture (Sept. 24, 1991); Roger Bishop, Supervisor, IDALS Pesticide Laboratory, Iowa Department of Agriculture and Land Stewardship (Aug. 29, 1991); Wayne Pask, Supervisor, Pesticide Residue Section, Office of the Indiana State Chemist (Aug. 28 & Sept. 5, 1991); Jim Stedelin, State Diagnostic Laboratory, Illinois Department of Agriculture (May 31, 1991); Steve Hutson, Pesticide Residue Analysis Laboratory, Wisconsin Department of Agriculture (Oct. 1, 1991).

FMC recommends the use of Command with other pesticides. However, because there have been so many reports of damage to non-target vegetation caused by Command, the maker of at least one other pesticide has refused to pay damage claims relating to the use of it's product, if it was used along with Command. United Press International, Dateline, Des Moines, Iowa, (June 20, 1989).

17. *Id.*

Before a pesticide can be registered and legally marketed, the EPA requires the maker to supply the EPA with data from a test method that is adequate to detect and quantify pesticide residues, and any of its major metabolites, on agricultural commodities.[18] Approved test methods for particular pesticides are published in the EPA's Pesticide Analytical Manual, and are available to state agencies authorized to enforce state and federal pesticide laws. Test methods must be sensitive enough not only to detect the presence of residues of a particular pesticide, but to quantify minute quantities that may be present in agricultural products intended for consumption.[19]

Generally, the test method developed by the pesticide maker is the best choice for detecting and quantifying pesticide residues on vegetation.[20] Consistent with this general practice, the method state laboratories use to analyze clomazone is the method developed by FMC. However, as Martha Bradley, an editor in the EPA Office of Pesticide Program's Pesticide Analytical Manual, notes, "there was a lot of calling back and forth between the EPA and FMC before that method was approved."[21] Even so, Ms. Bradley acknowledges that FMC's method does not meet the standards generally applied by the EPA to analytical methods for pesticide-residue analyses. The problem is that laboratory technicians outside of FMC laboratories could not replicate FMC's results. Chemists in state residue-analysis laboratories have had similar difficulty.

William Bulmer, supervisor of the Toxic Substances Section at the Michigan Department of Agriculture, notes that the Michigan pesticide-residue-analysis laboratory tried to work with FMC when Michigan's pesticide laboratory failed to detect clomazone in vegetation samples from sites under investigation. At first, Mr. Bulmer thought

18. *See* Residue Chemistry, 40 C.F.R. § 158.202(c) (1991).

19. On petition by the maker, or other interested party, the EPA may grant a tolerance for the presence of small amounts of a particular pesticide, remaining as residues, on a specific agricultural commodity. A specific tolerance is set forth as a rule in the Code of Federal Regulations. A tolerance is granted only when the maker has satisfied the Agency that the presence of the residue poses no unreasonable health or environmental risk. If no tolerance for a specific raw agricultural commodity has been granted, then even negligible residues are prohibited. The maker must supply EPA with a test method that is adequate to determine whether any residues on a specific raw agricultural commodity exceed the tolerance levels set forth in the Code of Federal Regulations. *See* EPA, Tolerances and Exemptions from Tolerances for Pesticide Chemicals In or On Raw Agricultural Commodities, 40 C.F.R. 180.01, 180.425 (1991).

20. McMahon & Burke, *Expanding and Tracking the Capabilities of Pesticide Multiresidue Methodology Used in the Food and Drug Administration's Pesticide Monitoring Programs*, 70 J. ASS'N OFFICIAL ANALYTICAL CHEMISTS 1072, 1079 (1987).

21. Telephone interview with Martha Bradley, Editor, Pesticide Analytical Manual, EPA, Office of Pesticide Programs (Sept. 24, 1991).

that the chemists were running the procedure incorrectly. When the Michigan laboratory checked its results against FMC's, using FMC's test method on a standard clomazone formula, the results from both analyses agreed. However, when the Michigan laboratory tried the method using field samples, the method sometimes failed to detect residues in the plant samples. The staff of the Michigan laboratory attempted to work with FMC to improve the performance of the clomazone test method, but according to Mr. Bulmer, the problems were never resolved.

FMC maintains that "background interference"[22] accounts for the inability of a properly run test method to detect clomazone residues in crops or soils.[23] Mr. Bulmer disagrees and cites instances where his laboratory was asked to document clomazone residues in vegetation growing adjacent to treated fields and showing visible damage from clomazone. No clomazone residues were detected in the plants from adjacent fields, even though clomazone residues were recovered from plants from the treated fields.

Although it is possible that residues on the non-target vegetation exist at such small quantities as to go undetected, Roger Bishop, supervisor of Iowa's pesticide laboratory, is suspicious of that explanation for several reasons. First, there are numerous instances where exposure is known to have occurred, yet his laboratory has been unable to detect clomazone in vegetation or soil samples from the investigated sites.[24] Second, there have been cases where vegetation samples actually display the characteristic bleaching, or chlorosis, caused by clomazone, yet laboratory analysis has failed to detect the presence of any clomazone residues. Finally, and even more disturbing according to Mr. Bishop, there are instances where laboratory analyses have failed to detect clomazone residues on whitened, damaged vegetation, even though residues have been detected in soil samples taken from the same site.[25]

22. "Background" refers to the presence of chemical compounds in a sample which are not eliminated during the chemical preparation of the sample for analysis. Background interference means that the presence of other chemicals in the sample tends to mask the presence of the particular chemical being analyzed.

23. FMC Corporation, Agricultural Chemical Group, Command Herbicide General Crop/ Soil Residue Method, Test Method No. ACG 124 (July 14, 1986).

24. Roger Bishop, *Review of Clomazone (Command) Analyses 1986-1991*, IDALS Pesticide Laboratory, Iowa Department of Agriculture (1991). Telephone interviews with: William Bulmer, Supervisor, Toxic Substances Section, Michigan Department of Agriculture (Sept. 24, 1991); Dave Fredrickson, Supervisor, Pesticide Section, Wisconsin Department of Agriculture, (Oct. 14, 1991).

25. *See* Bishop, *supra* note 24.

In Wisconsin, Dave Fredrickson of the Wisconsin Department of Agriculture acknowledges that the test method is so unreliable that the department's investigators must rely on visual signs of clomazone damage on vegetation. Steve Hutson, a chemist in Wisconsin's Department of Agriculture pesticide laboratory, admits that finding clomazone residues in plant samples sent to the laboratory is little more than a hit or miss proposition. Mr. Hutson laments that the laboratory does not have the money or the time to devote to developing or modifying a test method for clomazone to make it reliable in all cases.

In sum, the collective experience of Michigan, Iowa, and Wisconsin enforcement agencies indicates that the standard test method for detecting clomazone residues on vegetation does not work.

III. The Problem: Test Methods and Public Health

This failure to detect clomazone may have implications for public safety and health as well. The potential for unsafe levels of pesticide residues on plant crops intended for consumption by humans or animals is of special concern.

The EPA has the authority to grant a specific tolerance for pesticide residues on crops.[26] A specific tolerance permits a small amount of pesticide residue if it is determined not to pose unreasonable environmental or health risks when present on agricultural commodities. Where a tolerance has not been granted, even negligible residues of the pesticide are regarded as unsafe. Before obtaining a specific tolerance for a particular vegetable crop, the pesticide maker must show that the pesticide-residue test method is sensitive enough to determine whether any residues on the crop exceed the tolerance levels set by the Agency.[27] Where, as in drift cases, non-target, edible vegetation is exposed to a pesticide, any residues left on the vegetation would be considered unsafe if the EPA had not granted a tolerance for those agricultural commodities. This explains why the Romanskis were prohibited from selling their produce after the clomazone drift. No tolerance limit had been set for the herbs and spices exposed to clomazone.

The Environmental Protection Agency has granted tolerances for clomazone residues on soybeans, pumpkins, peas,[28] and more recently

26. Tolerances and Exceptions from Tolerances for Pesticide Chemicals In or On Raw Agricultural Commodities, 40 C.F.R. pt. 180 (1991).

27. 40 C.F.R. § 180.101(c) (1991).

28. 2-(2-Chlorophenol) methyl-4, 4-dimethyl-3-isoxazolidinone: tolerances for residues, 40 C.F.R. § 180.25 (1991).

for clomazone residues on peppers.[29] The Agency has proposed a rule granting a specific tolerance for winter squash.[30] The EPA granted the tolerances on the premise that there were no unreasonable adverse effects from small amounts of clomazone residue on the named crops, and that the analytical method was adequate to quantify the amount of clomazone residue present on the crop. This latter assumption is incorrect.

The tolerance set for peppers, peas, and soybeans is 0.05 parts per million,[31] meaning that any of these crops found to contain clomazone residues in excess of 0.05 parts per million would be considered potentially unsafe for human consumption. Mr. Hutson readily admits that the Wisconsin Department of Agriculture pesticide laboratory cannot reliably detect clomazone residues in vegetation samples which are less than one part per million, *or twenty times the tolerance limit*.[32] Standard testing methods, therefore, leave Wisconsin enforcement personnel with meaningless data and no assurance that clomazone residues on specific crops are below EPA tolerance levels. Without an assurance that EPA tolerance levels are not exceeded, the test data is meaningless and the crops could be unsafe. In the Romanski case—where edible plants were contaminated with clomazone, but the test results were negative—if some of the exposed plants had not shown damage, nothing would have prevented their sale to, and consumption by, the public.

Once again, the Wisconsin experience is shared by other states in which clomazone is used. In Illinois, test results generally are sensitive only to eighty parts per billion,[33] or sixteen times the tolerance limit for peppers, peas, and soybeans. Even then, the Illinois laboratory analyzes only *soil* samples from a site under investigation, rather

29. 56 Fed. Reg. 21,309 (May 8, 1991).

30. 56 Fed. Reg. 42,574 (Aug. 28, 1991).

31. "Tolerances are expressed in terms of parts by weight of the pesticide chemical per one million parts by weight of the agricultural commodity." 40 C.F.R. § 180.101(a) (1991). The tolerance 0.05 parts per million (ppm), is equivalent to 50 parts per billion (ppb). For both soybeans and peas the tolerance is 0.05 ppm; for pumpkins it is 0.1 ppm. 40 C.F.R. § 180.425 (1991).

32. If the detection limit of the test method is one part per million, that is roughly the same as searching for one person in a city with a million inhabitants. The tolerance level for peppers, 0.05 ppm, or 50 ppb, is more on the order of searching for one person in a country of 20 million, or 50 people among China's one billion inhabitants.

33. Telephone interview with Jim Stedelin, Illinois State Diagnostic Laboratory (May 31, 1991).

than the vegetation, where clomazone is more difficult to detect. Likewise, Wayne Pask, Indiana State Chemist, indicates that his laboratory has detected clomazone residues of less than fifty parts per billion in soil, but does not have data for vegetation samples. Indeed, FMC's test method only claims to be sensitive enough to detect and quantify clomazone residues on vegetables of thirty parts per billion.[34] This is a startling acknowledgment that EPA tolerances, set to avoid damage to public health, are unenforceable.[35]

IV. A Possible Explanation for Testing Inadequacy

Analysts familiar with clomazone have suggested a possible explanation for the failure of standard testing techniques to provide sufficient precision. Mr. Bulmer of Michigan thinks the compound that ultimately causes damage to non-target plants may not be clomazone at all, but instead may be clomazone transformed into another pesticidally active compound not detectable by current methods.

Once released into the environment, pesticides rapidly break down and are metabolized by plants, thus forming new chemical compounds. These transformation products, like the parent compound, may have pesticidal potential. Pesticide residues on non-target vegetation may include not only the parent compound, but also such transformation products, metabolites of the parent compound. Wisconsin pesticide enforcement official Dave Fredrickson, like Mr. Bulmer, believes the mysterious hit-and-run damage caused by clomazone to non-target vegetation can be explained on the basis of its metabolite behavior.[36] It is possible that clomazone undergoes a transformation after being released into the environment, so that the compound that drifts off-site is not clomazone, but a pesticidally-active transformation product. However, some research suggests that the clomazone is metabolized by sensitive non-target vegetation differently than it is in

34. FMC Corporation, Command Herbicide General Crop/Soil Residue Method, Test Method No. ACG 124 (July 14, 1986).

35. Wisconsin, Iowa, and Michigan pesticide laboratories have failed to detect clomazone residues in vegetation samples, even where known exposures have occurred, and where damage is visible. On the other hand, in Iowa, Roger Bishop indicates that his laboratory has detected clomazone, at below tolerance levels for soybeans, where no damage has occurred.

36. Telephone interviews with: Roger Bishop, *supra* note 1; Bill Bulmer, *supra* note 1; Dave Frederickson, Supervisor, Pesticide Section, Wisconsin Department of Agriculture (1991) (personal communication).

tolerant vegetation.[37] In either case the pesticide residues on non-target vegetation may go undetected by current analytical methods which are not geared to identifying clomazone metabolites.

Another explanation focuses on how the analytical method is developed and evaluated. According to Martha Bradley of the EPA, the residue analysis method is evaluated using applications of a standard formula of clomazone on a specific crop in the laboratory. Chemists add a known amount of the standard to the sample, and then perform the analysis, checking to see what percentage of the standard is recovered at the end. In the case of clomazone, chemists had difficulty recovering a generally acceptable percentage, even with modifications to the method eventually approved. Furthermore, clomazone added to a sample in the laboratory may be quite different from what is applied to a field under environmental conditions. Field-incurred residues on vegetation may include one or more transformation products of the parent compound in this case, clomazone, that are not detected by current test methods, rendering those methods unsuitable for analyzing environmentally incurred residues. The possibility of transformation by plants also explains the detectability of clomazone in soils adjacent to damaged plants showing no clomazone when tested to comparable levels of specificity.

V. Where to From Here

Current test methods are inadequate to detect and quantify residues of clomazone, or its transformation products, on exposed vegetation. For environmentally-incurred residues, the test results have been inconsistent and unreliable. Residue analyses have often yielded negative results, even where the vegetation sampled has displayed the characteristic bleaching associated with clomazone exposure. Where residues of clomazone have been detected in environmental samples, the best results have been obtained from soil samples, not vegetation samples. If pesticide residues are found in soil samples and not in vegetation samples from the same site, does that mean no residues

37. Differential metabolism and rate of uptake are recognized as important factors contributing to the selectivity of herbicides. Researchers have suggested that the compound clomazone may be a precursor to the compound which actually has herbicidal activity. Clomazone may be transformed upon uptake into another compound which is active. Vencill et al., *Absorption, Translocation, and Metabolism of 14-C-Clomazone in Soybean (Glycine Max) and Three Amaranths Weed Species*, J. PLANT GROWTH REG. 127-132 (1990); Leibl & Norman, *Responses of Corn, Soybean, Smooth Pigweed, Amaranths Hybrids L., and Velvetleaf, Abutilon Theophrasti Medik., to Clomazone*, 29 ABSTRACTS WEED SCI. SOC'Y AM. 88 (1989).

exist on those plants or that those residues are hidden? Results to date clearly suggest hidden residues.

Current test methods are not sensitive enough to quantify residues of clomazone on crops for which tolerance levels have been established. Even more disturbing, no tolerances have been established for most non-target exposures, meaning that even negligible residues of clomazone on those crops are considered unsafe. Current test methods, lacking the sensitivity to quantify residues at tolerance levels, are entirely inadequate where no clomazone residues are acceptable. Using the current test methods, we have no way of knowing whether a negative test result means that there are no unsafe residues on those plants, or that the test failed to detect residues. Of course, whitened vegetation is a visible sign of exposure to clomazone, but the bleaching is a symptom of exposure, and does not tell us whether clomazone residues are still present on the damaged vegetation. Significantly, laboratory results reported clomazone present in non-damaged, exposed vegetation. Thus, in cases of alleged exposure of non-target vegetation, negative test results, coupled with non-damaged plants, do not guarantee that the plants are free of clomazone residues.

Superimposed on these problems is the substantial risk that the existing methods test for the wrong compound. It may be that clomazone is transformed into another compound that also has pesticidal properties soon after release into the environment. It is this transformation product, or products, that may cause most of the non-target vegetation damage. In any case, these new compounds, if they exist, have not been identified as major transformation products of clomazone. Current test methods are geared only toward the detection of clomazone, not transformation products. Consequently, residue analyses may significantly underestimate the total residue load on vegetation sampled after exposure to clomazone.

The pesticide registration program places the burden on the pesticide maker to demonstrate adequate testing techniques. Partial or occasional recovery of clomazone residues in non-target plants exposed to clomazone simply does not meet that burden. When evaluating a pesticide for registration or when establishing a tolerance, the EPA must be assured that the product is safe for its intended use. Such assurance is not possible on the basis of the existing record for clomazone.

It is true that there is a degree of uncertainty attached to any chemical analysis. The results, dealing with very minute quantities of a substance, will reflect the technical skill of the analyst, the state of the available equipment, and the properties of the sample, as well as the capability of the analytical method. Nevertheless, the problems that have been encountered are not isolated, but rather, have occurred in a sufficient number of different state laboratories so that analyst or equipment error is an unlikely cause of the problems. The testing mechanisms are inadequate.

The EPA has established legally enforceable tolerances for residues on particular vegetable crops. In order for specific tolerances to have any value, the analytical method for establishing residual quantities of the pesticide on particular crops must be sufficiently reliable and sensitive. The state pesticide laboratories that test for clomazone residues have been unable to meet the level of sensitivity required to detect residues of clomazone on plants at tolerance levels set by the EPA. It also appears that the nature of the residues of clomazone are not adequately understood.[38] Clomazone could be transforming into one or several different products that exist on or in exposed vegetation as residues.[39] If that is the case, adequate test methods must be able to identify and quantify those residues, as well as the parent compound. Moreover, a determination must be made as to whether the total residue load, clomazone plus its transformation products, poses unreasonable risks for anyone consuming produce containing those residues.

The EPA has a procedure for weighing the risks posed by a pesticide against the benefits of its use. That procedure is called "Special Review," and is designed to determine whether, in light of new information available to the Agency, cancellation or use modification of a particular pesticide should be initiated.[40] Special Review may be initiated by any interested person, or by the Agency itself, when there is evidence that the pesticide may pose a risk to humans or the environment. When the pesticide is under Special Review, the burden is on the pesticide registrant, often the manufacturer, to show that the risks posed by the use of the pesticide are offset by the product's social, economic, and environmental benefits. If the registrant can not persuade the EPA that the pesticide product is entitled to continued registration, cancellation proceedings will be initiated.

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38. For example, tolerances have been established for clomazone on specific crops, but not for transformation products which may also be present in significant quantities on those crops. *See* 56 Fed. Reg. 21,309 (1991) (establishing a tolerance for clomazone on peppers).

39. Vencill et al., *supra* note 37, at 130-131, notes that the metabolites of clomazone have not been well characterized.

40. Special Review Procedures, 40 C.F.R. pt. 154 (1991).

Invoking Special Review could help to resolve the uncertainties associated with clomazone. Far from being an interdiction on the pesticide registrant, Special Review is an even-handed approach to regulating pesticide use. Once the registrant is notified that Special Review will be undertaken on a particular pesticide, the registrant has the opportunity to present evidence supporting the continued use of the product. Likewise, the Agency must consider evidence suggesting that the pesticide poses unreasonable, or previously unknown, risks to humans or the environment. The risks associated with the use of clomazone that we have looked at here were not adequately addressed prior to its registration in 1986. The EPA did not know then that the analytical method that was minimally workable with laboratory samples would be unreliable in field applications. Clomazone's track-record since 1986 requires that the EPA re-evaluate its continued registration. Otherwise, EPA regulation efforts are meaningless.

The burden on the maker, FMC, and clomazone users need not be great. Clomazone is only used from April through June. A Special Review begun immediately after the use season could be completed sufficiently in advance of the next season to leave growers either with a known safe pesticide or the need to resort to alternatives. The public is entitled to no less.