GLYPHOSATE: WEEDING OUR WAY TO THE TRUTH OF ROUNDUP'S CARCINOGENICITY

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I. INTRODUCTION

Glyphosate, under the tradename Roundup, has faced severe backlash in the news due to a jury's recent finding of $289 million in damages to a man citing the use of the popular herbicide for causing his terminal cancer.[1] A California Superior Court judge was expected to grant Monsanto's motion for new trial, but instead affirmed the case and lowered the damages to the amount

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1. Johnson v. Monsanto Co., No. CGC16550128, 2018 WL 4261442, at *1-2 (Cal. Super. Ct. Aug. 23, 2018).

of $78.5 million.[2] The reduction in damages is due to California's requirement for compensatory damages and punitive damages to be one to one.[3] The scientists who believe glyphosate is not carcinogenic have questioned the plaintiff's attorney's intentions, while society is unsure what to believe.[4] The jury's finding is likely due to the dynamics between a sympathetic plaintiff and a seemingly money-hungry corporation. It is difficult for a jury to face this emotionally complicated, difficult case and view the facts in an unbiased manner. While the evidence in the Johnson v. Monsanto Co. case seems to align with the jury's conclusion, is it scientifically accurate? This note will provide an unbiased analysis of the legal and scientific issues in the current, and future, glyphosate products liability cases.

II. WHAT WILL THIS NOTE COVER?

Glyphosate is the most used herbicide in the United States agricultural industry.[5] With its use dating back to 1974, the herbicide revolutionized the agricultural industry.[6] The product has had recent pushback from consumers because of the thousands of pending United States products liability cases and evidence showing a presence of the herbicide in some cereals.[7] However, are these concerns founded in science? Today's consumers are pushing for organic, pesticide-free, and non-genetically modified organism (non-GMO) foods, but what implications could this have on our global food supply?

This note begins with a brief history of the use of glyphosate and its use in agriculture. Next, this note will examine recent products liability cases where glyphosate has been cited as a carcinogen, and analyze different standards used to determine whether glyphosate is a carcinogen. Finally, this note will present science-based studies from both sides of the argument and challenge the reader to find the right solution.

2. Johnson v. Monsanto Co., No. CGC16550128, 2018 WL 5246323, at *5 (Cal. Super. Ct. Oct. 22, 2018).

3. Laurel Wamsley, *California Judge Cuts Award To $78.5 Million In Monsanto Weedkiller Case*, NPR (Oct. 3, 2018), https://perma.cc/4MQU-Y74C.

4. *Id.*

5. Henderson, A.M. et al., *Glyphosate*, NAT'L PESTICIDE INFO. CTR. (Nov. 10, 2018), https://perma.cc/7YYK-T4R7.

6. *Id.*; Dave Walton, *Without Glyphosate, What Would Farming Look Like?*, GENETIC LITERACY PROJECT (Feb. 14, 2017), https://perma.cc/XUL3-YYE2.

7. Alex Formuzis, *Roundup for Breakfast, Part 2: In New Tests, Week Killer Found in All Kids' Cereals Sampled*, EWG, https://perma.cc/C3C7-8CVS (archived Nov. 10, 2019); *More Documentation of EPA's Failures in Allowing Use of Roundup, as French Court Bans It*, BEYOND PESTICIDES (Jan. 18, 2019), https://perma.cc/22BM-8TKM.

III. WHAT IS GLYPHOSATE?

"Glyphosate is a[] herbicide. It is applied to the leaves of plants to kill both broadleaf plants and grasses. The sodium salt form of glyphosate is used to regulate plant growth and ripen specific crops."[8] Glyphosate is a particularly effective herbicide because it is a non-selective herbicide, which allows it to kill all plants.[9] Glyphosate is most commonly applied to corn and soybean crops.[10] Under the tradename Roundup, glyphosate can also be purchased for home use with lower levels of the active ingredient.[11] "[Glyphosate] is used for spot treatment of gardens, lawns, paved areas," in addition to treating agricultural crops.[12] While many people use the lower dose version for their personal garden, many anti-GMO activists condemn glyphosate use by farmers.[13] Activists claim the herbicide-resistant GMO crops allow farmers to "douse, drown, drench or saturate" their crops in glyphosate.[14] Is this actually the case? Iowa farmer, Dave Walton, who grows both genetically modified (GM) and non-GM corn, soybeans, alfalfa, and hay, claims he applies "a little more than half a gallon of total herbicide spread out over an acre."[15] Half a gallon per acre is far from the drowning activists describe, which Walton relates to the use of tanker airplanes fighting forest fires.[16] It seems farmers are following the label and recommendations from the manufacturer, which should decrease potential adverse effects.[17]

Although glyphosate has received a negative reputation in the media lately, its benefits when used in the agricultural field are undeniable.[18] The Canadian government has kept the best record of data on glyphosate dating back to 1983.[19] The climate and use of glyphosate in Ontario is similar to the corn belt in the United States.[20] The study shows, between 1983 and 2013, corn yield increased

8. Henderson, A.M. et al., *supra* note 5.

9. *Id.*

10. *Glyphosate pesticide found in popular cereals*, CTR. ENVTL. HEALTH, https://perma.cc/8KBY-6ZUF (archived Nov. 10, 2019).

11. *See Is there a safe alternative to Roundup?*, GREEN CITY BLUE LAKE, https://perma.cc/56A9-FTYH (archived Nov. 10, 2019).

12. *Id.*

13. Walton, *supra* note 6.

14. *Id.*

15. *Id.*

16. *Id.*

17. *See id.*

18. Kevin Folta & Robert Saik, *Talking Biotech: 30-year study confirms environmental benefits of glyphosate use*, GENETIC LITERACY PROJECT (Sept. 10, 2018), https://perma.cc/7Z3P-D3PJ.

19. *Id.*

20. *Id.*

by 74%, while glyphosate use increased from 1% to 54%.[21] Meanwhile, the total amount of herbicide used decreased by 39%, due to glyphosate's relatively low spray rate compared to the herbicides it replaced.[22] In addition to increased yield and decreased overall pesticide usage since glyphosate became the main herbicide used.[23] The benefits reported in the Ontario study do not end there. Less tillage, greenhouse gas emissions, and increased water efficiency are also supported in the data.[24] While some of these statistics may be attributable to process improvements made since 1983, there is no denying glyphosate, paired with the glyphosate resistant crops, have played a substantial role in these improvements.

A. The Issue

So, what's the catch? While glyphosate has many benefits, many issues have also arisen due to its use. Studies have surfaced showing glyphosate remains in the soil much longer than was initially anticipated.[25] Other studies have found glyphosate in popular cereals, wines, and beers.[26] As a result of these studies, questions of environmental concerns have arisen.[27] In addition, exposure to glyphosate has been linked to developmental and reproductive effects in earthworms.[28] Perhaps the most contentious debate of today revolves around whether prolonged use of glyphosate can cause cancer.[29] However, before addressing these issues, a history of glyphosate will be discussed.

21. *Id.*

22. *Id.*

23. *Id.*

24. *Id.*

25. SOIL ASS'N, THE IMPACT OF GLYPHOSATE ON SOIL HEALTH 1, https://perma.cc/42TL-L4A7 (archived Jan. 21, 2020).

26. *Glyphosate pesticide found in popular cereals*, *supra* note 10; Chris Morris, *Weed Killer Chemical Found in Beer and Wine, Report Says*, FORTUNE (Feb. 25, 2019), https://fortune.com/2019/02/25/glyphosate-weed-killer-beer-wine/.

27. *See* SOIL ASS'N, *supra* note 25.

28. *Id.* at 4.

29. *Compare* Health Can., *Monsanto Roundup controversy: Glyphosate unlikely to pose cancer risk, Canada confirms*, GENETIC LITERACY PROJECT (Jan. 14, 2019), https://perma.cc/9DZV-CZNP (discussing Health Canada's scientific review concluding that concerns raised by objectors of glyphosate could not be supported when considering the entire body of data); *with* Wamsley, *supra* note 3 (discussing plaintiff succeeding in suit against Monsanto for cancer allegedly caused by Roundup).

IV. A BRIEF HISTORY OF GLYPHOSATE

Stauffer Chemical Company filed the original patent for glyphosate in 1961.[30] The original use was a descaling and chelating agent,[31] meaning, the original product patent for glyphosate was intended for cleaning pipes and boilers.[32] It was not until 1971, Monsanto filed its method patent for using glyphosate as a weed killer.[33] In the patent, Monsanto presented twelve examples outlining the herbicidal benefits of various phosphonomethyl-glycine combinations.[34] Upon issuance of the final patent, Monsanto began marketing Roundup to the public in 1974.[35] Because glyphosate was such a powerful weed killer, Monsanto began studies to develop glyphosate-resistant crop seeds through genetic modification.[36] The glyphosate patent expired in 2000, but Monsanto continues to be the most popular manufacturer of glyphosate herbicides.[37] Furthermore, "[t]here are over 750 products containing glyphosate for sale in the United States."[38]

The true use and benefit of glyphosate came in 1996, when glyphosate-resistant seeds became available for use in the field.[39] The combination of glyphosate and glyphosate-resistant crops resulted in it becoming one of the most widely used herbicides in the world, which continued to increase in use each year.[40] The glyphosate tolerant seeds were the product of a joint venture between Monsanto, Asgrow, and Agracetus.[41] Monsanto had previously struggled to adopt new genetic engineering technology that could be apply to seeds.[42] Pioneer paid a one-time license fee of $500,000 for the glyphosate-resistant gene.[43] Pioneer markets the glyphosate-resistant soybeans, while Monsanto markets Roundup, creating a mutually beneficial relationship.[44]

30. U.S. Patent No. 3,160,632 (filed Jan. 30, 1961).

31. *Id.*

32. *A Short History of Glyphosate*, SUSTAINABLE PULSE (Sept. 6, 2017), https://perma.cc/LZ49-MP2V.

33. U.S. Patent No. 3,799,758 (filed Aug. 9, 1971).

34. *Id.*

35. *A Short History of Glyphosate*, *supra* note 32.

36. *Id.*

37. Patricial Van Arnum, *US Patent Expiry of Roundup Creates Uncertainty in Glyphosates*, INDEP. COMMODITY INTELLIGENCE SERVICES (Dec. 11, 2000), https://perma.cc/7UBC-SZ34.

38. Henderson, A.M. et al., *supra* note 5.

39. *A Short History of Glyphosate*, *supra* note 32.

40. *Id.*

41. *Id.*

42. *Id.*

43. *Id.*

44. *Id.*

A. A Potentially Fatal Patent?

In 2002, Monsanto filed a process patent for treating an animal subject for a pathogenic infection, wherein the infection is "by a pathogen containing the enzyme 5-enolpyruvoylshikimate-3-phosphate synthase."[45] This enzyme, according to the patent, is capable of being inhibited by administering an effective amount of a glyphosate and dicarboxylic acid mixture.[46] Essentially, Monsanto obtained a patent for glyphosate as an antibiotic, which led to major concerns about its use in crops.[47] Physicians warn us about the possibility of antibiotic resistance due to overuse of antibiotics, yet, Monsanto has patented the most widely used herbicide as an antibiotic.

When a novel and nonobvious use of an existing chemical is invented, a company will seek patent protection on the new use. Although the new use may be realized, it does not mean the patented invention will be put into practice. What was the intention of Monsanto in patenting this new use of glyphosate as an antibiotic? At this stage, we do not have adequate research for what this discovery could mean, but we do know that the effectiveness is dependent on the addition of di-carboxylic acids, not just glyphosate alone.[48] With studies of glyphosate being found in cereals, beers, and wines, what could this mean for the future? This question will have to be continually revisited by scientists due to consumer concern.

V. GLYPHOSATE: CARCINOGEN OR NOT?

Are the agricultural benefits of using glyphosate being outweighed by health and safety concerns? The Environmental Protection Agency (EPA), International Agency for Research on Cancer (IARC) and California's Proposition 65 (Prop. 65) have swayed in alternative directions on whether glyphosate should be listed as a carcinogen.[49] This has been a hotly debated matter even before glyphosate became widely used in the United States.[50]

45. U.S. Patent No. 7,771,736 B2 (filed Aug. 30, 2002).

46. *Id.*

47. Judy Stone, *Antibiotic Resistance From Unexpected Sources - - Herbicides, Dust And Metals*, FORBES (Apr. 1, 2015), https://perma.cc/4H3D-DSQG.

48. Robin Mesnage & Michael N. Antoniou, *Facts and Fallacies in the Debate on Glyphosate Toxicity*, FRONTIERS PUB. HEALTH, Nov. 2017, at 1, 3.

49. *See* CAL. OFFICE OF ENVTL. HEALTH HAZARD ASSESSMENT, INITIAL STATEMENT OF REASONS: GLYPHOSATE (Mar. 2017), https://perma.cc/89XW-NAEL; *see also EPA Releases Draft Risk Assessments for Glyphosate*, U.S. ENVTL. PROTECTION AGENCY (Dec. 18, 2017), https://perma.cc/LY3A-3QB3.

50. *A Short History of Glyphosate*, *supra* note 32 (citing an EPA study dating back to 1985 which found that glyphosate was a Class C Carcinogen, which means there is "suggestive evidence of carcinogenic potential," and EPA updated the classification to Class

A. What the EPA Has to Say About the Carcinogenicity

In 1985 the EPA included glyphosate on its list of Class C Carcinogens, on the scale where Group A is "[c]arcinogenic to [h]umans," and Group E is "[n]ot [l]ikely to be [c]arcinogenic to [h]umans."[51] Class C Carcinogens have "[s]uggestive [e]vidence of [c]arcinogenic [p]otential," which is a classification given to substances that have "limited animal evidence and little or no human data."[52] On December 18, 2017, the EPA released its draft Risk Assessments for glyphosate, concluding that "glyphosate is not likely to be carcinogenic to humans."[53] The study involves various "human health and ecological risk assessments for glyphosate."[54] The EPA is expected to publish the final decision in 2019.[55]

B. What IARC Has to Say About the Carcinogenicity

The EPA's 2017 decision directly contradicts the IARC's 2015 report declaring glyphosate as a Group 2A, or "probably carcinogenic."[56] IARC is a subdivision of the World Health Organization (WHO).[57] IARC defines "probably carcinogenic" as:

This category is used when there is limited evidence of carcinogenicity in humans and sufficient evidence of carcinogenicity in experimental animals. In some cases, an agent may be classified in this category when there is inadequate evidence of carcinogenicity in humans and sufficient evidence of carcinogenicity in experimental animals and strong evidence that the carcinogenesis is mediated by a mechanism that also operates in humans. Exceptionally, an agent may be classified in this category solely on the basis of limited evidence of carcinogenicity in humans. An agent may be assigned to this category if it clearly belongs, based on mechanistic considerations, to a class of agents for which one

E, "evidence of non-carcinogenicity for humans" in 1991, which "mysteriously" lined up with the first use of Roundup-Ready GM crops).

51. *Risk Assessment for Carcinogenic Effects*, U.S. ENVTL. PROTECTION AGENCY, https://perma.cc/EC6K-S29J (archived Nov. 10, 2019).

52. *Id.*

53. *EPA Releases Draft Risk Assessments for Glyphosate*, *supra* note 49.

54. *Id.*

55. *Id.*

56. INT'L AGENCY FOR RESEARCH ON CANCER, IARC MONOGRAPHS VOLUME 112: EVALUATION OF FIVE ORGANOPHOSPHATE INSECTICIDES AND HERBICIDES 1 (Mar. 2015), https://perma.cc/3RLU-6AES [hereinafter IARC MONOGRAPHS VOLUME 112].

57. *About WHO*, WORLD HEALTH ORG., https://perma.cc/6UK3-DPUG (archived Nov. 10, 2019); Steven M. Knott, *EPA's evaluation of the carcinogenic potential of glyphosate*, U.S. ENVTL. PROTECTION AGENCY, https://perma.cc/6N6Y-GEB8 (archived Nov. 10, 2019).

or more members have been classified in Group 1 or Group 2A.[58]

Therefore, there are several ways in which a substance can be listed as a Group 2A carcinogen.[59] Many everyday items are also in this category.[60] Acrylamide, "a chemical that is produced when starchy foods are heated to very high temperatures" is found in "fried foods, corn chips, cereal, and other foods" cooked at high temperatures.[61] Red meat is also within this category.[62] "In 2016, the IARC reported that consuming more than 100 grams of red meat once a day increased one's chances of stomach, breast, pancreatic and colorectal cancer by 15%."[63]

The 2015 IARC Glyphosate Monograph addresses the risk of cancer in humans in Section 2 of the document.[64] The document appears to present evidence and research in an unbiased manner.[65] The section begins by stating there is "no association between exposure to glyphosate and cancer of the prostate."[66] The monograph appears to be clearly laid out, with strong evidence from multiple trials and experiments, identifying what types of cancers are found to be linked to the use of glyphosate—while also identifying the types of cancer not associated with its use.[67]

Upon the issuance of the 2015 IARC Monograph, Monsanto issued a response addressing their concerns from the study.[68] In the response, Monsanto attacks the credibility of IARC:

In March 2015, a group called IARC incorrectly classified glyphosate as a "probable carcinogen." IARC is the same organization that determined beer, meat, cell phones, and coffee cause cancer. IARC is not a regulatory authority and did no independent studies. IARC is one of four programs within the World Health Organization (WHO) that has reviewed glyphosate, and the only one to

58. INT'L AGENCY FOR RESEARCH ON CANCER, IARC MONOGRAPHS ON THE EVALUATION OF CARCINOGENIC RISKS TO HUMANS 22 (2006), https://perma.cc/JR9A-K35D [hereinafter IARC MONOGRAPHS].

59. *See id.*

60. A. Gregory Luna, *5 Common IARC Group 2A Carcinogens Lurking In Your Home*, NATUROPATHIC EARTH (July 6, 2017), https://perma.cc/T7JL-K62Z.

61. *Id.*

62. *Id.*

63. *Id.* (emphasis omitted).

64. INT'L AGENCY FOR RESEARCH ON CANCER, GLYPHOSATE: MONOGRAPH – 112, at 11-16, https://perma.cc/R9VF-EZAE (archived May 21, 2020).

65. *See id.*

66. *Id.* at 11.

67. *Id.* at 11-16.

68. *See IARC's Report on Glyphosate*, MONSANTO (Apr. 21, 2017), https://perma.cc/5STC-FF4K.

have made such a finding.[69]

Monsanto further questions the scientific conclusions drawn in the Monograph by citing investigative reports by Reuters and the Times of London, which found that IARC allegedly left out crucial facts and studies.[70] In January 2019, documents filed in federal court threatened to expose Reuters journalist, Kate Kelland, for writing at the direction of Monsanto.[71] Internal correspondence suggests Monsanto executive Sam Murphey told Kelland to report that cancer scientist, Aaron Blair, said IARC would alter its analysis.[72] Monsanto goes even a step further, stating IARC is "closely aligned with U.S. trial lawyers."[73] Monsanto is implying some relationship between IARC and plaintiff's attorneys, who would ultimately benefit from new product liability claims.[74] Monsanto ends their response with quotes of support for glyphosate from regulatory bodies from around the world, dating from April 2015 to December 2017.[75]

IARC has been continuously updating their own Glyphosate Monographs page and has maintained the ruling found in 2015.[76] IARC issued a response to Monsanto stating the changes made between drafts of the Monograph are standard and are a result of the deliberations taking place between the IARC Monograph Working Group members.[77] The experiment left out of the final Monograph was a scientific study co-authored by a Monsanto scientist.[78] The IARC Monograph Working Group is formed by leading experts in a field, not IARC employees, in an attempt to provide a non-biased and thorough review of each Monograph published.[79] The Working Group found this study did not have sufficient evidence to support its conclusions and therefore could be biased.[80] I'm

69. *Id.*

70. *Id.*; *see* Kate Kelland, *In glyphosate review, WHO cancer agency edited out "non-carcinogenic" findings*, REUTERS INVESTIGATES (Oct. 19, 2017), https://perma.cc/CL94-AJWX; Ben Webster, *Weedkiller scientist was paid £120,000 by cancer lawyers*, THE TIMES (Oct. 18, 2017), https://perma.cc/HW9W-B3UV.

71. Carey Gillam, *New Monsanto documents expose cozy connection to Reuters reporter*, U.S. RIGHT TO KNOW (Jan. 16, 2019), https://perma.cc/ZW43-V5WV.

72. *Id.*

73. MONSANTO, *supra* note 68.

74. *See id.*

75. *See id.*

76. *IARC Monograph on Glyphosate*, INT'L AGENCY RES. ON CANCER, https://perma.cc/TKU5-97F6 (archived Nov. 10, 2019).

77. INT'L AGENCY FOR RESEARCH ON CANCER, IARC REJECTS FALSE CLAIMS IN REUTERS ARTICLE ("IN GLYPHOSATE REVIEW, WHO CANCER AGENCY EDITED OUT "NON-CARCINOGENIC" FINDINGS") 1-2 (Oct. 2017), https://perma.cc/27PL-CBEN.

78. *Id.*

79. *Id.*

80. *Id.*

not sure about you, but I seem to find myself aligning with whoever's dialogue I am currently reading. Both Monsanto and IARC are so clear in their statements, that it becomes unclear for the public who to believe.

C. What California's OEHHA Proposition 65

California's Office of Environmental Health Hazard Assessment (OEHHA) has a mission "to protect and enhance the health of Californians and our state's environment through scientific evaluations that inform, support and guide regulatory and other actions."[81] This mission is an honorable one, and one that leads California to be the nation's most progressive state for environmental regulations.[82] Prop. 65 is an example of this progress. In 1986, California voters adopted the Safe Drinking Water and Toxic Enforcement Act, which was designed to notify Californians of their "exposure to cancer-causing substances and reproductive toxins."[83] The aims of the legislation were to:

- Keep known toxins out of the drinking water[;]
- Require warnings to alert the public before they are exposed to the toxins[;]
- Allow private citizens to enforce the measure in court[; and]
- Require government officials to notify the public when illegal discharges of toxic waste could pose a serious risk to public health.[84]

As of October 26, 2018, the Prop. 65 list contained over 1000 chemicals, some of which have been officially delisted, but over 930 chemicals are still actively listed.[85]

On July 7, 2017, glyphosate was added to the Prop. 65 list for causing cancer.[86] The listing sounds conclusive and would likely lead consumers to fear

81. *About*, CAL. OFF. ENVTL. HEALTH HAZARD ASSESSMENT, https://perma.cc/9S7A-VDSH (archived Apr. 25, 2020).

82. Chuck DeVore, *California Vs. Texas: Human Flourishing—Comparing The Two States 1 In 5 Americans Call Home*, FORBES (Nov. 1, 2018), https://perma.cc/KB6T-ZFPD.

83. *History Of Proposition 65*, CUSTODIO & DUBEY, LLP, https://perma.cc/CH7L-YLSZ (archive Nov. 10, 2019).

84. *Id.*

85. *See* CAL. OFFICE OF ENVTL. HEALTH HAZARD ASSESSMENT, CHEMICALS KNOWN TO THE STATE TO CAUSE CANCER OR REPRODUCTIVE TOXICITY (Oct. 2018), https://perma.cc/7Wu7-DCJV.

86. *Glyphosate*, CAL. OFF. ENVTL. HEALTH HAZARD ASSESSMENT, https://perma.cc/VE2U-Y2QZ (archived Nov. 10, 2019).

the use of glyphosate. However, to be listed as causing cancer for Prop. 65 purposes, there needs to be "a 'one in 100,000' chance of developing cancer" when an individual is "exposed to the chemical over a 70-year lifetime."[87] Therefore, if a chemical presents a one in 100,000 chance of developing cancer, a "'clear and reasonable' warning" will need to be posted by a business that "knowingly and intentionally expos[es] anyone to a listed chemical."[88] The requirement could lead to many California businesses posting ominous warnings that consumers do not realize the true meaning of.[89]

D. The Addition of Glyphosate to the Proposition 65 List

Why was glyphosate added to the list? Prop. 65 has a policy that will add any chemical IARC deems carcinogenic to the list.[90] OEHHA acknowledges various groups have conducted independent studies that have disagreed whether glyphosate is a carcinogen, but ultimately it decided to add the herbicide to its list because of the Prop. 65 requirements.[91] OEHHA received 9,183 comments pertaining to its decision to add glyphosate to the Prop. 65 list.[92] Comments were received in support and denial of the findings of the IARC.[93] While many questioned the scientific reasoning present in the report, ultimately Prop. 65 requires IARC's probable carcinogens to be added to the list.[94]

In February 2018, United States District Judge William Shubb barred California from requiring cancer warnings on food products containing trace amounts of glyphosate.[95] This response was brought after a First Amendment challenge for the violation of free speech; stating the State of California was essentially requiring retailers to "post 'false, misleading and highly controversial statements.'"[96] Judge Shubb's ruling has required the State of California to

87. *Proposition 65 in Plain Language*, CAL. OFF. ENVTL. HEALTH HAZARD ASSESSMENT (Feb. 1, 2013), https://perma.cc/ZGF9-FQKW.

88. *Id.*

89. *Id.*

90. CAL. OFFICE OF ENVTL. HEALTH HAZARD ASSESSMENT, FREQUENTLY ASKED QUESTIONS: PROPOSITION 65 AND GLYPHOSATE 1, https://perma.cc/992B-TQ6M (archived Nov. 20, 2019) [hereinafter FAQs: PROPOSITION 65 & GLYPHOSATE].

91. *Id.*

92. *Glyphosate to be Listed under Proposition 65 as Known to the State to Cause Cancer*, CAL. OFF. ENVTL. HEALTH HAZARD ASSESSMENT (Mar. 28, 2017), https://perma.cc/KX43-K9PV.

93. CAL. OFFICE OF ENVTL. HEALTH HAZARD ASSESSMENT, GLYPHOSATE NSRL: FINAL STATEMENT OF REASONS 2 (Apr. 10, 2018), https://perma.cc/72PK-7DQA.

94. *Id.* at 9.

95. Geoffrey Mohan, *Glyphosate cancer warning in California halted*, L.A. TIMES: BUS. (Feb. 27, 2018), https://perma.cc/D4G2-2EAK.

96. *Id.*

reevaluate the warnings they require businesses to make.[97] The requirements have recently been updated to become clearer—requiring businesses to issue a warning prior to selling products with listed chemicals.[98]

The issues around glyphosate use are by no means a simple puzzle to solve. While there are significant benefits motivating farmers to use glyphosate, studies have shown glyphosate is carcinogenic and trace amounts are found in soil and food, frightening the public and making it impossible to ignore.[99]

VI. THE PRODUCTS LIABILITY CASE

Glyphosate has been making headlines throughout the year with recent product liability cases that have been brought before the court. The decision, sweeping headlines in August 2018, involved a jury verdict of $289 million to Dewayne Johnson, a man suffering from terminal cancer that he attributes to an accident that occurred at work.[100] The case arose in no-other than the Prop. 65 state, California.[101] On October 23, 2018, a California superior court judge upheld the jury verdict, while lowering the punitive damages to a constitutionally acceptable amount of $78.5 million.[102] The State of California requires compensatory and punitive damages to be one to one.[103]

Dewayne Johnson, a former groundskeeper for the Benicia Unified School District in California applied glyphosate-based products, such as Roundup and Ranger PRO, to the school properties.[104] At just forty-two years old, Johnson was "diagnosed with non-Hodgkin lymphoma."[105] "Non-Hodgkin's lymphoma is cancer that originates in your lymphatic system, the disease-fighting network spread throughout your body. In non-Hodgkin's lymphoma, tumors develop from lymphocytes — a type of white blood cell."[106] Johnson testified stating he

97. *See* Malerie Ma Roddy & Alex Garel-Frantzen, *New California Prop 65 Warning Requirements: What Businesses Should Consider Now*, NAT'L L. REV. (Oct. 16, 2018), https://perma.cc/58WA-CRJ3.

98. *Id.*

99. *See* IARC MONOGRAPHS, *supra* note 58; OFFICE OF PESTICIDE PROGRAMS, GLYPHOSATE ISSUE PAPER: EVALUATION OF CARCINOGENIC POTENTIAL (2016), https://perma.cc/RJ3Y-UASB; *Glyphosate pesticide found in popular cereals*, *supra* note 10; Morris, *supra* note 26.

100. *See* Wamsley, *supra* note 3.

101. Johnson v. Monsanto Co., No. 16-cv-01244-MMC, 2016 WL 1730361, at *1, (N.D. Cal. May 2, 2016).

102. Wamsley, *supra* note 3.

103. *Id.*

104. *Monsanto Co.*, 2016 WL 1730361, at *1.

105. *Id.*

106. *Non-Hodgkin's lymphoma*, MAYO CLINIC, https://perma.cc/6GKP-6BVR (archived

sprayed a high-concentration version of Roundup "about 20 to 30 times a year for 2 to 3 hours a day."[107]

Now forty-six, and in the late stages of his terminal cancer, Johnson presented evidence that convinced the jury that Roundup was the cause of his disease.[108] Johnson filed notice with the court in October 2018, stating he would accept the reduced reward of $78 million, but Monsanto filed an appeal.[109] Montano's appeal resulted in Johnson's attorneys also filing an appeal for the original jury award.[110] With a strong likelihood that Johnson will die in 2019, an expedited handling of the case has been approved by the First District Court of Appeals.[111] What's to come next? With over 8,000 cases filed over Monsanto's glyphosate, it's safe to say these products liability claims are not going to end soon.[112]

Does this seemingly endless supply of potential claims make Bayer regret its decision to acquire Monsanto? It looks as though this is not the case.[113] The decision, as explained by Werner Baumann, CEO of Bayer, was based on the facts, studies, scientific findings, and expert opinions in support of the quality of the herbicide.[114] He would have acquired the company "at any time, 'without any ifs, ands or buts.'"[115] Although the decision is not a regret of Bayer, it is still very likely the decision will be a costly one due to the pending litigation.[116]

However, not all the rulings have been bad for Bayer.[117] By January 2019, there were more than 9,300 plaintiffs waiting to have their day in court, but a January 2019 decision by United States District Judge Vince Chhabria significantly limited the evidence permissible in these cases.[118] The decision,

Nov. 10, 2019).

107. Wamsley, *supra* note 3.

108. *See Monsanto Co.*, 2016 WL 1730361, at *1.

109. Gary Ruskin, *Plaintiff Seeks Expedited Handling of Monsanto's Appeal as His Health Deteriorates*, U.S. RIGHT TO KNOW (Dec. 14, 2018), https://perma.cc/YVM2-MPKE.

110. *Id.*

111. Gary Ruskin, *New Year Off to a Strong Start for Monsanto*, U.S. RIGHT TO KNOW (Jan. 7, 2019), https://perma.cc/2T8A-KCAM.

112. Ludwig Burger et al., *Bayer's Monsanto faces 8,000 lawsuits on glyphosate*, REUTERS: ENV'T (Aug. 23, 2018), https://perma.cc/ET9H-988J.

113. *See* Frank Dohmen et al., *Safe Or Not, Roundup Is Toxic for Bayer*, SPIEGEL ONLINE (Jan. 10, 2019), https://perma.cc/G22D-LNLE.

114. *Id.*

115. *Id.*

116. *See id.*

117. Naomi Kresge, *Bayer Gains as Judge Limits Evidence in Roundup Cancer Cases*, BLOOMBERG: TECH. (Jan. 4, 2019), https://perma.cc/3SBX-Y4GB.

118. *Id.*

resulting in a Bayer AG share increase, limited the evidence to only whether glyphosate causes cancer and will no longer allow plaintiffs to try to convince juries Monsanto "tried to 'influence regulatory agencies and manipulate public opinion.'"[119] The decision cites "the issues related to manipulation and influence" as key issues relating to the high damage award, "but [that it was] 'mostly a distraction'" when it came to the question of "whether glyphosate is to blame for cancer."[120] Bayer welcomed the decision, stating it was "an 'encouraging signal and a step toward a more objective discussion.'"[121] Objective decisions, while difficult for juries to assess in these emotionally driven cases, are still expected and deserved.

The next products liability case began on February 25, 2019.[122] Edwin Hardeman was diagnosed with non-Hodgkin's lymphoma in February 2015, after waking up on Christmas morning in 2014 with a "golf-ball sized lump on his neck."[123] His diagnosis predated the IARC study finding that glyphosate was a "probable human carcinogen" by about one month.[124] Hardeman applied around 5,900 gallons of Roundup over twenty-six years while he treated his fifty-six acres of land.[125] Hardeman took pride in maintaining his land himself and, therefore, completed the weeding without the help of professionals.[126]

With lessons from Johnson in mind, Bayer has chosen to utilize their own trial team.[127] On January 18, 2019, Judge Chhabria made the uncommon decision to bifurcate the trial.[128] In the first phase, only evidence pertaining to the causation between glyphosate and cancer will be presented.[129] If causation is found by the jury, the second phase will allow the plaintiff to present evidence of Monsanto's "efforts to manipulate regulators and the scientific literature and 'ghost write' various articles."[130] Because the trial is divided into two phases,

119. *Id.*

120. *Id.*

121. *Id.*

122. *See* Helen Christophi, *Roundup Cancer Trial Close to Mistrial After Third Juror Dismissed*, COURTHOUSE NEWS SERV. (Mar. 5, 2019), https://perma.cc/W2M6-TNT9.

123. *Id.*

124. *Id.*

125. *Id.*

126. *Id.*

127. Gary Ruskin, *Attorneys Scramble Ahead of Next Trial*, U.S. RIGHT TO KNOW (Dec. 11, 2018), https://perma.cc/5C7U-DV9Z.

128. Gary Ruskin, *Evidentiary Hearing Set*, U.S. RIGHT TO KNOW (Jan. 18, 2019), https://perma.cc/CY2Y-TXQP.

129. *Id.*

130. *Id.*

evidentiary questions already have been brought.[131]

After losing three jurors, the trial is cautiously continuing with the six jurors, the minimum required for a valid verdict.[132] Judge Chhabria has been tough on both sides in this case, going as far as to sanction a plaintiff attorney.[133] Judge Chhabria issued a response to Monsanto's request for Summary Judgement on March 7, 2019, stating, "To take just one example . . . the De Roos (2003) study supports a conclusion that glyphosate is a risk factor for [non-Hopkin lymphoma], yet Monsanto fails to mention it in[ ]its motion. Monsanto cannot prevail on a motion for summary judgment by simply ignoring large swaths of evidence."[134] Therefore, there is evidence of a valid claim and it is possible for Hardeman to be awarded punitive damages.[135] Judge Chhabria takes his holding one step further by stating,

Although the evidence that Roundup causes cancer is quite equivocal, there is strong evidence from which a jury could conclude that Monsanto does not particularly care whether its product is in fact giving people cancer, focusing instead on manipulating public opinion and undermining anyone who raises genuine and legitimate concerns about the issue.[136]

Perhaps, in the grand scheme of things, we should not be concerned so much about whether glyphosate is truly a carcinogen, and focus more on the potential bad faith in which Monsanto has been acting. This statement by Judge Chhabria is an interesting one that brings to light some of the non-legal and non-scientific issues surrounding this topic. If we step back and realize Monsanto is focusing on manipulation, as opposed to properly correcting the minds of the public, perhaps all that should matter in this type of claim—as it is ultimately a question of fact that should be left to the jury to determine. It seems proper the jury would be allowed the most truthful and accurate information.

131. *Id.*

132. Christophi, *supra* note 122.

133. Gary Ruskin, *Judicial Threats and Judge Jokes*, U.S. RIGHT TO KNOW (Feb. 27, 2019), https://perma.cc/GYD7-USKP.

134. Gary Ruskin, *Judge Has Harsh Words for Monsanto*, U.S. RIGHT TO KNOW (Mar. 7, 2019), https://perma.cc/JD7N-9M5B.

135. *Id.*

136. *Id*.

VII. GLYPHOSATE: METHODS OF EXPOSURE

Glyphosate exposure can happen in a variety of ways, and can lead to a number of symptoms and potential disease.[137] Glyphosate can be absorbed through the skin, eyes, or as you breathe it in.[138] You may even ingest it through means of accidental ingestion after spraying the herbicide, or due to the trace amounts found in foods containing glyphosate-treated crops.[139] Although "[g]lyphosate isn't likely to vaporize after it is sprayed," there is still potential for exposure after touching recently treated plants.[140] Once absorbed in the body, glyphosate is expelled relatively quickly, often through urine and feces.[141]

An independent study conducted by the Center for Environmental Health shows a presence of glyphosate in cereals.[142] Now, we all know that drinking glyphosate straight from a fresh bottle of Roundup will not yield positive results, but effect does it have if it is found in many of the cereals we, and our children, eat daily? The twenty-eight oat-based cereals all tested positive for containing glyphosate, and twenty-six had detection levels above the Environmental Working Group's health benchmark.[143]

There is substantial evidence showing that glyphosate is absorbed into our bodies, but what does this mean? Glyphosate, alone, has low toxicity.[144] However, products applied to plants, like Roundup, contain other ingredients to ensure optimal plant take-up.[145] The combined effects of the ingredients can lead to eye, nose, throat, and skin irritation.[146] Ingesting glyphosate and products containing glyphosate can cause nausea, vomiting, diarrhea, and burning of the mouth and throat.[147] Reportedly, there have even been cases of intentional ingestion that ultimately led to death.[148] "Glyphosate exposure has been linked to developmental and reproductive effects at high doses that were administered to rats repeatedly during pregnancy."[149] "These effects were not observed at lower

137. *See* Henderson, A.M. et al., *supra* note 5.
138. *Id.*
139. *Id.*; *see Glyphosate pesticide found in popular cereals*, *supra* note 10.
140. Henderson, A.M. et al., *supra* note 5.
141. Henderson, A.M. et al., *supra* note 5.
142. *Glyphosate pesticide found in popular cereals*, *supra* note 10.
143. Formuzis, *supra* note 7.
144. Henderson, A.M. et al., *supra* note 5.
145. *Id.*
146. *Id.*
147. *Id.*
148. *Id.*
149. Joseph Marchinchin, *The Glyphosate Debate*, TURFCARE SUPPLY CORP (Sept. 14, 2018), https://perma.cc/AJM5-6YH4.

doses."[150] Glyphosate's carcinogenicity is a current debate that experts cannot seem to agree on.[151]

VIII. CARCINOGENICITY: WHAT DOES THE SCIENCE SHOW US?

Scientific studies have hotly debated glyphosate's use. While some studies suggest carcinogenic features of glyphosate, others show that there is no conclusive evidence of such.[152] Because there are brilliant scientists on both sides of this spectrum, we will review several studies and compare the merits of each case study.

A. The EPA Studies

The EPA has conducted studies on glyphosate's carcinogenicity since 1985.[153] This original study resulted in a Class C chemical rating, or Possible Human Carcinogen.[154] This rating was based on the presence of kidney tumors in male mice.[155] In 1986, the EPA requested the Federal Insecticide, Fungicide, and Rodenticide Act's (FIFRA) Scientific Advisory Panel to evaluate the carcinogenicity of glyphosate.[156] The review resulted in a recommendation of a Class D rating, or Not Classifiable as to Human Carcinogenicity.[157] They "determined that the data on renal tumors in male mice were equivocal (only an increase in adenomas was observed and the increase did not reach statistical significance)."[158] Another rat carcinogenicity study was completed in 1991, finding that glyphosate should be a Class E chemical, or Evidence of Non-Carcinogenicity for Humans.[159] This was based on the lack of evidence that could establish finding glyphosate exposure causes cancer in mice and rats.[160]

The most recent EPA glyphosate study took place in September 2015.[161] The Cancer Assessment Review Committee (CARC) reviewed studies submitted by Monsanto and other studies in open literature.[162] CARC ultimately concluded

150. *Id.*
151. *See* Wamsley, *supra* note 3.
152. *See generally* IARC MONOGRAPHS, *supra* note 58; *see* OFFICE OF PESTICIDE PROGRAMS, *supra* note 99, at 19-20.
153. OFFICE OF PESTICIDE PROGRAMS, *supra* note 99, at 12.
154. *Id.*
155. *Id.*
156. *Id.*
157. *Id.*
158. *Id.*
159. *Id.* at 13.
160. *Id.*
161. *Id.*
162. *Id.*

glyphosate is "[n]ot Likely to be Carcinogenic to Humans."[163] However, the CARC study failed to account for other recent studies by IARC, Joint Food and Agriculture Organization/WHO Meeting on Pesticide Residues, and the European Food Safety Authority.[164] The EPA released the Draft Risk Assessments on December 18, 2017.[165] They received public comments and are expected to publish the final document and registration review decision in 2019.[166] The draft document, consistent with a wide variety of scientific reviews by other countries and the 2017 National Institute of Health Agricultural Health Survey, affirmed CARC's conclusion, finding glyphosate is "not likely to be carcinogenic to humans."[167]

B. The IARC Study

The study completed by IARC in 2015 started the uproar surrounding the carcinogenicity of glyphosate.[168] Although the EPA has changed its views on the carcinogenicity of glyphosate multiple times, the study completed by IARC ultimately led to this national debate.[169] Upon publishing this study, OEHHA was required to add glyphosate to the Prop. 65 list, which brought attention to this issue—perhaps even causing the product liability cases that Monsanto faces.[170]

IARC studies are compiled and reviewed by a non-bias working group.[171] IARC used the studies from the EPA and human studies of exposure in the United States, Canada, and Sweden.[172] Ultimately, IARC concluded there was "limited evidence of carcinogenicity in humans for non-Hodgkin lymphoma."[173] However, upon review of the EPA mice and rat studies and "several more recent positive results," the group concluded there was "sufficient evidence of carcinogenicity in experimental animals."[174]

163. *Id.*

164. *Id.*

165. *EPA Releases Draft Risk Assessments for Glyphosate*, *supra* note 49.

166. *Id.*

167. *Id.*

168. *See IARC Monograph on Glyphosate*, *supra* note 76.

169. *See* IARC DIR., IARC RESPONSE TO CRITICISMS OF THE MONOGRAPHS AND THE GLYPHOSATE EVALUATION (Jan. 2018), https://perma.cc/QH5T-NTGP. *See History: Overview*, BAYER, https://perma.cc/UYE3-NYM4 (archived May 25, 2020) (showing Bayer acquired Monsanto on June 7th, 2018 as part of its Crop Science Division).

170. PROPOSITION 65 & GLYPHOSATE, *supra* note 90.

171. IARC MONOGRAPHS VOLUME 112, *supra* note 56.

172. *Id.*

173. *Id.* at 1 (emphasis original).

174. *Id.* (emphasis original).

C. University of California Berkeley, University of Washington, and Icahn School of Medicine at Mount Sinai Study

Published on February 10, 2019, a new study by the three universities, claim a high correlation between the risk of non-Hodgkin's lymphoma and glyphosate use.[175] The study ultimately concludes glyphosate raises the risk of non-Hodgkin's lymphoma by 41%.[176] While this may seem drastic, this number may not be something to write home about. 41% is a massive increase, but we must consider who the studies were aimed at to realize the full impact of the study. The study evaluated high exposure herbicide applicators—people who spray crops routinely.[177]

IX. HOW IS GLYPHOSATE REGULATED?

Herbicides are highly regulated on a national and state level in the United States.[178] The EPA is the federal body responsible for regulating herbicides through codification in the FIFRA, Federal Food, Drug, and Cosmetic Act (FFDCA), Food Quality Protection Act of 1996 (FQPA), Pesticide Registration Improvement Act (PRIA), and Endangered Species Act (ESA).[179] The FIFRA "gives the EPA authority to regulate the sale, use and distribution of pesticides."[180] The FFDCA "gives the EPA authority to set limits on the amount of pesticide residues allowed on food or animal feed."[181] The FQPA "amended FIFRA and FFDCA by increasing the safety standards for new pesticides used on foods. FQPA also required older pesticides and previously established tolerances (link) to be periodically re-assessed using the new, tougher standards."[182] The PRIA "[e]stablishes the fees and time-lines associated with pesticide registration . . . actions."[183] The ESA "[r]equires the EPA to assess the risk of

175. Luoping Zhang et al., *Exposure to Glyphosate-Based Herbicides and Risk for Non-Hodgkin Lymphoma: A Meta-Analysis and Supporting Evidence*, 781 MUTATION RES. 186 (2019).

176. Gillam, *supra* note 71.

177. Zhang et al., *supra* note 175.

178. *See Pesticide Laws and Regulations*, NAT'L PESTICIDE INFO. CTR., https://perma.cc/M6LN-5WSG (archived Nov. 10, 2019); *see also State Pesticide Regulatory Agencies*, NAT'L PESTICIDE INFO. CTR., https://perma.cc/9EZH-BC5P (archived Nov. 10, 2019).

179. *Pesticide Laws and Regulations*, *supra* note 178.

180. *Id.*

181. *Id.*

182. *Id.*

183. *Id.*

pesticides to threatened or endangered species and their habitats."[184]

In addition to these federal rules, states also have their own department that regulates pesticide usage.[185] Like the federal pesticide registration, each pesticide must obtain registration in each state that it will be used in.[186] States also require handlers to be trained and licensed prior to use.[187] States review the label of each pesticide prior to registration in their state and require updated labels to be submitted each time a change occurs.[188] Federal and state governments are working hard to ensure the safety of the public by not only evaluating what chemicals are being sprayed in their state, but also ensuring those who spray know how to do so properly.[189]

With so many regulations in place, it is vital for users to follow the instructions laid out on the label. However, it is often observed many do not follow the directions carefully enough.[190] Glyphosate is a highly regulated chemical with specific directions for use that must be followed by users, but perhaps some of the directions are being overlooked. Glyphosate labels are reviewed and approved by both the EPA and each state that Roundup is used. Following the label directions is required for optimum use and results, not just for crop yields, but for user and consumer safety.

X. ARE THERE OTHER, COMPARABLE, SOLUTIONS AVAILABLE?

Based on differentiating opinions, glyphosate can be either easily replaced or impossible to replace.[191] The fact that so many farmers heavily rely on glyphosate in improving their crop yields seems to weigh in favor of the difficulty to replace.[192] As the saying goes, everything is good in moderation. The world has not followed this simple rule in regards to glyphosate, which has led to fears— other than cancer—in farms throughout the world. Issues arise when one weed killer is relied on above the rest. Palmer Amaranth, a glyphosate-resistant weed, has become widely prominent throughout Iowa, with an expectancy to grow elsewhere.[193] The rapid growth of this weed points to another fault in

184. *Id.*

185. *Id.*

186. *State Pesticide Regulatory Agencies*, *supra* note 178.

187. *Id.*

188. *Id.*

189. *Id.*; *Pesticide Laws and Regulations*, *supra* note 178.

190. *See* Stuart Armitage, *Separating fact from fiction on glyphosate*, QUEENSL. COUNTRY LIFE (Oct. 16, 2018), https://perma.cc/3RKD-X6AB.

191. *See* Andrew Porterfield, *European farmers: Finding replacement for glyphosate is no easy task*, GENETIC LITERACY PROJECT (Nov. 14, 2017), https://perma.cc/8EQ2-QZE4.

192. *See* Folta & Saik, *supra* note 18.

193. Coll. Of Agric. Life Scis., *Palmer Amaranth Now Identified in at Least Nine Iowa*

glyphosate. Like humans to antibiotics, maybe this prolonged use of glyphosate can lead to a resistance in weeds.

Glyphosate caused a large reduction in herbicide use when it was first used, and it continues to be the most popular herbicide. As a result, it has become difficult for farmers and homeowners alike to consider alternatives. Glyphosate is non-selective so it can control various types of weeds. But, at what cost? There are alternative methods available. To control annual broadleaf weeds, a combination of manual removal, flame, steam or hot foam weeding, and post-emergent herbicides could be used.[194] Some of these herbicides are even Organic Material Review Institute (OMRI) certified and non-selective, an OMRI certification is an organic certification that states recognize.[195] Controlling perennial weeds would "require a more diversified selection of control options."[196] Ultimately, there are available alternatives to the use of glyphosate, but they "will be, in some way, less effective, less convenient, and/or more expensive."[197] This potential extra cost, combined with potential less effectiveness, is likely to result in a reluctance to adopt new practices.

XI. CONCLUSION

Several conclusions can be drawn from this research. First, there is not enough scientific evidence to conclusively decide whether glyphosate is truly a carcinogen. While studies have been presented leading to different conclusions, it is hard to determine proper conclusion. Second, even though the carcinogenicity of glyphosate is not conclusive, it does seem wise to follow the guidance of leading experts in the field by developing a plan on how to most effectively utilize herbicides. Third, we must educate the public on both the benefits, as well as the concerns, surrounding GMOs and pesticides. While the media focuses most of the attention on the issues surrounding these topics, it is very rare that you will find a scientifically backed paper regarding these findings. They are often aimed at the lay reader that will not seek the truth.

Additionally, I would suggest that the EPA, IARC and Prop. 65 regulations and rulings regarding carcinogenicity of substances have more clearly defined boundaries, and that the actual definitions of their respective categories are given more readily to the public. It is frightening to read that something is "probably

Counties, IOWA ST. U. EXTENSION & OUTREACH: INTEGRATED CROP MGMT. (Aug. 15, 2016), https://perma.cc/25K9-RGJD.

194. Joe Neal & Andrew Senesac, *Are There Alternatives to Glyphosate for Weed Control in Landscapes?*, N.C. ST. PUBLICATIONS (Oct. 2, 2018), https://perma.cc/M8AW-XLVN.

195. *Id.*

196. *Id.*

197. *Id.*

carcinogenic to humans," but it is difficult to accept when there are other regulatory bodies finding the opposite. Because a standard is not clearly defined, any "regulatory" body can create their own standard and ultimately find whatever they want within their own parameters. This is not good science, nor does it make for good law.

Finally, and most importantly, some type of standard must be presented to juries to ensure both sides of these product liability cases are being properly reviewed. It should not be simple to attribute terminal cancer to a single product.