

EXPERT WITNESS REPORT

RE: Plaintiffs Nemeth, Lutz and Mabs v. Defendants Syngenta Crop Protection LLC, Syngenta AG, Chevron USA Inc, FMC Corp

In the Court of Common Pleas, Philadelphia County Trial Division

Case No. 210800644

(Plaintiffs' Expert)

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This report is being provided pursuant to the agreements of the parties, the Court's scheduling and other orders, the Local Rules, and the Rules of Civil Procedure and Evidence. If additional information that may be relevant to my opinions comes to light or is discovered and produced by the parties near or after the date this report is filed, I reserve the right to supplement my opinions. Further, I may offer testimony at trial on any subject addressed in the reports or testimony of any witness related to the subjects of my opinions under the applicable disclosure agreements or Rules.

I. Scope of Opinion

I have been retained by the law firm of Wallace Miller, on behalf of Plaintiff's Nemeth, Lutz and Mabs (the Plaintiffs), as a general expert witness on chemical safety; specifically, on the toxicity and health effects of paraquat dichloride, hazard communication and product labeling, personal protective equipment recommendations, and duty to warn end-users of hazards. More specifically, in this report, my opinions relate to the circumstances involving occupational exposure to paraquat.

I have been informed that other experts will testify that PQ is a neurotoxin and a likely cause of PD, and that the Defendants possessed this knowledge. For the purposes of this report, I am assuming that PQ is a neurotoxin and a likely cause of PD. My own investigation (as detailed below) reveals that Syngenta and Chevron possessed this knowledge. I am also relying on other experts to support when and what knowledge they possessed.

II. Executive Summary

Paraquat herbicide is manufactured by Syngenta, formerly Imperial Chemical Industries (ICI), and has been registered for sale in the United States since 1964. The U.S. distributor for the product was Chevron, from 1964 to 1985. The toxicity of paraquat to humans has been examined and published numerous times since the 1960's. While toxicity due to ingestion is not disputed, health effects through inhalation, dermal absorption, and nasal-mucosal absorption have been disputed by ICI/Syngenta. Many studies and internal documents provide strong evidence that ICI/Syngenta had knowledge of these additional routes of entry and associated health effects. However, ICI/Syngenta has failed in its duty to provide adequate warnings of these risks to product users.

Based upon my review of the materials described herein, and a reasonable degree of scientific certainty, I have reached the following conclusions:

Opinion 1: There has existed in the scientific literature sufficient justification to warn users of paraquat dichloride of neurological and other health risks. The Defendants failed in their duty to warn.

Opinion 2: The Defendants failed to adequately communicate the need for appropriate and effective personal protective equipment

III. Qualifications

I am an associate professor of Human Factors and Safety Engineering, in the Grado Department of Industrial and Systems Engineering, at Virginia Tech. I hold MS and PhD degrees in safety engineering, an MS degree in ecology, and the certified industrial hygienist (CIH) and certified safety professional (CSP) credentials. I have over 27 years of experience in the fields of industrial hygiene and safety engineering. From 1996 to 2007, I was engaged in a professional career in safety and health, wherein I directed the Environmental, Health and Safety Services office, an organization responsible for ensuring compliance with safety, health, and environmental standards at Virginia Tech, a land-grant institution with large-scale agriculture operations. Specifically, I led the following programs: Hazard Communication, Hazardous Materials, Chemical Hygiene, Industrial Hygiene, and Respiratory Protection, and Medical Surveillance. I also managed the Occupational Medicine Clinic for the university, which provided medical screenings for 10,000 employees exposed to various occupational health hazards. Many of these employees worked on the university farms and groundskeeping staff and were monitored for exposure to pesticides and herbicides in our clinic. Our office worked closely with the Virginia Tech Pesticide Programs to provide safety training to applicators of pesticides and herbicides. During that professional career, I also held the Certified Hazardous Materials Manager credential.

I have 24 years of university teaching experience and have taught courses on product safety, labels and warnings, system safety analysis, occupational safety, industrial hygiene, risk control, and human factors engineering. I was an adjunct faculty member from 1999 to 2007. In 2007, I entered my current tenure-track faculty career.

My research expertise is in the realm of *Prevention through Design: designing products and systems to eliminate hazards*. Most of my research has involved the prevention of exposure to chemical health hazards. I have been involved in Prevention through Design efforts at the national level. I have served on an advisory committee of the National Institute for Occupational Safety and Health (NIOSH) concerning the development of PtD initiatives. I am the author of a textbook chapter on the subject in the Handbook of Industrial and Systems Engineering. I was an invited speaker at the NIOSH conference entitled: "Prevention Through Design Conference: A New Way of Doing Business." I was an invited speaker on the topic at the Purdue University event entitled, "The Engineer of 2020". In 2012, I led a Professional Development Course at the American Industrial Hygiene Conference and Expo, on the subject of Prevention through Design. Additionally, I developed an educational curriculum for NIOSH,

on the subject of PtD in manufacturing engineering. The Occupational Safety and Health Administration (OSHA) and Environment Canada have cited my published work in their rulemaking. Most recently, I served as a faculty member in the 2023 Consumer Product Safety Professional Certification Program. My current curriculum vita, which contains a list of my publications, is attached to this report (Exhibit A).

IV. Previous Testimony or Deposition

In the four years preceding the date of this report, I have testified as an expert witness in eight previous cases. A complete list of my expert witness cases is provided in my curriculum vita (Exhibit A) and in my Case History (Exhibit B).

V. Compensation

Below is a summary of the compensation my firm, Dickerson Consulting LLC, is receiving for the study and testimony in the case.

HOURLY RATES

Document Review, Research	\$300/hr
Site Inspection, Discovery, Report	\$300/hr
Travel Time	\$200/hr
Deposition Time	\$300/hr
Trial Testimony	\$300/hr

REIMBURSIBLE EXPENSES

Copies, office supplies	Actual cost
Photographs	Actual cost
Travel, calls, exhibit materials, shipping	Actual cost
Mileage	\$0.65 per mile

VI. Basis for Opinions

In arriving at my stated opinions, I performed the following documents review.

The opinions stated in this report are based upon my examination of the documents submitted to me for this purpose. Any conclusions resulting therefrom can be based only upon the data submitted to me and an examination of same. As of the date of this report, I have reviewed the following records and documents:

Depositions (and exhibits):

1. Douglas Nemeth (07/30/24)
2. Douglas Nemeth (08/06/24)
3. Clark Ouzts (02/22/22)
4. Clark Ouzts (02/23/22)
5. Sarah Hull (05/01/24)
6. Sherry Duvall (04/13/23)

Standards, Guidelines, Scientific Literature:

1. 40 CFR Part 156 (05/18/23): Protection of Environment, Chapter I – Environmental Protection Agency; Subchapter E – Pesticide Programs; Part 156 – Labeling Requirements for Pesticides and Devices.
2. World Health Organization. (2020). *International Code of Conduct on Pesticide Management: guidelines for personal protection when handling and applying pesticides*. World Health Organization.
3. United States Code Title 7, Chapter 6, Subchapter II: Environmental Pesticide Control.
4. Nations, U. (2011). Globally harmonized system of classification and labelling of chemicals (GHS). United Nations: New York, NY, USA.
5. Occupational Safety and Health Administration, Hazard Communication Standard (CFR 1910.1200)
6. Tangamornsuksan, W., Lohitnavy, O., Sruamsiri, R., Chaiyakunapruk, N., Norman Scholfield, C., Reisfeld, B., & Lohitnavy, M. (2019). Paraquat exposure and Parkinson's disease: A systematic review and meta-analysis. *Archives of Environmental & Occupational Health*, 74(5), 225-238.
7. Memorandum (06/26/19), U.S. Environmental Protection Agency, "Paraquat Dichloride: Systematic review of the literature to evaluate the relationship between paraquat dichloride exposure and Parkinson's disease; A.W. Wray and A. Niman, Health Effects Division.
8. Memorandum (06/26/19), U.S. Environmental Protection Agency, "Paraquat Dichloride: Draft Human Risk Assessment in Support of Registration Review; W. Britton, Health Effects Division.

9. Boyd, W. A., Blain, R. B., Skuce, C. R., Thayer, K. A., & Rooney, A. A. (2020). NTP Research Report on the Scoping Review of Paraquat Dichloride Exposure and Parkinson's Disease: Research Report 16.
10. Vaccari, C., El Dib, R., Gomaa, H., Lopes, L. C., & De Camargo, J. L. (2019). Paraquat and Parkinson's disease: a systematic review and meta-analysis of observational studies. *Journal of Toxicology and Environmental Health, Part B*, 22(5-6), 172-202.
11. Memorandum (06/22/21), U.S. Environmental Protection Agency, "Paraquat: HED Response to Comments on the Proposed Interim Decision for Registration Review and updated Occupational Handler Exposure and Risk Estimates." W. Britton, Health Effects Division.
12. Kamel F, Tanner CM, Umbach DM, Hoppin JA, Alavanja MCR, Blair A, Comyns K, Goldman SM, Korell M, Langston JW, et al 2007. Pesticide exposure and self-reported Parkinson's disease in the agricultural health study. *Am J Epidemiol*. 165(4):364-374.
13. Hartling, L., Guise, J. M., Hempel, S., Featherstone, R., Mitchell, M. D., Motu'apuaka, M. L., ... & Umscheid, C. A. (2017). Fit for purpose: perspectives on rapid reviews from end-user interviews. *Systematic reviews*, 6, 1-11.
14. Swan A.A.B. "Exposure of spray operators to paraquat." *Brit. J. indust. Med.* 26, 322-329, 1969
15. Wogalter, M. S., DeJoy, D., & Laughery, K. R. (Eds.). (1999). *Warnings and risk communication*. CRC Press.
16. Bohme, S. R., & Egilman, D. (2006). Consider the Source: Warnings and Anti-Warnings in the Tobacco, Automobile, Beryllium, and Pharmaceutical Industries. In M. S. Wogalter (Ed.), *Handbook of warnings* (pp. 635-644). Lawrence Erlbaum Associates Publishers.
17. Ayres, T. (2013). Warnings, Anti-Warnings, and Pacifiers. *Proceedings of the Human Factors and Ergonomics Society Annual Meeting*, 57(1), 1698-1701.
18. Wogalter, M. S. (Ed.). (2006). *Handbook of warnings*. CRC Press.
19. Richardson JR, Fitsanakis V, Westerink RHS, Kanthasamy AG. Neurotoxicity of pesticides. *Acta Neuropathol*. 2019 Sep;138(3):343-362. doi: 10.1007/s00401-019-02033-9. Epub 2019 Jun 13. PMID: 31197504; PMCID: PMC6826260.

Miscellaneous Records:

1. Notice to Plead (no. 559), May Term 2022, Plaintiffs v. Defendants Syngenta Crop Protection LLC, Syngenta AG, Chevron USA Inc, FMC Corp, In the Court of Common Pleas, Philadelphia County Trial Division
2. Opinion of the Court (8/15/2024); Chief Judge Chagares, United States Court of Appeals for the Third Circuit (No. 22-3075); David Schaffner Jr and Theresa Sue Schaffner v. Monsanto Corp (Appellant).
3. Report (03/14/86). Imperial Chemical Industries PLC, Central Toxicology Laboratory, Cheshire U.K. Report No. CLT/P/1467. "Paraquat: Penetration through Protective Clothing Materials from a Malaysian Gramoxone Formulation". R.J. Ward and R.C. Scott; Division Ref: SA 83/85, Y00061/071/001, Study JV1203
4. Memorandum (06/12/97) Sonia Ellis, "Paraquat: Toxicology 'ECCO' Meeting Outcome"
5. Report (09/12/88); ICI Central Toxicology, Cheshire U.K. "Paraquat: Penetration from Gramoxone TMF through Samples of Protective Clothing Materials"; R.J. Ward; Report No. CTL/L/2159; CTL Ref: Y00061/131/001, Study No: JV1286.
6. Email correspondence (04/23/01); From Mike Clapp to Jerry Wells, Leah Rosenheck, Drew Davidson, Martin Wilks, Ian Wheals, "RE: Paraquat: Respiratory Protection".
7. Report: "Investigation into the incidents of nose bleeding on the paraquat plant" (12/10/68). Pilkington-Sullivan Works No. 2 Paraquat Plant.
8. Case file: "Yugoslavian Poisoning Case" (1973)
9. Report (No. OHS/R/0003, 04/23/91) "A Clinical Survey of Paraquat Formulation Workers", M. Kinoulty, J. Tomenson, I. Tams; ICI Central Toxicology Laboratory, Cheshire U.K.
10. Memorandum EPA Health Effects Division (2000): "Review of Paraquat Incident Reports Involving Inhalation"
11. Email correspondence (11/09/11); From Kevin Ledgerwood to Andy Cook, "Paraquat Sold Formulation".
12. Report and letter (04/25/79); From R.J. Greenough (Inveresk Research International) to A.J. Vernal (Imperial Chemical Industries Ltd), RE ICI Study No. HR0083.

13. Report (undated); “To Observe and Report on Possible Toxic Effects of Paraquat When Utilized as a Weed Killer on the Human Organism”, R.H. Isaac, Medical Officer, Dunlop Malayan Estates Ltd.
14. Internal communication document (undated, unaddressed), from “Monty” to “Jerry” discussing revision to warnings on Gramoxone and Gramoxone MAX labels.
15. MEETING REPORT - PARAQUAT LABEL REVISION - CUSA-00089490 (1974)
16. Hogarty, EXPOSURE OF SPRAY OPERATORS TO PARAQUAT - CHEV-SJ0021369(1975).
17. CHEV-SJ0114927 - CTL/P/581 PARAQUAT: OCCUPATIONAL EXPOSURE AND DRIFT HAZARD EVALUATION DURING AERIAL APPLICATION TO COTTON IN CALIFORNIA, USA (1981).
18. PERCUTANEOUS PENETRATION OF ¹⁴C-PARAQUAT IN MAN PROTOCOL NO. 11.133 CUSA-00285254 (1982).
19. Forbess et al. “Exposure Measurements of Applicators Who Mix and Spray Paraquat in Grape Vineyards.” HortScience 17(6):955—956. 1982.
20. CUSA-00187245 – Letter re: PARAQUAT WORKERS EXPOSURE STUDY - DR T L LAVY [Forbess] ET AL: UNIVERSITY OF ARKANSAS (1981).
21. CUSA-00187245 – Letter re: PARAQUAT WORKERS EXPOSURE STUDY - DR T L LAVY [Forbess] ET AL: UNIVERSITY OF ARKANSAS (1983).
22. Memorandum (08/12/05) From Nick Sturgess to Elliott Barry, “Olfactory transport to the brain”
23. Email correspondence (04/05/17) From Kim Travis Syngenta to Jerry Campbell and Harvey Clewell, “Inhalation route for PBPK model”
24. Letter (07/21/76) From David Ferguson (Imperial Chemical Industries Ltd) to David G. Sharp (Cia Imperial de Industrias Quimicas do Brasil) RE “Application of Bipyridyls by ULV machines”
25. Letter (05/12/71) To Dr. R.D. Wessel (Chevron Chemical Company), From N. Wright (Industrial Hygiene Research, Imperial Chemical Industries Ltd), RE: “Paraquat: Subacute Human Exposure”.
26. Report PARA-94-AE-01 (April 1995), Zeneca Ag Products Western Research Center: “Paraquat: Worker Exposure During Mixing, Loading, and Application of GRAMOXONE EXTRA to Pecans Using Vehicle-Mounted, Ground Boom Equipment”

27. Meeting Report – Paraquat Label Revision (March 29, 1974)(File No. 771.1996);
Chevron Chemical Company Ortho Division, Research and Development, Richmond,
CA.

28. Syngenta product labels language (1986 - 2018)

SYNG-PQ-01147191
SYNG-PQT-ATR-16037814
SYNG-PQT-ATR-15059138
SYNG-PQ-00529973
SYNG-PQ-00532658
SYNG-PQ-00527378
SYNG-PQ-00526472
SYNG-PQ-00531071
SYNG-PQ-00531074
SYNG-PQ-00523997
SYNG-PQ-00530143
SYNG-PQ-13800599
SYNG-PQ-02326023
SYNG-PQ-02627933
SYNG-PQ-02612119
SYNG-PQT-ATR-14181304
SYNG-PQ-00529927
SYNG-PQ-00539075
SYNG-PQ-13814651
SYNG-PQT-ATR-15867380
SYNG-PQ-00526463
SYNG-PQ-13806284
SYNG-PQ-05636514
SYNG-PQ-05639221
SYNG-PQ-05620996
SYNG-PQ-00533159
SYNG-PQ-00522609
SYNG-PQ-00534470
SYNG-PQ-05636662

SYNG-PQ-00539639
SYNG-PQ-00527798
SYNG-PQ-00526745
SYNG-PQ-00542236
SYNG-PQ-02322958
SYNG-PQ-00525630
SYNG-PQ-00525795
SYNG-PQ-02326325
SYNG-PQ-00526638
SYNG-PQ-00547048
SYNG-PQ-01147970
SYNG-PQ-00535575
SYNG-PQ-00546834
SYNG-PQ-00548743
SYNG-PQ-00541942
SYNG-PQ-00547955
SYNG-PQ-00544592
SYNG-PQ-00546420
SYNG-PQ-00546474
SYNG-PQ-00541027
SYNG-PQ-00543054
SYNG-PQ-00542678
SYNG-PQT-ATR-13201533
SYNG-PQ-00534246
SYNG-PQ-00547230
SYNG-PQ-00534440
SYNG-PQ-00549586
SYNG-PQ-00549353
SYNG-PQ-01147905
SYNG-PQ-00548497
SYNG-PQ-00546772
SYNG-PQ-00548265
SYNG-PQ-00549413
SYNG-PQ-00546356

SYNG-PQ-00530038
SYNG-PQ-00545108
SYNG-PQ-00548328
SYNG-PQ-00544759
SYNG-PQ-00546719
SYNG-PQ-00544073
SYNG-PQ-30811180
SYNG-PQ-00525969
SYNG-PQ-00535120
SYNG-PQ-00544460
SYNG-PQ-02610123
SYNG-PQ-00546985
SYNG-PQ-00544948
SYNG-PQ-00546525
SYNG-PQT-ATR-16562435
SYNG-PQ-00537522
SYNG-PQ-00547604
SYNG-PQ-00547883
SYNG-PQ-00544815
SYNG-PQ-00527296
SYNG-PQ-00536191
SYNG-PQ-02614990
SYNG-PQ-02629246
SYNG-PQ-00547675
SYNG-PQ-00223774
SYNG-PQ-30899057
SYNG-PQ-00527090
SYNG-PQ-00536832
SYNG-PQ-30896534
SYNG-PQ-00526909
SYNG-PQ-30904133
SYNG-PQ-30887570
SYNG-PQ-30882713
SYNG-PQ-00198334

SYNG-PQ-30848418
SYNG-PQ-13804161
SYNG-PQ-13801541
SYNG-PQ-13798708
SYNG-PQ-13877847
SYNG-PQ-13828476
SYNG-PQ-13964699
SYNG-PQ-13779960
SYNG-PQ-13792043
SYNG-PQ-13747774
SYNG-PQ-13774687
SYNG-PQ-13773574
SYNG-PQ-13751275
SYNG-PQ-02323427
SYNG-PQ-30811918
SYNG-PQ-30815830
SYNG-PQ-30823514
SYNG-PQ-02041790
SYNG-PQ-30817701
SYNG-PQ-00535943
SYNG-PQ-21745461
SYNG-PQ-02041048
SYNG-PQT-ATR-11263064

29. Chevron product labels language (1965-1982)

CUSA-00111054
CHEV-SJ0001590
CHEV-SJ0001587
CHEV-SJ0001578
CHEV-SJ0001563
CHEV-SJ0001551
CHEV-SJ0001541
CHEV-SJ0001538
CHEV-SJ0096104

CHEV-SJ0096210
CHEV-SJ0001523
CHEV-SJ0001513
CHEV-SJ0001464
CHEV-SJ0001451
CHEV-SJ0096313
CHEV-SJ0096289
CHEV-SJ0096301
CHEV-SJ0096405-0096407
CHEV-SJ0096306-0096307
CHEV-SJ0001407
CHEV-SJ0096742-0096746
CHEV-SJ0096798-0096801
CHEV-SJ0096767-0096770
CHEV-SJ0096759-0096762
CHEV-SJ0001399
CHEV-SJ0001401
CHEV-SJ0096947-0096950
CHEV-SJ0097074-0097078
CHEV-SJ0097225-0097229
CHEV-SJ0097182-0097186
CHEV-SJ0097305-0097309
CHEV-SJ0097295-0097300
CHEV-SJ0097421-0097426
CHEV-SJ0097382-0097387
CHEV-SJ0097391-0097396
CHEV-SJ0087060-0087065
CHEV-SJ0088181-0088186
CHEV-SJ0088191-0088196
CHEV-SJ0001386
CHEV-SJ0001383
CHEV-SJ0088167-0088168
CHEV-SJ0088141-0088146
CHEV-SJ0088098-0088104

CUSA-00225237-00225244
CHEV-SJ0087975-0087982
CHEV-SJ0087985-0087987
CHEV-SJ0087933-0087940
CUSA-00100388
CHEV-SJ0087907-0087914
CHEV-SJ0087869-0087876
CHEV-SJ0087812-0087819
CUSA-00225201-00225210
CHEV-SJ0087677-0087684
CHEV-SJ0087651-0087658
CHEV-SJ0087613-0087620
CHEV-SJ0087563-0087570
CHEV-SJ0087541-0087548
CHEV-SJ0087493-0087500
CHEV-SJ0087445-0087452
CUSA-00103075-00103082
CHEV-SJ0087242-0087249
CHEV-SJ0098941-0098948
CUSA-00094706
CUSA-00339895-00339902
CUSA-00226134-00226141
CUSA-00094491-0094498
CUSA-00263840
CHEV-SJ0099421-0099428
CHEV-SJ0099435-0099443
CHEV-SJ0070074-0070082
CHEV-SJ0070086-0070094
CHEV-SJ0096322-0096323
CHEV-SJ0096429-0096430
CHEV-SJ0095981-0095988
CHEV-SJ0088079-0088080
CHEV-SJ0096623-0096625
CHEV-SJ0095937-0095943

CHEV-SJ0095889-0095894
CHEV-SJ0096037-0096044
CHEV-SJ0095821-0095822
CHEV-SJ0095944-0095950
CHEV-SJ0096013-0096020
CUSA-00120746-00120747
CHEV-SJ0095840-0095843
CHEV-SJ0095877
CUSA-00240173-00240174
CHEV-SJ0095989-0095996
CHEV-SJ0087983-0087984
CHEV-SJ0095848-0095851
CHEV-SJ0099038
CHEV-SJ0086062
CHEV-SJ0096021-0096028
CUSA-00054213-0054214
CHEV-SJ0095833-0095835
CHEV-SJ0095913-0095918
CHEV-SJ0096045-0096052
CHEV-SJ0095951-0095957
CHEV-SJ0095860-0095866
CUSA-00054209-00054210
CHEV-SJ0086056
CHEV-SJ0095852-0095855
CUSA-00103061
CUSA-00212024
CUSA-00054199-00054200
CUSA-00145321
CHEV-SJ0096310-0096312
CUSA-00054201-00054202
CUSA-00225512-00225517
CHEV-SJ0086045-0086047
CHEV-SJ0095958-0095964
CHEV-SJ0095882-0095883

CUSA-00306415
CHEV-SJ0095965-0095972
CHEV-SJ0095925-0095930
CHEV-SJ0096053-0096060
CHEV-SJ0095997-0096004
CHEV-SJ0095895-0095900
CUSA-00307093-00307096
CUSA-00307092
CHEV-SJ0097293-0097294
CHEV-SJ0001548
CHEV-SJ0086029-0086031
CHEV-SJ0086024-0086026
CHEV-SJ0095901-0095906
CHEV-SJ0096061-0096068
CHEV-SJ0095783-0095784
CUSA-00145320
CHEV-SJ0095931-0095936
CUSA-00145319
CHEV-SJ0095836-0095839
CHEV-SJ0096646-0096649
CHEV-SJ0095907-0095912
CHEV-SJ0096029-0096036
CUSA-00093439
CHEV-SJ0096005-0096012
CHEV-SJ0097379-0097380
CHEV-SJ0095884-0095888
CHEV-SJ0096771-0096772
CHEV-SJ0095973-0095980
CHEV-SJ0095666-0095673
CHEV-SJ0095682-0095689
CUSA-00266340-00266347
CUSA-00435200
CUSA-00211321-00211329
CUSA-00255793

CUSA-00303442
CUSA-00263838-00263839
CUSA-00273217
CHEV-SJ0095867-0095871
CUSA-00145323
CUSA-00145324
CHEV-SJ0096069-0096076
CUSA-00303440
CHEV-SJ0095621-0095622
CUSA-00113836
CHEV-SJ0001378
CUSA-00255792
CUSA-00263837
CUSA-00116359
CUSA-00116358
CUSA-00116357
CUSA-00255790
CUSA-00390099
CUSA-00390088

- 30. Current product label
- 31. Syngenta Safety Data Sheets (2009 – 2013)
- 32. Chevron Safety Data Sheets (1980 – 1984)
- 33. Current product counter card, Gramoxone 3LB

34. Material Safety Data Sheets:

CHEV-SJ0022751
CUSA-00124536
CUSA-00033354
CUSA-00070089
CUSA-00124540
CHEV-SJ0007772
CHEV-SJ0015086
CUSA-00124516
CUSA-00331990

CUSA-00331987

CUSA-00077015

CUSA-00046826

CUSA-00274750

CUSA-00314099

CUSA-00124511

CUSA-00124523

CUSA-00124549

CUSA-00124531

SYNG-PQT-ATR-04175683

SYNG-PQT-ATR-02528265

SYNG-PQT-ATR-04254157

SYNG-PQT-ATR-02446982

SYNG-PQ-32089799

SYNG-PQT-ATR-04254054

VII. Statement of Opinions

Based upon the foregoing and a reasonable degree of scientific certainty, I have reached the following conclusions:

Opinion 1:

There has existed in the scientific literature sufficient justification to warn users of paraquat dichloride of neurological and other health risks. The Defendants failed in their duty to warn.

Background

Paraquat dichloride (commonly referred to as paraquat) is a restricted-use, broad-spectrum herbicide that is commonly used in the United States to control weeds in agricultural and horticultural crops. The association between paraquat exposure and Parkinson's disease (PD) has been studied for decades. In very recent years, several systematic reviews of the literature have been conducted and are summarized here.

In the United States, the Environmental Protection Agency (EPA) is responsible for review and registration of pesticide products. The Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA) is the Federal statute that governs the registration, distribution, sale, and use of pesticides in the United States. With certain exceptions, a pesticide is any substance or mixture of substances intended for preventing, destroying, repelling, or mitigating any pest, or intended for use as a plant regulator, defoliant, or desiccant, or any nitrogen stabilizer. Therefore, paraquat dichloride falls under this statute. FIFRA, having been first enacted in 1947, pre-dates the EPA. When the EPA was enacted in 1970, enforcement of FIFRA was assigned to that federal agency. Before a pesticide may be sold or distributed in the United States, it must be registered (licensed) with the EPA. Before EPA may register a pesticide under FIFRA, the applicant must show, among other things that using the pesticide according to specifications "will not generally cause unreasonable adverse effects on the environment." The economic, social, and environmental costs and benefits of the use of any pesticide are factors when FIFRA determines whether the product poses an "unreasonable adverse risk to man (sic) or the environment".

Paraquat dichloride was first registered as a pesticide in the U.S. in 1964. EPA issued a Registration Standard for paraquat dichloride in June 1987 (NTIS# PB88-217005). A December 1991 Data Call-In (DCI) required additional ecological effects, environmental fate and residue chemistry data. EPA initiated registration review for paraquat in 2011. In October 2019, EPA released the draft human health and ecological risk assessments for public comment. In October 2020, EPA released the paraquat proposed interim decision and addendum to the paraquat draft human health risk assessment. After reviewing public comments on the proposed interim decision, EPA released the paraquat interim decision in July 2021.

Evidence in the Literature of Parkinson's Disease Association

As a part of the registration review process, the EPA Office of Pesticide Programs (OPP) performed a fit-for-purpose systematic review to evaluate the significance and environmental relevance of the postulated association between paraquat exposure and PD. A “fit-for-purpose” review is a type of “rapid review” and involves of a finite set of studies. Rapid reviews are a form of evidence synthesis that may provide more timely information for decision-making compared with standard systematic reviews. Systematic reviews are defined as “a review of a clearly formulated question(s) that use systematic and explicit methods to identify, select, and critically appraise relevant research, and to collect and analyze data from the studies that are included in the review” (Hartling et al, 2017). While systematic reviews are comprehensive, they can take on average one to two years to complete and involve a substantial amount of resources to produce using current standard protocols. Rapid reviews “are literature reviews that use methods to accelerate or streamline traditional [systematic review] processes” in order to meet the needs and timelines of the end-users (e.g., “government policymakers, health care institutions, health professionals, and patient associations”). This type of review is used to accomplish an expedited literature summary process (Hartling et al, 2017). In a pesticide registration process, this type of review would rely heavily on studies provided by the product manufacturer.

In the OPP rapid review process, 26 human studies were included. Despite the limited scope and rapid-review process, the EPA nevertheless concluded the following (Wray and Nimon, 2019):

The evaluation of 26 human studies considered were all epidemiologic articles and reported findings on 13 study populations, including three agricultural cohorts, nine hospital-based populations, and one PD registry in Nebraska. These study populations may have been exposed to paraquat through occupational and non-occupation exposure pathways that vary in terms of magnitude, frequency, and duration, with occupational study populations being more likely to experience exposure as a result of direct use of paraquat. With respect to occupational exposure, it was determined that *there is limited, but insufficient epidemiologic evidence of a clear associative or causal relationship*. This conclusion was based on mixed findings in both the Agricultural Health Study cohort and other study populations. These studies may all be subject to uncertainty due to limitations in their design, exposure assessment approach, and potential for bias. With respect to non-occupational study populations, evidence from three study populations was evaluated and it was determined that *there is insufficient epidemiologic evidence of a clear associative or causal relationship*. This conclusion was based on the small number of studies on non-occupational populations, lack of consistent evidence of a positive association, and the potential for bias.

I call attention to the statement: “with respect to occupational exposure, it was determined that **there is limited**, but insufficient, epidemiological **evidence of a clear associative or causal relationship**.” Therefore, the authors of this rapid-review do indicate that this small sample of studies demonstrated evidence of a relationship between occupational exposure to paraquat and the development of Parkinson’s Disease. They state that the evidence (in their non-systematic review) was limited or insufficient. The evidence was insufficient because the number of studies reviewed was limited. However, systematic reviews *have* provided sufficient evidence of a positive association.

Kamel et al (2007) found positive associations between self-reported incident and prevalent PD and occupational exposure to paraquat in a very large cohort Agricultural Health Study. Since the time of the EPA literature review, Vaccari et al (2019) published a systematic review of the literature and meta-analysis and found a positive association between paraquat exposure and PD occurrence. The National Toxicology Program (Boyd et al, 2020) conducted a systematic scoping literature review and published the results in “NTP Research Report on the Scoping Review of Paraquat Dichloride Exposure and Parkinson’s Disease”. This review concluded “a relatively large body of evidence was identified that collectively describes the potential association between paraquat exposure and Parkinson’s disease.” While a consensus exists, at this point in time, that causality cannot be definitively stated, there is ample evidence of a strong association between paraquat exposure and PD. There is ample evidence of neurotoxicity of paraquat, from animal studies. Therefore, it is my opinion that the manufacturer had a duty to warn paraquat users of this hazard and the steps necessary to mitigate the effects of exposure to the product. As I outline in following sections of this report, they failed to do so.

Evidence in the Literature of Other Health Effects and Routes of Entry

According to the U.S. Environmental Protection Agency document entitled, “Paraquat Dichloride: Draft Human Risk Assessment in Support of Registration Review” (Britton, 2019)

The primary target organ of paraquat is the lungs with evidence of lung inflammation, scarring, and compromised lung function observed throughout the toxicity database in different species and across routes of exposure (oral and inhalation). Other target organs identified in the toxicity database include the kidneys (mice and rabbits), and eyes (rats). Paraquat caused minimal to moderate skin irritation in rabbits and rats following acute dermal exposure and was not acutely lethal in rats up to 2000 mg technical concentrate/kg (paraquat ion not calculated). Prolonged dermal exposure, however, is more corrosive to the skin. Paraquat has been found to be highly toxic to humans through the route of ingestion. Fatalities have occurred through accidental ingestion of the product.

Numerous studies in the 1970's and 1980's examined routes of entry other than ingestion: dermal absorption and nasal-mucosal absorption. A study examined worker exposure and dermal absorption (Staiff, 1975) using dosimetry and biomonitoring. It concluded a potential dermal absorption exposure rate of 0.01- 3.40 mg/hr. A 1980 study (Chester et al) using dosimetry and biomonitoring of Malaysian paraquat sprayers found a mean actual dermal exposure of operators was 2.2 mg paraquat/h, with a range of 0 to 12.6 mg paraquat/h. Their mean total potential exposure was 66 mg paraquat/h, range 12.1 to 170 mg paraquat/h. The mean airborne concentration of paraquat in their breathing zones was 0.97 pg/m³, range 0.41 to 2.75 pg/m³. Paraquat was found in a spot check of urine in 9 out of 19 sprayers. A 1981 Health Hazard Evaluation report of a dosimetry study of workers involved in aerial spraying found that: “Dermal exposure ranged from 0.05 to 2.42mg/hour for a pilot and a swath-marker, respectively. The dermal exposure of the mixer-loader was of the same order as that of the pilots”. No respirable paraquat was detected in the breathing zone of any worker. The highest total (all droplets irrespective of size) airborne paraquat concentration determined was 26.3ug paraquat/m³ for a swath-marker. The lack of respirable aerosols would indicate that the route of entry was something other than inhalation. Aerosols smaller than 5 micrometers in diameter are respirable, but aerosols larger than that are capable of being deposited in the upper airways (nasal, pharyngeal, and bronchial passages).

ICI was aware of this potential for dermal route of entry, as evidenced by notes of meeting between Chevron and Syngenta in 1979, which state: “The Dermal exposure problem is of some concern since there have been some published reports of death or injury from dermal contact.”

Evidence of Defendant Prior Knowledge of Health Effects

In the materials I reviewed for this report, there were several internal documents obtained from the Defendants, all of which documented a long-standing corporate knowledge of the health risks associated with paraquat. These documents reveal ongoing knowledge, spanning decades, of the neurotoxicity of Paraquat, the passage of Paraquat across the blood-brain barrier, and the potential for skin absorption and nasal-mucosal absorption of inhalable-size-category aerosols that can lead to systemic health effects and fatality.

Neurotoxicity evidence. As long ago as 1958, ICI had conducted studies which concluded that Paraquat “appears to have a moderate toxicity” mainly by affecting the central nervous system, and it can be absorbed through the skin.” (SYNG-PQ-23457731)

Rodents used in early toxicity studies demonstrated neurotoxic effects after exposure to Paraquat, including incoordination, tremors, hyperexcitability, and violent forced movements. (SYNG-PQ-03056264); (SYNG-PQ-00548877); (SYNG-PQ-02455626); (SYNG-PQ-01604378). These internal findings were confirmed by outside research. An independent study in 1971 by outside researchers in Poland (translated by Syngenta) concluded that “[i]t follows from the above results, that gramoxone acts on the central nervous system.” (SYNG-PQ-02457809). A 1990 study also demonstrated that Paraquat is able “to cross the blood-brain barrier.” (SYNG-PQ-01984579).

In addition to animal studies, Syngenta received autopsy reports of human paraquat poisoning victims, beginning in 1968. An internal document regarding that 1968 report indicates that results showed that even the ingestion of a “relatively small quantity” of Paraquat would cause an amount “rather higher than we would have expected” to accumulate in the brain (SYNG-PQ-04263689). Autopsies conducted throughout the 1970s and 1980s repeatedly found paraquat in the brain of poisoning victims, and demonstrated that Paraquat remained in the brain for at least 25 days (SYNG-PQ-02459333).

Syngenta knew from internal and outside studies that male mice exposed to Paraquat consistently suffered a loss of dopaminergic neurons in the substantia nigra. This finding was “judged to be real, to be related to paraquat treatment, and to be adverse in nature.” (SYNG-PQ-37252264). Syngenta determined that based on these findings “it is prudent to assume that this finding is potentially relevant to man.” Id. In September 2008, Dr. Donato Dimonte, a Parkinson’s Disease researcher and Syngenta consultant reiterated these findings in a presentation to the company. (SYNG-PQ-00034773). In March 2009, former scientist for Syngenta, Dr. Ted Lock, published a review of the existing literature and stated “[w]hat is now beyond doubt is that paraquat can enter dopaminergic neurons in the substantia nigra of C57B16 mice in sufficient concentration to cause cell death.” (SYNG-PQ-20758517).

In an internal memorandum, Syngenta scientists discussed recent reports showing that paraquat can penetrate the blood brain barrier, gain access to deeper structures in the brain, and can lead to free radical production and membrane damage. (SYNG-PQ-13085990). Based on this evidence, Syngenta recognized that the data linking Paraquat to Parkinson’s Disease “seem quite compelling...” Id.

Nasal-mucosal route of entry evidence. An internal memorandum in 1968 describes an ongoing investigation into worker nose bleeding incidents among paraquat manufacturing facility workers at the Pilkington-Sullivan Works No. 2 Paraquat Plant (SYNG-PQ-02518502). A 1973 paraquat fatality case is documented, wherein the 29-year-old Yugoslavian applicator was spray-applying paraquat in an agricultural setting. Post-mortem analysis indicated that paraquat was the causative agent (SYNG-PQ-13110293). In a 1979 letter from Inveresk Research Institute to ICI, the possibility of nasal mucosal route of entry and occupational fatality is discussed (A.J. Vernal, 1979)(SYNG-PQ-02469884). Also in 1979, a letter from ICI scientist David Ferguson states that droplets entering the oro-nasal passages is a potential route of entry.

In a study produced by the ICI Central Toxicology Laboratory in 1991, workers with exposure to paraquat were found to have a statistically higher incidence of nose bleed symptoms than did workers without paraquat exposure (Kinoulty et al, 1991). An EPA study of Poison Control Center call data regarding inhalation exposure to paraquat found that large droplets of paraquat could enter the nasal passages and pose a “serious hazard”. Systemic exposure can result via this route of entry. The report notes that nose bleeds are common among those with systemic

symptomology (Review of Paraquat Incident Reports involving Inhalation DP Barcode D260797, Chemical #061601, 2000). In a 2011 email exchange between Kevin Ledgerwood and Andy Cook regarding paraquat solid formulation, the toxicity of occupational exposure to paraquat is described in detail. An undated letter by R.H. Isaac of the Dunlop Malayan Estates details a fatality by pneumonitis following paraquat exposure (SYNG-PQ-13114356). In an email exchange between Barry Elliott and Nick Sturgess (2005), the possibility is discussed of nasal mucosal absorption as a route of entry with a transport path to the central nervous system (SYNG-PQ-01980100). And, finally, in 2017, an email exchange between Kim Travis and Jerry Campbell, discusses the inclusion of nasal route of entry into the inhalation toxicological model.

Duty to Warn of Health Effects

Originally, the United States Department of Agriculture (USDA) administered FIFRA, which monitored the efficacy claims of manufacturers through a registration program. FIFRA's initial intent was to protect farmers by requiring accurate labeling of pesticide contents, thereby enabling farmers to make informed choices regarding the product's effectiveness and safety. In 1970, with the formation of EPA, responsibility for administering FIFRA transferred from USDA to EPA. The primary objective of FIFRA is to ensure that, when applied as instructed, pesticides will not generally cause unreasonable risk to human health or the environment. To reach this objective, FIFRA includes provisions that require EPA to establish programs pertaining to the communication of hazards. Below is a summary of those communication requirements, as outlined in 40 CFR Part 156: Labeling Requirements for Pesticides and Devices. In sections that follow, I discuss how the Defendants failed to meet these requirements.

Label Requirements (40 CFR Part 156.10)

Contents. All registered pesticide products must display labels that show the following information clearly and prominently:

- Name, brand, or trademark product sold under
- Name and address of the producer or registrant
- Net contents
- Product registration number
- Producing establishment's number
- Ingredient statement
- Warning or precautionary statements
- Directions for use
- Use classification

Legibility. All words, statements, graphic representations, designs, or other information required on the label must be clearly legible to a person with normal vision, and must be placed with such conspicuousness and expressed in such terms as to render it likely to be read and understood by the ordinary individual under customary conditions of purchase and use. All required label text must be 6-point font or larger, appear on a clear contrasting background, and not be obscured or crowded.

False or Misleading Claims. The regulation requires labels to be free from “false or misleading” statements, such as regarding the composition of the product, the effectiveness of the product, statements that negate or detract from labeling statements required by the act, claims of safety, statements that minimize the risks.

Directions for Use. The regulation describes the requirements for preparing the directions of use. These must be easily read and understood by the average target user of the product. When followed, they must be adequate to protect from personal injury and adverse effects. The directions must be placed on conspicuous part of the product label. The directions must contain the following items:

- 1) Statement of use classification (restricted, in the case of paraquat)
- 2) Violation of Federal Law to use in manner inconsistent with labeling
- 3) Sites of application
- 4) Target pests
- 5) Dosage rates
- 6) Method of application (dilution, equipment)
- 7) Frequency and timing of application
- 8) Worker protection statements
- 9) Use, storage, disposal
- 10) Limitations on use

Human Hazard and Precautionary Statements. Hazard statements are required to describe the type of hazard that may occur, while precautionary statements will direct or inform the users of actions to take to avoid the hazard or mitigate its effects. All required warning

statements shall be grouped together on the label and shall appear with sufficient prominence relative to the other front panel text and graphic material to make them unlikely to be overlooked under customary conditions of use. The label must contain a Toxicity Category for acute hazards of pesticide products. Most human hazard, precautionary statements, and personal protective equipment statements are based on the toxicity category. Below is the table from 156.62, describing the toxicity category system employed.

Acute Toxicity Categories for Pesticide Products

Hazard Indicators	I	II	III	IV
Oral LD ₅₀	Up to and including 50 mg/kg	>50 thru 500 mg/kg	>500 thru 5,000 mg/kg	>5,000 mg/kg
Dermal LD ₅₀	Up to and including 200 mg/kg	>200 thru 2000 mg/kg	>2000 thru 20,000 mg/kg	>20,000 mg/kg
Inhalation LC ₅₀	Up to and including 0.2 mg/liter	>0.2 thru 2 mg/liter	>2 thru 20 mg/liter	>20 mg/liter
Eye irritation	Corrosive; corneal opacity not reversible within 7 days	Corneal opacity reversible within 7 days; irritation persisting for 7 days	No corneal opacity; irritation reversible within 7 days	No irritation
Skin irritation	Corrosive	Severe irritation at 72 hours	Moderate irritation at 72 hours	Mild or slight irritation at 72 hours

Paraquat is toxic to humans (Category II) by the oral route and moderately toxic (Category III) through the skin. Pure paraquat, when ingested, is highly toxic to mammals, including humans, causing severe inflammation and potentially leading to severe lung damage (e.g., irreversible pulmonary fibrosis, also known as 'paraquat lung'), acute respiratory distress syndrome (ARDS), and death. The mortality rate is estimated between 60–90%. Paraquat is also toxic when inhaled and is in the Toxicity Category I for acute inhalation effects. Paraquat also causes moderate to severe irritation of the eye and skin (Category III).

The regulation states: “when data or other information show that an acute hazard may exist to humans or domestic animals, the label must bear precautionary statements describing the particular hazard, the routes of exposure, and the precautions to be taken to avoid accident, injury, or toxic effect or to mitigate the effect. Since data do exist to indicate that paraquat may cause neurotoxicity, the label must contain precautionary statements describing that hazard and precautions. The precautionary statement must be preceded by an appropriate signal word. Signal words (Danger, Warning, Caution) reflect the toxicity category of the product, as described below:

- (a) **Requirement.** Except as provided in paragraph (a)(4), each pesticide product must bear on the front panel a signal word, reflecting the highest Toxicity Category (Category I is the highest toxicity category) to which the product is assigned by any of the five routes of exposure in § 156.62. The signal word must also appear together with the heading for the human precautionary statement section of the labeling (see § 156.70).
- (1) **Toxicity Category I.** Any pesticide product meeting the criteria of Toxicity Category I for any route of exposure must bear on the front panel the signal word "DANGER." In addition, if the product is assigned to Toxicity Category I on the basis of its oral, inhalation or dermal toxicity (as distinct from skin and eye irritation), the word "Poison" must appear in red on a background of distinctly contrasting color, and the skull and crossbones symbol must appear in immediate proximity to the word "Poison."
 - (2) **Toxicity Category II.** Any pesticide product meeting the criteria of Toxicity Category II as the highest category by any route of exposure must bear on the front panel the signal word "WARNING."
 - (3) **Toxicity Category III.** Any pesticide product meeting the criteria of Toxicity Category III as the highest category by any route of exposure must bear on the front panel the signal word "CAUTION."
 - (4) **Toxicity Category IV.** A pesticide product meeting the criteria of Toxicity Category IV by all routes of exposure is not required to bear a signal word. If a signal word is used, it must be "CAUTION."

Personal Protective Equipment. Each product shall bear the personal protective equipment statements prescribed by section 156.212, as shown below.

Table 1—Minimum Personal Protective Equipment (PPE) and Work Clothing for Handling Activities

Route of Exposure	Toxicity Category of End-Use Product			
	I	II	III	IV
Dermal Toxicity or Skin Irritation Potential ¹	Coveralls worn over long-sleeved shirt and long pants	Coveralls worn over short-sleeved shirt and short pants	Long-sleeved shirt and long pants	Long-sleeved shirt and long pants
	Socks	Socks	Socks	Socks
	Chemical-resistant footwear	Chemical-resistant footwear	Shoes	Shoes
	Chemical-resistant	Chemical-resistant	Chemical-	No minimum ⁴
	gloves ²	gloves ²	resistant gloves ²	
Inhalation Toxicity	Respiratory protection device ³	Respiratory protection device ³	No minimum ⁴	No minimum ⁴
Eye Irritation Potential	Protective eyewear	Protective eyewear	No minimum ⁴	No minimum ⁴

According to the above table, paraquat should contain the following label recommendations for PPE usage: long-sleeved shirt, long pants, socks, shoes, chemical-resistant gloves, respiratory

protection device, protective eyewear. In 2023, the EPA revised requirements for labeling and now requires specification of type of respiratory protection device.

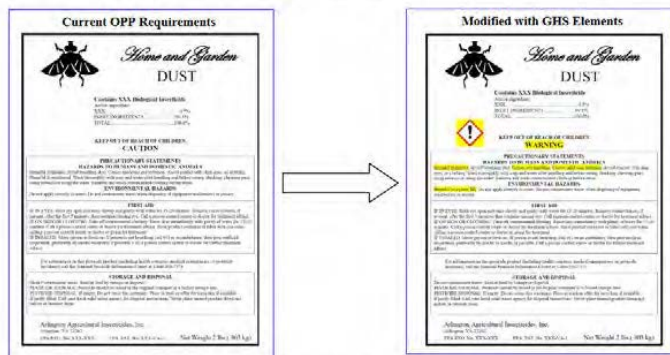
Other Chemical Label Standards

The Globally Harmonized System of Classification and Labelling of Chemicals (GHS) is a worldwide initiative to promote standard criteria for classifying chemicals according to their health, physical and environmental hazards. It uses pictograms, hazard statements, and the signal words “Danger” and “Warning” to communicate hazard information on product labels and safety data sheets in a logical and comprehensive way. The primary goal of GHS is better protection of human health and the environment by providing chemical users and handlers, emergency first responders and the public with enhanced and consistent information on chemical hazards.

While the EPA Office of Pesticide Programs had been involved in the development of the GHS system, the OPP has not yet required GHS-compliant labels. The EPA OPP has a different set of requirements for pesticide product labels, as discussed in the preceding sections. These are the requirements the Defendants were to have adhered to in the communication of paraquat hazards.

Sample Pesticide Label with Current and GHS Requirements

To help stakeholders gain a better understanding of how GHS may affect the appearance of pesticide product labels, EPA's Office of Pesticide Programs (OPP) has drafted the following sample labels, shown with current requirements and with modifications necessary to be consistent with GHS. Select an example below to view a larger image and to learn more about each label.



Assigning the appropriate hazard communication elements to pesticide products requires knowledge of the product's toxicity categories. The assumptions for the toxicity categories of the sample product are as follows:

Under Current OPP Requirements:

- Acute Inhalation Toxicity: Category III
- Acute Dermal Toxicity: Category IV
- Acute Oral Toxicity: Category IV
- Skin Corrosion/Irritation: Category III
- Eye Damage/Irritation: Category III
- Acute Hazard to the Aquatic Environment: N/A

Under GHS:

- Acute Inhalation Toxicity: Category 4
- Acute Dermal Toxicity: Unclassified
- Acute Oral Toxicity: Unclassified
- Skin Corrosion/Irritation: Category 3
- Eye Damage/Irritation: Category 2 B
- Acute Hazard to the Aquatic Environment: Category 3

The United States Occupational Safety and Health Administration (OSHA), through its Hazard Communication Standard (29 CFR 1910.1200) adopted the GHS system and required chemical manufacturers and distributors to produce GHS-compliant labels and Safety Data Sheets for chemical products sold and distributed within the United States, as of June 1, 2015. The Hazard Communication Standard applies to manufacturers and distributors of chemical products. However, pesticides that are regulated by FIFRA are exempt from the Hazard Communication Standard and the FIFRA labeling requirements take precedence.

Evidence of Defendant Failure in Duty to Warn

My review of product labels, safety data sheets, marketing materials, and internal correspondence for the paraquat product reveals that the Defendants failed to adequately warn users. Below, I summarize the deficiencies I noted in the communication of risk to paraquat users.

The product label from the 1980's did not conform to the requirements of the EPA FIFRA outlined in 40 CFR Part 156: Labeling Requirements for Pesticides and Devices. Specifically lacking were adequate Human Hazard and Precautionary Statements. Hazard statements are required to describe the type of hazard that may occur, while precautionary statements will direct or inform the users of actions to take to avoid the hazard or mitigate its effects. The label from that period of time did not provide sufficient information about inhalation, skin absorption, and nasal absorption routes of entry. The range of health effects known at that time were not communicated on the label. Therefore, the hazard was not adequately described and the mitigation for avoiding the routes of exposure were not adequately described.

Toxicity categories were not assessed and communicated. And, the personal protective equipment recommendations, which stem from the hazard statement and toxicity categories, were not adequate for the hazards. The statement of PPE recommendation (shown below) only recommend PPE for the tasks with exposure to highly concentrated paraquat. It states: "when pouring, loading, mixing concentrate or when exposure to concentrate is possible, wear:" and then lists the PPE categories. While this list of PPE is appropriate for mitigating the risk, there should not be a recommendation for these tasks only. There should also be a recommendation for the application tasks and for tasks that result in drift-exposure.

When pouring, loading, mixing concentrate or when exposure to concentrate is possible wear:

A NIOSH/MSHA-approved pesticide respirator.

Protective clothing (disposable suit/coveralls or long-sleeved shirt and pants).

Full face shield.

Mid-forearm waterproof gloves.

Waterproof apron and footwear.

When spraying end-use dilution outside of an enclosed cab or aircraft or when contacting vegetation wet with spray wear:

Protective clothing (disposable suit/coveralls or long-sleeved shirt and pants).

Wide-brimmed hat.

Waterproof footwear.

REMOVE contaminated clothing and wash separate from other laundry before reuse.

PPE Recommendations on Paraquat Label

Front Panel

RESTRICTED USE PESTICIDE	
For retail sale to and use only by Certified Applicators or persons under their direct supervision and only for those uses covered by the Certified Applicator's certification.	
GRAMOXONE® EXTRA Herbicide	
A Weed, Grass, and Harvest Aid Herbicide	
KEEP OUT OF REACH OF CHILDREN	
DANGER POISON	
ONE SWALLOW CAN KILL!	
SYMPTOMS ARE PROLONGED AND PAINFUL. ONSET OF SYMPTOMS MAY BE DELAYED FOR UP TO 3 DAYS AFTER SWALLOWING.	
PELIGRO	
PRECAUCION AL USUARIO: Si usted no lee ingles, no use este producto hasta que la etiqueta le haya sido explicada ampliamente.	
• DO NOT USE OR STORE IN OR AROUND THE HOME. • DO NOT REMOVE CONTENTS EXCEPT FOR IMMEDIATE USE. • NEVER PUT INTO FOOD, DRINK OR OTHER CONTAINERS. • REFER TO SIDE PANEL FOR STATEMENT OF PRACTICAL TREATMENT. • READ PRECAUTIONARY STATEMENTS ON SIDE/BACK PANELS.	
ACTIVE INGREDIENT:	
Paraquat dichloride (1,1'-dimethyl-4,4'-bipyridinium dichloride)	37.05%
INERT INGREDIENTS:	62.95%
Total	100.00%
Contains 2.5 lbs paraquat cation per gallon.	
Contains stench (odor) and emetic.	
EPA Reg. No. 10182-280	
EPA Est. No.	
BEST AVAILABLE COPY	
Net Contents:	
Made in U.S.A.	
ICI Agricultural Products	
ICI Americas Inc.	
Wilmington, DE 19897	

Front Panel of ICI Paraquat Label

Despite considerable evidence that the Defendants knew of the dermal absorption and intranasal routes-of-entry of the paraquat product into the bodily systems of the users; and despite evidence that the Defendants knew of neurological and organ-system health effects associated with these non-ingestion routes of entry, the Defendants persistently failed to include this information on the product warnings and instructions. Internal documents and correspondence among members of the Defendants organization provide evidence that the organization knew of the potential for paraquat to enter the central nervous system through the nasal mucosal absorption pathway. Yet, the Defendant has persisted in fighting to prevent the EPA from including this information in its recent review of the product registration. Below, I provide some of the evidence of these facts.

In the minutes of a 1974 meeting to review the EPA label for the product, ICI is quoted as saying: “Our present label has been severely criticized as being inadequate in that the instructions are not clear and can be misinterpreted. The regulatory and public health agencies feel that human health must be protected at all costs. The question has been raised: What health effects does continuous Paraquat exposure pose to workers? At the present time we are unable to properly respond to this question to the complete satisfaction of Public Health and Regulatory people.”

In a 1982 letter from Chevron to the EPA, regarding their reluctant inclusion of dermal exposure warning information on the revised label: “We had hoped and believed that the jury would be persuaded by the medical evidence we presented, that even in spite of a callous disregard of label precautions, diluted paraquat spray simply could not have penetrated intact skin in the manner alleged, or caused a chronic lung fibrosis. But the second jury awarded damages against us. Apparently, the jury was also unimpressed with the strong evidence of misuse on Mr. Ferebee's part.”

When Chevron ultimately changed the label following the lawsuit, Syngenta acknowledged that this would “cause immense problems for both companies” and advised against sending a letter to distributors notifying them of the label change as it was “likely to go unnoticed by all but those who make a specific effort to compare the old and new texts in detail.” (SYNG-PQ-13120361). Statements such as these clearly evidence the defendants approach to warnings; minimize risks associated with Paraquat and deliberately keep critical information about Paraquat's adverse health effects from applicators.

Although it is documented that the Defendant knew of additional routes of entry in the 1970's, it finally included language about them on the label in the 1980's. This change was reluctant, as is indicated in this quote. Notice to Paraquat Consumer (1983), the Defendant states: "Our labels for years have emphasized the fact that drinking a fairly small amount of the concentrate can cause death...Another change is to add in connection with the DANGER signal that fatality may result if the product is absorbed through the skin or inhaled a... These changes, shifting somewhat the emphasis from the hazard of ingestion to other exposures, are not made because of any new scientific information concerning the action of this product in case of human exposure. We believe that the emphasis of the old label was and is entirely appropriate... While it is very, unlikely that permanent systemic injury will come from dermal exposure or inhalation of spray mist, and we know of no fully documented case where this has occurred without the most extreme misuse...Another reason for a label change is that Chevron Chemical Company's judgment (even when concurred in by most of the scientific world and by EPA) is subject to being second-guessed in court by a group of people who are likely to be inexperienced and motivated largely by natural sympathy – for someone who is sick or dead." In this remarkable quote, the Defendant states that they are grudgingly including the hazard information, because of litigation actions against them.

The defendants could have amended the label as information came to light about the health hazards and PPE requirements. A registrant may file an amended registration at any time to update the label to ensure compliance with FIFRA. 40 C.F.R. § 152.50. The registrant must provide the EPA with "draft labeling incorporating the proposed labeling changes." 40 C.F.R. § 152.50 (e). Additionally, with each new formulation registered the registrant shall provide a draft label and also "furnish with his application any factual information of which he is aware regarding unreasonable adverse effects of the pesticide on man or the environment, which would be required to be reported under FIFRA sec. 6(a)(2) if the product were registered." 40 C.F.R. § 152.50(f)(3). Syngenta and Chevron have obtained at least 34 unique registrations of Paraquat formulations over the last fifty years

There is evidence in the materials I reviewed that paints a picture of longstanding pattern on the part of the Defendants in which they dispute scientific findings of independent researchers and lobby vehemently against federal regulation of the product warnings and communications.

Evidence of this was noted in my review of the 2021 HED Response to Comments on the Proposed Interim Decision for Registration Review and updated Occupational Handler Exposure and Risk Estimates, one example of many is provided, below:

Comments from Syngenta Crop Protection (EPA-HQ-OPP-2011-0855-0276)

Comments Regarding the PBPK Model

Syngenta commissioned a paraquat in vivo pharmacokinetic and excretion in Cynomolgus Monkeys in the context of the development of physiologically based pharmacokinetic (PBPK) model in non-human primates (MRID 51247201) ... Pharmacokinetics were effectively proportional to dose. Urinary excretion was the predominant route of paraquat clearance and reflected the decline in plasma concentrations with 82.9% of the administered dose (n=6) being recovered in excreta from the Phase 3 and Phase 4 animals. An average of ca. 10% of the administered dose remained in the monkeys at 48 hours after dosing (Phase 4), consistent with a 48-hour urinary excretion of 90% of the administered dose. Considering the physical and chemical properties of [14C]-paraquat dichloride and its tendency to adsorb to the surface of laboratory materials, only having ca. 7% of the administered dose unaccounted for in the excreta of our study, assumed due to procedural losses, is substantially less than would have been expected based on previously established precedents in published reports of other kinetic investigations (Roffey et. al., 2007). This cynomolgus monkey study did not specifically examine PQ kinetics in the brain. The independent studies of Bartlett et al. (2009) using macaques dosed intravenously with [11C]-radiolabelled paraquat, elegantly addressed paraquat brain kinetics without euthanasia of the animals and used quantitative PET (Positron Emission Tomography) imaging which is considered as the gold standard for in vivo imaging.

EPA response

The studies identified by Syngenta in this comment do not contribute new information that impacts the conclusions of the systematic review (SR). The PBPK study does not address brain kinetics and the referenced Bartlett et al. (2009) study is already discussed in the SR. The Agency refers Syngenta to the SR (A. Wray, TXR 0057888, D449106, 06/26/2019) for further details.

Defendant paraquat marketing representative, when asked if Syngenta should have communicated the neurotoxicity hazard to users (Ouzts deposition, 09/28/20, page 101):

10	Q.	Yeah. Yeah. Is the fact that paraquat
11	gets into the brains of applicators as Dr. Botham	
12	says Syngenta has known for 25 years -- is that	
13	something you think Syngenta should have told	
14	farmers and applicators of paraquat since the time	
15	they first knew it and understood it?	
16	MR. WEIR:	Same objections. It's also
17	vague and ambiguous.	
18	THE WITNESS:	The assessment as far as
19	I would believe the information would be shared? I	
20	think so, yes, sir.	

Human Factors researchers have studied the phenomenon of “anti-warnings”, a term that refers to strategies used by product manufacturers to soften the impact of hazard warnings. Bohme and Egilman (2013) report that two strategies are used to prevent hazard warnings from impacting product sales. The first is inadequate warnings (or no warnings at all). In pursuit of the inadequate warning strategy, a company might suppress findings of studies that reveal hazards of the product. Or, they might lobby regulatory or consensus organizations to prevent the passage of mandatory hazard reporting rules. The second anti-warning strategy is the production of marketing or product communications that directly conflict with the hazard warnings (Wogalter, 1999). The defendants in this case engaged in both anti-warning strategies. They engaged in attempts to suppress the release of internal studies that indicated hazards or inadequacy of PPE, for example. They also have lobbied the EPA whenever a review of their product has been undertaken by that agency. Examples of these anti-warning efforts are enumerated in the sections that precede this. The defendants also engaged in the second type of anti-warning strategy: the production of media that directly conflicts with the hazard communication information. Some examples of this anti-warning strategy are shown, below.

In a brochure published by the Chevron Chemical Company in July 1984 entitled “Paraquat in Perspective”, there are several examples of anti-warnings. In the excerpt pictured here, the statement “it is an environmentally sound product and does not adversely affect health when used in accordance with label directions” appears on the first page. This was written after the aforementioned internal documents dated 1968, 1973, and 1979 discussed health risks and fatalities associated with the product. This brochure was published after internal documents discussed the possibility of nasal-mucosal entry into the body. But the “label directions” mentioned in the passage did not explain how to protect against that route of entry.

PARAQUAT in PERSPECTIVE

Paraquat is an agricultural herbicide discovered by Imperial Chemical Industries PLC (ICI) in the late 1950s and marketed in the United States by Chevron Chemical Company since 1966.

In the past few years, many Americans have become aware of Paraquat, not because of its essential role on the farm, but because the U.S. and foreign governments have used it to destroy illegally grown marijuana crops in their countries. The result is a heightened awareness of the herbicide by the non-farm public and a fear that Paraquat-contaminated marijuana could pose health hazards to those who smoked or ingested the substance.

Although there have been no cases of injury to humans by the smoking of Paraquat-treated marijuana, the fear of damage remains. And with each new development in the government's effort to control the illegally grown substance comes another wave of adverse and misleading media attention about Paraquat. The facts are these:

- There have been no cases of poisoning resulting from the proper agricultural use of Paraquat;

- Paraquat is one of the most commonly used and versatile herbicides on the market today. It is used annually on 10 to 12 million acres of U.S. cropland and in more than 100 countries around the world.

- It is an environmentally sound product and does not adversely affect health when used in accordance with label directions.

- It is a restricted use herbicide in the United States and must be applied by trained and licensed applicators or persons under their direct supervision.

- Paraquat use on the farm can actually improve the environment when used in soil-saving, conservation-tillage programs. At the same time, it enables farmers to conserve energy, time, labor and capital.

Whether or not the U.S. or other governments decide to use Paraquat to eradicate marijuana obscures the basic question of its originally intended use on the farm. It is this broader question of environmental and health risks of Paraquat in the agricultural community, measured against benefits, that this booklet will address.

Information for this brochure was provided by The United States Department of Agriculture, the United States Bureau of Health Statistics, The Soil Conservation Service, the National Agricultural Chemicals Association and other sources. It is based on the best scientific evidence available in July, 1984. Since scientific research is always continuing, be sure to refer to the most current information and label available. Always use products strictly in accordance with

label danger statements and directions and with applicable state and federal regulations. If you have further questions about Paraquat, write to:

Manager Public Affairs
Chevron Chemical Company
575 Market Street
San Francisco, CA 94105

CUSA-00019357

The use of images that conflict with manufacturer warnings and safety instructions is another method of anti-warning. In the 1984 Paraquat in Perspective brochure, the following image appeared in which the paraquat handler is wearing a short-sleeved. This, despite the photo caption which reads: “must be used ... in accordance with label directions”. However, the product label at that time stated:

Protective clothing (disposable suit/coveralls or long-sleeved shirt and pants).

This image, therefore, is directly conflicting the warning message to protect skin from the chemical. It is a classic example of anti-warning.



Farm chemicals—like all potentially dangerous products— must be used carefully and in accordance with label directions.

The Paraquat in Perspective brochure dedicates an entire section to minimizing the health risks associated with the product (shown below). This section equates paraquat with the chemicals found in a naturally occurring potato. This is a perfect example of anti-warning. This is confusing the end-user by saying that paraquat is no different from natural items. The section goes on to state that the ocean is composed of chemicals and “do we ‘hold the potatoes’ and stop swimming at the beach? Of course not!” This false equivalency is clearly an attempt to create

misunderstanding of the hazard communications on the product packaging. This is in direct contrast to the following image of the product label, in which the product hazard is stated as "POISON One swallow can kill!".

In the marketing brochure, Paraquat is equated to a potato or the ocean. The reader is given the impression that the product is no more dangerous than an organic potato. But, in actuality, "one swallow can kill".

CHEMICALS in BALANCE

Many factors influence whether a particular substance will cause poisoning. The most critical of these factors is the amount of the toxic substance compared to the amount required to cause illness. Substances present in relatively small quantities will most likely have no ill effect.

Those who oppose the use of chemicals to

The Potato



12 ALCOHOLS

9 ALDEHYDES

2 ESTERS

13 HYDROCARBONS

4 KETONES

109 OTHER CHEMICALS INCLUDING ARSENIC

produce food should consider that food is nothing more than different combinations of chemicals. Potatoes, for example, organically grown or not,

contain some 150 chemicals according to the National Academy of Sciences. They include 12 alcohols, nine aldehydes, two esters, 13 hydrocarbons and four ketones. They also contain arsenic.

Arsenic, incidentally, is not unique to potatoes. It is so widely dispersed in nature that virtually all fruit, vegetables, fish and animal meat contain at least a few atoms of it. There are about three billion pounds of it in ocean water. It hasn't been added by mankind. Ocean water just happens to be made up of many elements and chemicals, of which arsenic is one.

Do we "hold the potatoes" and stop swimming at the beach? Of course not. A swimmer would have to swallow a few hundred gallons of sea water daily to be affected by the arsenic. Of deeper concern should be the sodium chloride (table salt) he ingests, because the salt in the first quart or two of sea water would most likely prove fatal.

Current research indicates that many of the most abundant and nutritious foods we eat every day have evolved the ability to synthesize chemicals that are poisonous to insects, animals and other predators.

That's good for the plant. But these chemicals are also known to induce genetic changes and even cancer in animals and humans. Plants that produce these natural pesticides are so widespread in nature that no human diet could be made entirely free of them.

In fact, human consumption of these natural pesticides is probably 10,000 times higher than the dietary intake of man-made pesticides.

For protection against potential dangers from man-made substances introduced into the environment, proper scientific study and a sensible assessment of risks and benefits—followed by moderation and safe handling—is the rational answer.

CUSA-00019368



DANGER
CAN KILL IF SWALLOWED
HARMFUL TO THE EYES AND SKIN

FIRST AID TREATMENT

IF SWALLOWED

Immediately induce vomiting by inserting finger in throat. Administer fluids and induce further vomiting. Get to a hospital or physician fast. PROMPT TREATMENT IS ESSENTIAL. Symptoms of injury may be delayed.

SKIN CONTAMINATION

In case of contact, wash immediately with water. Remove clothing and wash skin where necessary. Prolonged contact will cause severe irritation. Repeated contact may increase danger of absorption.

EYE CONTAMINATION

In case of contact, wash thoroughly with water and get medical attention.

INHALATION

Do not breathe spray mist. Exposure to spray mist may cause irritation and nose bleeds. Stop and check spray procedure.

Note to Physicians: Emergency Information—call (415) 233-3737.

CONTENTS OF THIS LABEL: This Chemical Company (Chemical) warrants that this material conforms to the chemical description on the label and is ready to be used as described herein. Chemical neither makes, nor authorizes any agent or representative to make any other warranty or statement of MERCHANTABILITY, guarantee or representation, express or implied, concerning this material. 2. Certain anti-informative terms (except Chemical's name) cannot be used in connection with this Chemical. Such terms include, but are not limited to, danger to health and crops to which the material is applied, safe to handle, secure, and danger caused by drift to other parts of crops. Such risks occur even though the product is responsibly handled in accordance with the label and even though the Chemical is labeled. Buyer and user acknowledge and assume all risks and liability (except those assumed by Chemical under a separate liability agreement) from handling, storage and use of this material.

POISON DO NOT REMOVE EXCEPT
FOR IMMEDIATE USE.
ONE SWALLOW CAN KILL!

RESTRICTED USE PESTICIDE

For retail sale to and use only by Certified Applicator or persons under their direct supervision and only for those uses covered by the Certified Applicator's certification.



ORTHO Dual Paraquat

A Weed and Grass Killer • Harvest Aid Chemical
NEVER PUT INTO FOOD, DRINK OR OTHER CONTAINERS

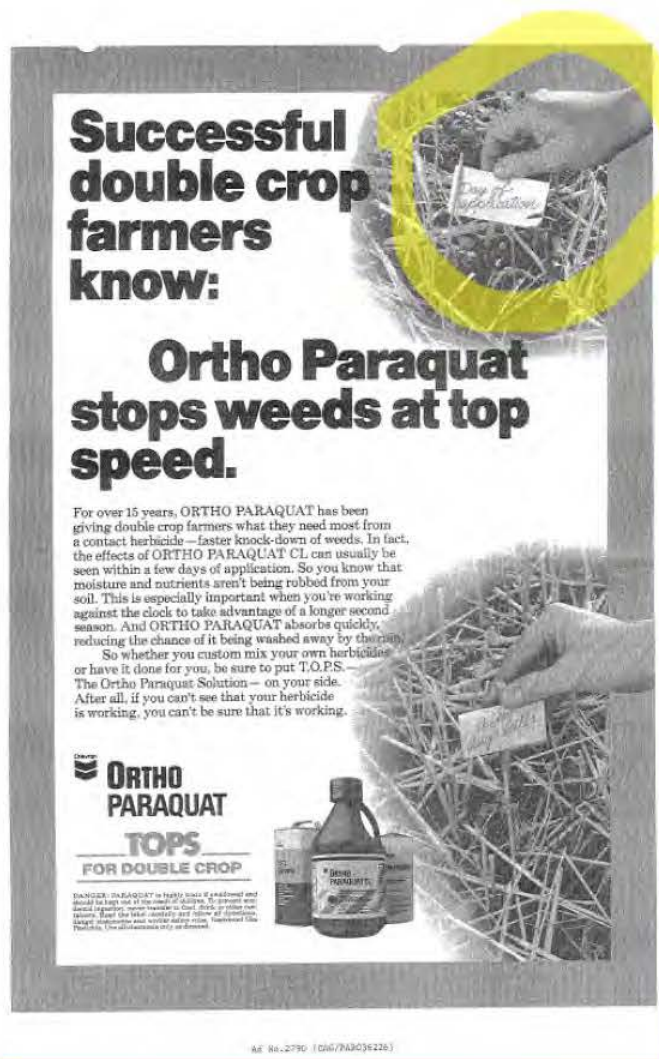


DANGER CAN KILL IF SWALLOWED
KEEP OUT OF REACH OF CHILDREN
DO NOT USE OR STORE IN OR AROUND THE HOME

Active Ingredients:
Paraquat bis (methylsulfate) (7, 7'-dimethyl-4,4'-bipyridinium bis (methylsulfate)) 42%
Inert Ingredients 58%
Contains 2 lbs. Paraquat cation per gallon, U.S. Pat. No. 2,972,528

READ FIRST AID AND SAFETY RULES ON SIDE PANELS
NET CONTENTS 1 GALLON LIQUID

In marketing materials, the defendants included images of product users **not** using the product in accordance with product label instructions. For example, the following examples of defendant product advertisement show a farmer not wearing the PPE as per the label instructions and an ungloved hand next to plants that had just been treated with Paraquat. These are in direct contradiction to the label instructions from that same time period (shown below). Marketing images that directly conflict with a product's warning and safety instructions is a perfect example of anti-warning. The user receives conflicting and confusing information. Visual images are more readily comprehended by the user (Wogalter, 1999) and will have a greater impact on the user perception of the product than will the text-based warning and safety instruction on the label (Wogalter, 2006).



Successful double crop farmers know:

Ortho Paraquat stops weeds at top speed.

For over 15 years, ORTHO PARAQUAT has been giving double crop farmers what they need most from a contact herbicide—faster knock-down of weeds. In fact, the effects of ORTHO PARAQUAT CL can usually be seen within a few days of application. So you know that moisture and nutrients aren't being robbed from your soil. This is especially important when you're working against the clock to take advantage of a longer second season. And ORTHO PARAQUAT absorbs quickly, reducing the chance of it being washed away by the rain.

So whether you custom mix your own herbicides or have it done for you, be sure to put T.O.P.S.—The Ortho Paraquat Solution—on your side. After all, if you can't see that your herbicide is working, you can't be sure that it's working.

ORTHOPARAQUAT
TOPS
FOR DOUBLE CROP

WARNING: ORTHO PARAQUAT is highly toxic if swallowed and should be kept out of the reach of children. It causes immediate skin irritation, severe burns to skin, and is highly corrosive. Keep the label on the container and follow all directions. Do not inhale vapors and avoid contact with eyes. Wash hands thoroughly after use. Do not eat, drink, or smoke while using. Use appropriate PPE as directed.

AE 98-2790 (046/7943036226)

READ ENTIRE LABEL. USE STRICTLY IN ACCORDANCE WITH DANGER STATEMENTS AND DIRECTIONS AND WITH APPLICABLE STATE AND FEDERAL REGULATIONS.

READ DANGER AND FIRST AID TREATMENT ON FRONT PANEL AND WORKER SAFETY RULES ON BACK OF PAMPHLET.

NOTE: Do not use around home gardens, schools, playgrounds or other areas likely to be contacted by children or pets.

ORTHO Dual Paraquat is a special formulation of bipyridinium salt that is non-corrosive to aluminum and may be used in ground sprayers. This product is effective on both broadleaved and grassy weeds.

DIRECTIONS

ORCHARDS AND VINEYARDS AND WINDBREAK, SHADE AND ORNAMENTAL TREES: For kill of annual broadleaf weeds and grasses and for top kill and suppression of perennials and green suckers under Filbert trees, in the interspaces and around the base of trees and vines—Almonds, Apples, Apricots, Avocados, Bananas, Cherries, Citrus, Coffee, Figs, Filberts, Grapes, Macadamia Nuts, Nectarines, Olives, Papayas, Peaches, Pears, Plums, Prunes, Walnuts and other Trees such as Arborvitae, Ash, Elm, Fir, Oak and Pine—Apply as a directed spray at 1 to 2 qts. per sprayed acre in 50 to 200 gals. water to thoroughly cover the weeds and grasses. Add ORTHO X-77 Spreader (non-ionic) at 8 oz. per 100 gals. Apply when the weeds and grasses are succulent and the new growth is from 1 to 6 inches high. For mature woody weeds, green suckers, late germinating weeds and grasses, and for perennials—retreatment or spot treatment may be necessary.

CAUTION: Do not allow spray to contact green stems, fruit or foliage as injury may result. Do not spray under windy conditions and use a shield for young trees or vines. Do not allow animals to graze on treated areas.

POTATO VINES: PREHARVEST VINE KILLING—1 to 2 pts. per acre. Use the 2 pt. rate where vine growth is vigorous or where quick vine kill is desired or 2 applications of 1 pt. when vine growth is dense. Use the 1 pt. rate on maturing vines. Apply in 50 to 100 gals. water per acre with thorough coverage. Add 8 oz. ORTHO X-77 Spreader (non-ionic) per 100 gals. water. Do not make more than 2 applications with a minimum of 5 days between applications. Do not apply within 3 days of harvest. Do not pasture livestock in treated potato fields. To avoid injury to subsequent crops, do not use on muck or peat soils.

PREPLANT AND PREEMERGENCE USE—For Kill of Emerged Annual Broadleaf Weeds and Grasses and for Top Kill and Suppression of Perennials—Apply when the weeds and grasses are succulent and growth is from 1 to 6" high (larger plants are less affected by this treatment).

NOTE: To prevent injury to germinating crop seedlings, do not apply preplant or preemergence to soils lacking clay minerals, i.e., peat, muck, pure sand, artificial planting media.

CORN ONLY—For kill of existing vegetation and residual control where corn will be planted directly into a cover crop, established sod or in previous crop residues: Apply 1-2 pints ORTHO Dual Paraquat plus 2½-3¼ lbs. Atrazine 80 Wettable per acre, as a broadcast spray. Refer to Atrazine 80 Wettable label for directions, limitations and cautions. Apply 20-60 gallons diluted spray per acre. Add ORTHO X-77 Spreader (non-ionic) at 8 oz. per 100 gallons diluted spray. Add Atrazine to spray tank first, mixing thoroughly in water. Then add ORTHO Dual Paraquat and surfactant. Constant agitation recommended at all times.

POTATOES—Early Postemergence Treatment—Apply 1 qt. per acre as a broadcast application in 30 to 100 gals. water after planting. Delay application to provide maximum weed and grass emergence but apply before 40 per cent of the potatoes have emerged. An application made after 40 per cent emergence will reduce yields. Add ORTHO X-77 Spreader (non-ionic) at 8 oz. per 100 gals. spray.

NONCROP AREAS—(Roadsides, Highway Margins, Rights-of-way, Around Commercial Buildings, Power Plants, Storage Yards and Other Installations, Fence Lines, Parkways and Similar Noncrop Areas)—For the Control of Annual Broadleaved Weeds and Grasses (such as Burdock, Chickweed, Filaree, Groundsel, Nettle, Pigweed, Plantain, Puncturevine, Purslane, Red Clover, Shepherdspurse, Thistle, Wild Mustard, Wild Radish, Wild Oats,

Bluegrass, Cheat Grass, Crabgrass) and Top Kill and suppression of Perennial Weeds (such as Bermudagrass, Johnsongrass and Morning glory)—1 to 2 qts. per acre. Apply for full coverage and thorough weed contact (50 to 100 gals. dilute spray per acre). Best results are obtained when applications are made to young, succulent weeds and grasses. Mature, woody weeds are less susceptible. Repeat applications as needed. Add ORTHO X-77 Spreader (non-ionic) at 8 oz. per 100 gals. ORTHO Dual Paraquat is compatible with many residual herbicides. Avoid spray contact with foliage or fruit of food crops and ornamentals.

WORKER SAFETY RULES

Avoid accidents. Follow these pesticide Safety rules when handling this product.

USE STRICTLY IN ACCORDANCE WITH DANGER STATEMENTS AND DIRECTIONS, AND WITH APPLICABLE STATE AND FEDERAL REGULATIONS.

WASH SPLASHES from skin and eyes immediately

REMOVE and wash contaminated clothing

WASH before eating, smoking and drinking

CONCENTRATE/MIXING

Wear full face shield, rubber gloves and apron when handling concentrate

SPRAY APPLICATION

Avoid working in spray mist. If there is risk of exposure wear goggles and approved face mask capable of filtering spray droplets. Wear waterproof footwear and clothing when spraying or when contacting vegetation wet with spray.

ENVIRONMENTAL SAFETY CAUTIONS**WILDLIFE**

This product is toxic to wildlife. Birds and other wildlife in treated areas may be killed. Keep out of lakes, streams and ponds. Do not apply where runoff is likely to occur.

DRIFT

ORTHO Dual Paraquat is a contact herbicide that kills all green plant tissue. Do not apply under conditions involving possible drift to food, forage or other plantings that might be damaged or the crops thereof rendered unfit for sale, use or consumption.

EQUIPMENT/CONTAINERS

Flush all spray equipment with water after use each day.

WASH and destroy containers when empty — Never reuse

DO NOT contaminate water when cleaning equipment or disposing of wastes.

STORE AT TEMPERATURES ABOVE 32°F.

Do not contaminate feed, foodstuffs or drinking water.

CONDITIONS OF SALE: 1. Chevron Chemical Company (Chevron) warrants that this material conforms to the chemical description on the label and is reasonably fit for use as directed hereon. Chevron neither makes, nor authorizes any agent or representative to make, any other warranty of FITNESS or of MERCHANTABILITY, guarantee or representation, express or implied, concerning this material.

2. Critical and unforeseeable factors beyond Chevron's control prevent it from eliminating all risks in connection with the use of chemicals. Such risks include, but are not limited to, damage to plants and crops to which the material is applied, lack of complete control, and damage caused by drift to other plants or crops. Such risks occur even though the product is reasonably fit for the uses stated hereon and even though label directions are followed. Buyer and user acknowledge and assume all risks and liability (except those assumed by Chevron under 1 above) resulting from handling, storage, and use of this material.

CHEV 14636

Manufactured for

Chevron Chemical Company

Ortho Division/San Francisco CA 94119 Richmond CA 94804
Form 8910-C Product 1000-21 EPA Reg. No. 239-1994

CHEV-SJ0001385

CONTROL VINES WITHOUT HOEING!

You can count on it—the old enemies like milkweed vine and Virginia creeper will be sneaking in as usual. Unchecked, they can almost take over a grove. But hoeing just isn't the modern way to untangle the mess. It's too costly and time-consuming. The idea is to get them before they get you. Spray them with ORTHO Paraquat CL before they are entangled in the foliage.

ORTHO Paraquat CL gives you a sensible, economical alterna-

tive. It's a non-selective contact herbicide that burns back stubborn vines, weeds and grasses with astonishing speed. You can actually see it begin to work in a matter of hours. And Paraquat can be used in a weed control program with many residual herbicides. Since Paraquat is inactivated on contact with the soil, it's not taken up by the tree as some residual herbicides are, so there's no danger of chlorotic foliage. *Do not spray green tissue.* But Paraquat can be used directly on the tree trunk if bark is *not green*. Paraquat is a

toxic chemical and must be used strictly in accordance with label instructions.

For best results, apply Paraquat with ORTHO X-77 Spreader.

It insures more thorough wetting and improved weed kill.

So hang up that hoe for good.

Talk to your ORTHO Dealer about the economics of vine and weed control with Paraquat.

He'll make a believer out of you.

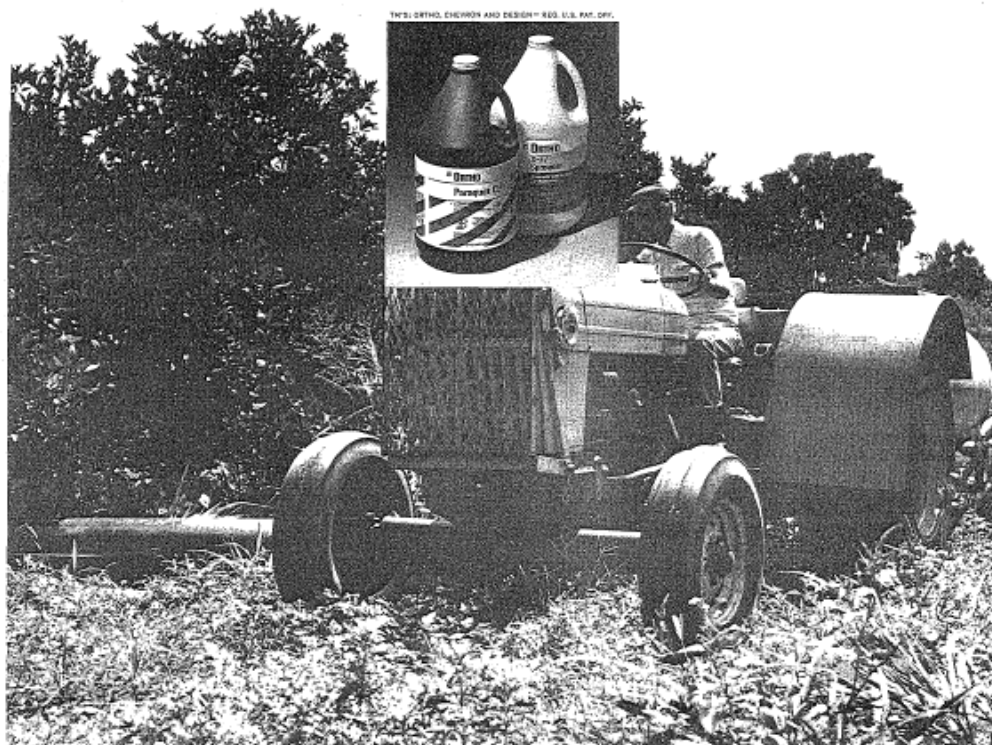
AVOID ACCIDENTS. FOR SAFETY READ THE ENTIRE LABEL, INCLUDING CAUTIONS AND WARNINGS. USE ALL CHEMICALS ONLY AS DIRECTED.



ORTHO

Chevron Chemical Company

THIS ORTHO, CHEVRON AND DESIGN™ REG. U.S. PAT. OFF.



In an internal document, the defendants admit to the process of anti-warning.

Marketing

Our increasing percent of sales are dependent of "influencers" such as state and university cooperators, soil conservation people and field specialists. Restricted list classification doesn't appear to adversely affect sales as evidenced by the larger number of registrations. In the past, the usefulness and efficacy of Paraquat was used to offset complains about drift problems and health hazard potential. However, with glyphosate introduction into the market these arguments will lose their emphasis.

It was pointed out that regulatory agencies and use regulations have a direct effect on sales. Some people could be persuaded not to have fears about Paraquat hazards while others cannot. Marketing felt that the signs are unmistakable - that people are being influenced on the hazards from Paraquat use. They felt a specific antidote for Paraquat would greatly decrease adverse pressure. Marketing did not feel that label recommendations for use of goggles and respirator would greatly affect sales. Marketing felt that the best course of action in preventing registration restrictions was to modify our present label in a way that was acceptable to the regulatory agencies.

This excerpt is from a Meeting Report of the Chevron Chemical Company Ortho Division in 1974. The meeting was held to discuss proposed label changes. The regulatory agency was driving this proposed label change to instruct users to use additional PPE. In the passage provided above, the defendants are stating that the organization has had an ongoing concern that "fears about Paraquat" would negatively impact sales. They state that usefulness and efficacy of the product used to outweigh the public concern for hazards. But that a competitive product (glyphosate, aka RoundUp) entry into the market necessitated additional measures to prevent loss of market share. The passage states that "some people could be persuaded not to have fears about Paraquat hazards..." **This passage is direct evidence of a strategy of anti-warning in which the defendants engaged.** The passage concludes with a statement that a label change to advise for additional PPE use would be a preferred option over the risk of regulatory ban of the product from the United States.

A 2003 Q&A was created by Syngenta's communications team for relaying information about the safety of Paraquat. The Q&A states that Syngenta recommends the operator does not need any special protective clothing. Ford-Duvall Depo. at 146-150; SYNG-PQ-01981745_R. This was Syngenta's external message through 2010. Id. at 150:18-151:10. In response to questions regarding personal protective equipment, Syngenta acknowledged that not wearing gloves and masks were not only predictable deviations from the labeling instructions but also minor deviations. Id. at 155-156. And even without this PPE, Paraquat was still safe. Id. at 156-157.

In summary, the Defendant has shown a decades-long pattern of failing to communicate hazard information in its possession. It evidenced delays in updating the product labels and it resisted inclusion of hazard information in the product review by the EPA.

Opinion 2:

The Defendants failed to adequately communicate the need for appropriate and effective personal protective equipment

As with the hazard information, the Defendants also possessed information about Personal Protective Equipment (PPE) adequacy for years before this information was conveyed to the product-using public. Here is some of the evidence of this fact, below.

First, an internal email correspondence in which a member of the Defendants organization states that there has been an historical reluctance to state on the label the need for appropriate respiratory protection. While the Defendants knew (as documented, above) of the potential for nasal and inhalation routes of entry since the 1970's, this email is dated 2001 and the label at that time still did not address mitigating the hazards with appropriate PPE.

From: Rosenheck Leah USGR
Sent: 20 April 2001 17:45
To: Clapp Mike GBAP; Wells Jerry USGR
Cc: Dixon Monty USGR; Chester Graham GBFH; Davidson Drew USUW; Wilks Martin GBFH; Wheals Ian CHBS
Subject: RE: Paraquat: Respiratory Protection

Mike,

California keeps a database of all adverse incident reports (we have obtained this many times for other products) and I believe it is quite easy to obtain, although I have not done this myself. Tim Pastoor or Linda Meyer or Dennis Kelly should know how to do this.

I suggest that Martin and Graham are in a better position to discuss why respirators are not considered necessary. However, our exposure models are not infallible and if there are problems being encountered by workers handling our product in the field, we may have to adjust our thinking to ensure that the problem is resolved.

You would need to speak to our US sales and field technical staff to assess the impact of adding a respirator to the label. Nowadays the use of PPE and engineering controls such as closed cabs are much more prevalent than they used to be, and this request for a respirator may not be as much as an inconvenience as previously thought.

Leah

In 1986, the ICI Central Toxicology Laboratory published a study of paraquat penetration through various protective clothing materials. The results were important, in that they found some commonly used materials, which applicators could wear according to the paraquat label instructions, offered no protection at all, while others provided adequate protection. This important information was not communicated to the product-using public through product label and instructions. Here are the findings of the 1986 study:

No paraquat ($<0.05\mu\text{g}/\text{ml}$) was found to have penetrated polyethylene-coated and Saran-coated TYVEK during the 6 hr exposure time. KIMGUARD material had a short resistance to paraquat ion from the concentrate (mean break-through time $<0.5\text{hr}$; mean penetration rate $608\mu\text{g cm}^{-2}\text{hr}^{-1}$) and the spray dilution (mean break-through time 2.2 hr; mean penetration rate $1.01\mu\text{g cm}^{-2}\text{hr}^{-1}$). TYVEK, COROVIN and unfinished cotton offered little resistance to either formulation, the breakthrough times being immediately after application.

These data would indicate that both polyethylene-coated and Saran-coated TYVEK will offer spray operators protection against both concentrate GRAMOXONE and the spray strength dilution.

From the results obtained, TYVEK, COROVIN and unfinished cotton cannot be recommended for protective clothing for use during the application of GRAMOXONE.

In 1988, the ICI Central Toxicology Laboratory published its findings regarding adequacy of protective glove materials, in a document entitled: PARAQUAT: PENETRATION FROM 'GRAMOXONE TMF' THROUGH SAMPLES OF PROTECTIVE CLOTHING MATERIALS. The report contains a disclaimer on the front page, which reads:

It should not be photocopied or microfilmed; nor should it be released in any form to an outside party. Information contained herein should not be used by a registration authority to support registration of any other product without written permission of ICI.

The materials tested were MLF, PVC, and nitrile. After a 6-hour test period, no paraquat penetration of the materials was detected. Again, this is useful information for the users, but was not communicated via the product labels or instructions.

A 1995 report (PARA-94-AE-01) undertaken to evaluate the need for additional PPE information on the product labels evaluated worker exposure during normal product use conditions: spray-applying product through vehicle-mounted ground boom, mixing product, and loading product into equipment. The study found 6 of 17 participants had detectable

paraquat in the urine following the exposing activities. The report identified the highest exposing tasks as: spraying, mixing, and rinsing containers.

This information demonstrates that Syngenta had knowledge that the PPE included on the labeling for Paraquat was not sufficient to adequately protect consumers. The labeling only required long pants and a long-sleeved shirt for those spraying paraquat in the United States. Syngenta scientists however, had concluded based on an internal study that “unfinished cotton cannot be recommended for protective clothing for use during the application of GRAMOXONE.”

Summary

There is considerable evidence to demonstrate that the Defendants possessed information about the paraquat neurotoxicity; nasal, skin, and inhalation routes of entry; and, personal protective equipment adequacy. The evidence shows that the Defendants possessed this information for many decades. There is also considerable evidence that the Defendants actively avoided communicating this information to the users of the paraquat products, through anti-warning strategies. The Defendants did not provide adequate warnings or safety instructions to users of the product. Based on the health hazard information and PPE efficacy information described in this report, the defendants should have included the following warning on the product labels:



DANGER POISON

May Be Fatal if Swallowed; Poisonous if Inhaled

Do not breath mist, do not get in nose, eyes or on skin

Product and spray are poisonous if ingested, inhaled, or if absorbed by skin or nasal passages.

May cause irritation to the nose, skin, and eyes.

Repeated exposures may cause permanent and serious neurologic effects

Wear full chemical-resistant clothing, face shield, and chemically-resistant gloves

Clothing should be polyethylene-coated or Saran-coated Tyvek – other materials will not protect

Wear NIOSH-approved P-100 particulate filtering face piece when mixing or exposed to spray
or drift

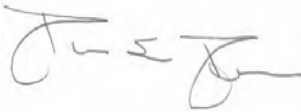
Immediately wash skin, eyes thoroughly with water upon exposure

The warning above would have been in compliance with FIFRA and would have conveyed the necessary degree of hazard and precautions to be taken to avoid the hazard. Since the Defendants did not provide this information on the product packaging, they failed in their duty to warn users of the hazards associated with this product.

VIII. Signature

I have reached the conclusions contained herein, based upon the foregoing and a reasonable degree of engineering certainty. If additional information that may be relevant to my opinions comes to light or is discovered and produced by the parties near or after the date this report is filed, I reserve the right to supplement my opinions. Further, I may offer testimony at trial on any subject addressed in the reports or testimony of any witness related to the subjects of my opinions under the applicable disclosure agreements or Rules.

Respectfully Submitted by:



Deborah E. Dickerson, PhD CIH CSP

October 3, 2024

Date

IX. Exhibits

EXHIBIT A:

Curriculum Vita

Deborah E. Dickerson (nee Young-Corbett)

Dated 09/07/24

Deborah E. Dickerson, PhD CIH CSP CHMM

Associate Professor: Human Factors and Safety Engineering
Director: Product and System Safety Laboratory
Virginia Tech
544 Whittemore Hall, Blacksburg, VA 24061
540-449-2068
debdicterson@vt.edu
<https://www.dickersonresearchgroup.com/>

Education

Doctor of Philosophy (2007)
Virginia Tech, Industrial and Systems Engineering (Safety Engineering)

Master of Science (2006)
Virginia Tech, Industrial and Systems Engineering (Safety Engineering)

Master of Science (1999)
North Carolina State University, Biological Sciences

Bachelor of Science (1996)
Virginia Tech, Biological Sciences

Certifications

Certified Industrial Hygienist (CIH) 2001 - present
Comprehensive Practice 8234CP; American Board of Industrial Hygiene

Certified Safety Professional (CSP) 2003 - present
Comprehensive Practice 17546; Board of Certified Safety Professionals

Certified Hazardous Materials Manager (CHMM) 2003 - 2021
Master Level 12240; The Institute of Hazardous Materials Management

Asbestos Management Planner 1996 – 2006
Virginia Department of Professional and Occupational Regulation, 18VAC15-20

Research Interests

Control of hazardous materials and risks in work, system, and product design

Expertise Summary

Over 25 years of professional and academic experience in product safety, system safety, industrial hygiene, hazardous materials management, and hazard control.

Expertise in: product design and safety; design of product warnings and labels; chemical exposure risks, analysis, and health outcomes; industrial system design, safety, and training.

Professional Experience

Associate Professor (June 2015 – present)

Virginia Tech, Grado Department of Industrial and Systems Engineering
Developing research, scholarship, and educational programs emphasizing control of hazards in systems and products.

Director (July 2018 – present)

Product and System Safety Laboratory, Virginia Tech
Leading research on safe design of products, systems, and warnings.

President (June 2014 – present)

Dickerson Consulting LLC
Providing consultation, design, training, and expert witness services in the areas of product and system safety, industrial hygiene, occupational safety, accident prevention. Expert witness services for plaintiff and defense in industrial accident, chemical release, and product design cases in federal and state jurisdictions.

Assistant Professor (August 2007 – June 2015)

Virginia Tech, Via Department of Civil and Environmental Engineering
Developed research, scholarship and educational programs emphasizing control of hazards arising from the built environment and inherent to construction processes.

Director (1996-2006)

Environmental, Health & Safety Services, Virginia Tech
Led operation, including staff of 26 and combined budgets of 3.4 million. Responsible for environmental and occupational compliance services for the more than 10,000 employees of this major land-grant university. Managed the following programs: chemical hygiene and laboratory safety, hazardous chemical waste management, asbestos and lead management, chemical health hazards, industrial ventilation, non-ionizing radiation, laboratory safety, infection control, hearing conservation, pulmonary function testing, respiratory protection, asbestos and lead, and medical surveillance. Managed annual operating budget of 1.1 million.

Adjunct Instructor (1999–2006)

Industrial & Systems Engineering, Virginia Tech
Developed new curricula and taught coursework in industrial hygiene and occupational safety. Served as faculty advisor for student section of American Society of Safety Engineers.

Teaching Experience

Courses Taught

Product Safety: Design, Warnings, Liability	2023 – present
System Safety Analysis	2022 – present
Principles of Industrial Hygiene	1999 – present
Risk and Hazard Control	2019 – present
Introduction to Human Factors Engineering	2019 – 2022
Occupational Safety	2000 – 2006
Prevention through Design	2008 – 2014
Building Technology System Design	2008 – 2010
Indoor Environmental Quality and Sustainable Facilities	2009 – 2011
Construction Health and Safety	2017 – 2018
Building HVAC Design	2009 – 2011

Expert Witness Experience

Nature of case: equipment design and manufacturing defects (Entanglement)
Huffstetler v. Burkle North America, Inc. and Robert Burkle GmbH d/b/a Burkle
Process Technologies and Stiles Machinery, Inc.
United States District Court, Western District of Virginia, Danville Division
Plaintiff's Expert

Nature of case: equipment design defects, equipment warnings defects (Asphyxia)
Smith v. Defendants Messer North America, Inc., Messer Gas LLC
State Court of Gwinnett County, State of Georgia
Plaintiff's Expert

Nature of case: equipment design defects, equipment warnings defects (Asphyxia)
Saulo Suarez-Bernal estate v. Defendants
Messer North America, Inc., Messer Gas LLC
State Court of Gwinnett County, State of Georgia
Plaintiff's Expert

Nature of case: equipment design defects, equipment warnings defects (Asphyxia)
Elias-Cabrera estate v. Defendants Messer North America, Inc., Messer Gas LLC
Plaintiff's Expert
State Court of Gwinnett County, State of Georgia
Jones v. DAS Companies, Inc., et al.
United States District Court, District of South Carolina
Plaintiff's Expert

Nature of case: negligence (Indoor environmental contamination)
McCully vs. Jenkins Restorations
Frederick 6th Circuit Court, State of Maryland
Plaintiff's Expert

Nature of case: chemical warnings defects (Chemical exposure)
Baniecki v. Pardis Sabeti, et al.
Superior Court of the Commonwealth of Massachusetts
Plaintiff's Expert

Nature of case: chemical warnings defects (Chemical exposure)
Heaton v. Defendant CWT Savannah Holdings LLC, d/b/a Westin Savannah Harbor
Resort and Spa
State Court of Chatham County, Georgia
Plaintiff's Expert

Nature of case: product warnings and instructions defects (IPL Laser)
Gina Mastrostefano v. Defendants Focus Medical, LLC, Boston Aesthetics, LLC
Superior Court of Bristol, Commonwealth of Massachusetts
Plaintiff's Expert

Nature of case: worker's compensation (extreme temperature, heat stroke)
Estate of Michael Earnheart v. Premier Restorations LLC and Accident Fund Insurance
Company of America, Jurisdiction Claim No. VA02000035040, Virginia Workers
Compensation Commission
Plaintiff's Expert

Nature of case: premises liability (trip/fall)
Osborne v. NOVA Healthcare Group, LLC
Circuit Court of Scott County at Gate City, Virginia
Defense Expert

Nature of case: negligence, breach of contract (indoor environmental contamination)
Morga v. MD Flooring Solutions
Circuit Court, State of Maryland
Plaintiff's Expert

Nature of case: product liability, toxic tort (Paraquat)
Multiple Plaintiffs v. Syngenta Crop Protection, LLC
State Court of Pennsylvania, Multi-district
Consulting Expert

Nature of case: product liability, toxic tort (Aqueous Fire-Fighting Foam, AFFF)
Multiple Plaintiffs v. 3M Corp.
U.S. District Court, District of South Carolina
Consulting Expert

Nature of case: product design defect, product warning defects (Radiant heat burn)
Thomas v. Defendants CJS Enterprises d/b/a Tuscan Sun Spa and Salon, Sunshine
Holding LLC, Cheri J. Satterfield, Steve L. Holbert, Sunlights Balayage Inc
Circuit Court of Monongalia County, West Virginia
Defense Expert

Nature of case: premises liability (trip/fall)
 Smith v. Café at South Street, LLC; Richmod Street Holdings, LLC
 Providence/Bristol County Superior Court, State of Rhode Island Superior Court
 Plaintiff's Expert

Nature of case: chemical product warnings defects (Chemical reaction)
 Malphus v. Aulick Chemical Solutions, Inc.
 United States District Court, District of South Carolina
 Plaintiff's Expert

Nature of case: premises liability (asbestos containing materials, ACM)
 Multiple Plaintiffs v. Wells Fargo
 United States District Court, District of Southern California
 Defense consulting expert

Nature of case: product design and warnings defects (pressure intensifier)
 Martinez-Saldivar v. Hypertherm Inc, Park Industries, Siemens Corp., et al
 District Court, Clark County, Nevada
 Defense Expert

Research Activities

Sponsored Research and Other Grants

(Total: \$13,904,208)

Project Title: Center for Innovation in Construction Safety and Health
Sponsor: National Institute for Occupational Safety and Health (NIOSH)
Funding Amount: \$9,887,239
Beginning/Ending Dates: 08/30/09 – 08/29/14
Role: Co-PI
Description: Establish research center at Virginia Tech

Project Title: (T03) Safety and Ergonomics Training
Sponsor: National Institute for Occupational Safety and Health (NIOSH)
Funding Amount: \$1,395,106
Beginning/Ending Dates: 07/01/16 – 06/30/21
Role: Co-PI
Description: Training grant (T3) provides graduate education to students interested in studying occupational safety and health and safety engineering

Project Title: Health Hazard Controls: Evidence-based intervention strategy
Sponsor: National Institute for Occupational Safety and Health (NIOSH)
Funding Amount: \$980,460
Beginning/Ending Dates: 11/01/19 – 10/31/24
Description: Design solutions to control health hazards
Project Title: Interdisciplinary Team in Pervasive Computing Design

Sponsor: Office of Vice President for Research at Virginia Tech
Funding Amount: \$200,000
Beginning/Ending Dates: 08/2007-05/2009
Role: co-PI
Project Title: Bio-Inspired Buildings: Integrating Building and Biological Systems Theories to Transform the Built Environment

Sponsor: Dean of the Graduate School, Virginia Tech
Funding Amount: \$900,000
Beginning/Ending Dates: 8/13-8/16
Role: co-PI
Description: Creation of a multidisciplinary doctoral program in bio-inspired building and infrastructure design

Project Title: Sustainable Healthy Schools
Sponsor: National Science Foundation
Funding Amount: \$174,275
Beginning/Ending Dates: 08/09-08/12
Role: Principal Investigator
Description: Systems engineering management of school hazards

Project Title: (Ro1) Dust-control: Strategic Technology Intervention
Sponsor: National Institute for Occupational Safety and Health
Funding Amount: \$580,275
Beginning/Ending Dates: 08/09-08/13
Role: Principal Investigator
Description: Theory-based behavioral and attitudinal interventions to produce changes in stakeholder willingness to adopt safety innovations.

Project Title: (Ro1) Prevention through Design (PtD) Adoption Readiness
Sponsor: National Institute for Occupational Safety and Health (NIOSH)
Funding Amount: \$251,071
Beginning/Ending Dates: 08/15/12-08/14/14
Role: PI
Description: Survey research on safety innovation perceptions

Project Title: Pervasive Computing Innovations
Sponsor: Institute for Critical Technology and Applied Science (ICTAS)
Funding Amount: \$10,000
Beginning/Ending Dates: 2007-2008
Role: PI
Description: Design prototype for a wearable sensor to detect carbon monoxide

Project Title: Current Trends and Stakeholder Perceptions of Radon-resistant Home Construction
Sponsor: Institute for Culture, Society, and the Environment
Funding Amount: \$19,500

Beginning/Ending Dates: 5/16-8/16

Role: PI

Description: Current trends in Radon Resistant Construction in the U.S. homebuilding market

Project Title: Positioning MLSoC to Discover Lifecycle Value in the Dynamic Construction Industry

Sponsor: Research Affiliates Myers-Lawson School of Construction

Funding Amount: \$75,000

Beginning/Ending Dates: 07/12-07/13

Role: Co-PI

Description: Funding to plan for the BioBuild Program

Project Title: Prevention through Design in Masonry

Sponsor: Center for Innovation in Construction Safety and Health

Funding Amount: \$5,000

Beginning/Ending Dates: 1/2011-7/2011

Role: PI

Description: Pilot project grant to perform study of ventilated saw design

Project Title: Occupational Respiratory Hazards

Sponsor: Institute for Critical Technology and Applied Science (ICTAS)

Funding Amount: \$10,000

Beginning/Ending Dates: 1/2009-6/2009

Role: PI

Description: Pilot project on silica exposures and equipment design

Project Title: Graduate Student Tuition Support

Sponsor: DARPA

Funding Amount: \$7,500

Beginning/Ending Dates: 1/2008-12/2008

Role: PI

Description: Participation in design competition

Project Title: Building-related Environmental Assessment and Technology in Housing, Existing (BREATHE)

Sponsor: Institute for Culture, Society, and the Environment

Funding Amount: \$18,000

Beginning/Ending Dates: 5/2008-8-2008

Role: PI

Description: Pilot study of indoor environmental quality in homes

Project Title: Respiratory Hazard Monitoring

Sponsor: Institute for Critical Technology and Applied Science (ICTAS)

Funding Amount: \$19,500

Beginning/Ending Dates: 2007-2008

Description: Design for a ventilated sanding tool.

Publications

Book chapter

1. Young-Corbett, DE. (2013). Prevention through Design: Eliminating Occupational and Environmental Risk through Design of Equipment, Work, and Systems. *Chapter in: The Handbook of Industrial and Systems Engineering*, 2nd Edition. Taylor and Francis, CRC Press. Boca Raton, FL. Badiru, AB, editor.

Papers in refereed journals

1. Dickerson, D.E., Pettaway, K.J. (2024). Comprehensibility and User Experience of GHS Chemical Warning Symbols. *Applied Human Factors* 7(5): 205-214.
2. Dickerson, D. E. (2023). Construction Health Hazard Control Innovations: A Web-Based Intervention to Change Perceptions. *International Journal of Construction Education and Research*, 1-20.
3. Young-Corbett, D.E. and Nussbaum, M.A. (2009a). Dust Control Technology Usage Patterns in the Drywall Finishing Industry. *Journal of Occupation and Environmental Hygiene*. 6(6): 315-323.
4. Young-Corbett, D.E. and Nussbaum, M.A. (2009b). Dust Control Effectiveness of Drywall Sanding Tools. *Journal of Occupational and Environmental Hygiene*. 6(7): 385-389. (2009 Impact Factor: 1.180)
5. Young-Corbett, D.E., Nussbaum M.A. and Winchester, W.W. (2010). Usability evaluation and redesign specifications for drywall sanding tools. *International Journal of Industrial Ergonomics*. 40(1): 112-118.
6. Forsyth, J.B. *, Martin, T.L., Young-Corbett, D.E., Dorsa, E. (2012). Feasibility of Intelligent Monitoring of Construction Workers for Carbon Monoxide Poisoning. *Journal of IEEE Transactions on Automation Science and Engineering*. 9(3)
7. Bhattacharjee, S., Ghosh, S*, Young-Corbett, D., Fiori, C. (2013). Comparison of Industry Expectations and Student Perceptions of Knowledge and Skills Required for Construction Career Success. *International Journal of Construction Education and Research* 9(1):19-38.
8. Popov, G, Blunt, LA, McGlothlin, G, Young-Corbett, D, Zey, JN, Heckel, P, (2013). Integrating Prevention through Design in Undergraduate Curricula. *Professional Safety: Journal of the American Society of Safety Engineers* 44-49
9. Young-Corbett. (2014). Prevention through Design (PtD): Health Hazards in Asphalt Roofing. *Journal of Construction Engineering and Management*. 140(9): September 2014.

10. Weidman, J., Dickerson, D. E., & Koebel, C. T. (2015). Intervention to improve purchasing decision-maker perceptions of ventilated tools. *Journal of Construction Engineering and Management*, 141(6), 04015007.
11. Weidman, J., Dickerson, D. E., & Koebel, C. T. (2015). Prevention through design adoption readiness model (PtD ARM): An integrated conceptual model. *Work*, 52(4), 865-876.
12. Ghosh, S., & Dickerson, D. (2015). Modified interaction process analysis as a macroergonomic method of analyzing communication patterns in construction. *IIE Transactions on Occupational Ergonomics and Human Factors*, 3(1), 45-57.
13. Weidman, J., Dickerson, D., & Koebel, C. T. (2015). Prevention through Design: A Macroergonomic Conceptual Approach to Risk Reduction. *IIE Transactions on Occupational Ergonomics and Human Factors*, 3(1), 24-36.
14. Dickerson, D. E., & Ackerman, P. J. (2016). Risk-based maintenance management of US public school facilities. *Procedia Engineering*, 145, 685-692.
15. Weidman, J., Dickerson, D. E., & Koebel, C. T. (2016). Effective intervention strategy to improve worker readiness to adopt ventilated tools. *Journal of Construction Engineering and Management*, 142(8), 04016028.
16. Dickerson, D. E. (2016). Environmental relative burden index: a streamlined life cycle assessment method for facilities pollution prevention. *Journal of Green Building*, 11(1), 95-107.
17. Weidman, J. E., Dickerson, D. E., & Koebel, C. T. (2016). Technology Champions: A Theory-Based Intervention to Improve Adoption of Occupational Safety Innovations. *International Journal of Construction Education and Research*, 12(3), 193-207.
18. Kim, S., Nussbaum, M. A., Schoenfisch, A. L., Barrett, S. M., Bolding, M. C., & Dickerson, D. E. (2017). Occupational Safety and Health Concerns in Logging: A Cross-Sectional Assessment in Virginia. *Forests*, 8(11), 440.
19. Ghosh, S., Dickerson, D. E., & Mills, T. (2019). Effect of the Last Planner System® on Social Interactions among Project Participants. *International Journal of Construction Education and Research*, 1-18.

Papers in refereed conference proceedings

1. Halder, S., Alimoradi, S., Afsari, K., Dickerson, D. E. (Accepted, Awaiting Publication/Presentation). A Computer Vision Approach to Assessing Work-Related Musculoskeletal Disorder (WMSD) Risk in Construction Workers. Construction Research Congress 2024.

2. Sexton-Lewis, P.*, Kleiner, B.M., and Young, D.E. (2004). User feedback on Moldex N-100 filtering face-piece design. *Proceedings of the 48th Annual Meeting of the Human Factors and Ergonomics Society*. (pp: 2013 – 2017) New Orleans, LA.
3. Young, D.E. and Kleiner, B.M. (2008). Drywall finishing industry: macro-ergonomic evaluation and intervention design. *Proceedings of the 9th edition of Human Factors in Organizational Design and Management (ODAM) International Symposium*. L. Sznclwar, F. Marcia and U. Montedo (Editors); Sao Paulo, Brazil.
4. Young-Corbett, D.E. (2009). Building-related Environmental Assessment and Technology in Housing, Existing (BREATHE): development of standardized protocols for evaluating the indoor environmental quality of existing housing. *Proceedings of the 9th International Conference and Exhibition of Healthy Buildings 2009*. September 13-17. Syracuse, NY. USA.
5. Ghosh, S.*, and Young-Corbett, D. (2009). Intersection between Lean Construction and Safety Research: A Review of Literature. *Proceedings of the 2009 Industrial Engineering Research Conference*, May 30 – June 3, Miami, FL.
6. Ghosh, S.*, Young-Corbett, D., and Fiori, C. M. (2010). Emergent Themes of Instruments used to Measure Safety Climate in Construction. *Proceedings of the 2010 Construction Research Congress (CRC2010)*, May 8 – 11, Banff, Alberta.
7. Bhattacharjee, S., Ghosh, S.*, and Young-Corbett, D. (2010). Energy Service Performance Contracting in Construction: A Review of the Literature. *Proceedings of the 46th ASC Annual International Conference*, held April 7- 10, Boston, MA.
8. Sexton-Lewis, P.*, Young-Corbett, D.E., and Kleiner, B.M. (2010). Bioaerosol Exposures and Respiratory Symptoms Associated with Landscaping Mulch-handling Task. *American Industrial Hygiene Conference and Exposition*. May 22-27, Denver, CO, USA.
9. Bhattacharjee, S.*, Ghosh, S.*, and Young-Corbett, D. (2010). The Next Step to Improve Safety – Prevention through Design. *Proceedings of 2010 Associated Schools of Construction Region III Conference*. October 20-23, 2010. Downers,GA.
10. Young-Corbett, D. and Ackerman, P.* (2011). Condition Assessment Methodologies for Public School Indoor Environmental Health. *Proceedings of Indoor Air 2011: The 12th International Conference on Indoor Air Quality and Climate*. Austin, TX. June 5-10, 2011.
11. Young-Corbett, D. (2011). Sustainable Healthy Schools: A Lifecycle Analysis (LCA) Framework for Facility Condition Management. *Proceedings of the*

- International Conference on Sustainable Design and Construction*. American Society of Civil Engineers. Kansas City, MO. March 23-25, 2011.
12. Bhattacharjee, S., Ghosh, S.*, and Young-Corbett, D. (2011) The Next Step to Improve Safety – Prevention through Design. *47th Annual International Conference of Associated Schools of Construction*. April 6-9, 2011. Omaha, Nebraska, USA.
 13. McNair, L., Young-Corbett, D. (2011). Building New Engineering Education Theory and Practice for Interdisciplinary Pervasive Computing Design. *Proceedings of the 2011 Annual Conference and Exposition of the American Society for Engineering Education*. Vancouver, BC, Canada. June 26 – 29, 2011.
 14. Forsyth, J.B.*, Martin, T.L., Young-Corbett, D., Dorsa, E. (2011) Feasibility Study of a Wearable Carbon Monoxide Warning System for Construction Workers. *9th Annual IEEE International Conference on Pervasive Computing and Communications (PerCom 2011)*. Seattle, WA. March 21-25, 2011.
 15. Ghosh, S.*, Bhattacharjee, S., and Young-Corbett, D. (2011). Identifying Critical Barriers Inhibiting Use of ESPC in the Private Building Sector. *47th Annual International Conference of Associated Schools of Construction*. April 6-9, 2011. Omaha, Nebraska, USA.
 16. Bhattacharjee, S., Ghosh, S.*, and Young-Corbett, D. (2011). Safety Improvement Approaches in Construction Industry: A Review and Future Directions. *Proceedings of the 47th Annual International Conference of Associated Schools of Construction*. April 6-9, 2011. Omaha, Nebraska, USA.
 17. Ghosh, S.*, Young-Corbett, D., and Van Aken, E. (2011). Role of Social Interaction in Construction Production Planning: A Conceptual Model. *Proceedings of the Institute of Industrial Engineers (IIE) Annual Conference and Expo 2011*. May 21 – May 25, 2011, in Reno, Nevada, USA.
 18. Young-Corbett, D and Ackerman, P. (2011). Condition Assessment Methodologies for Public School Indoor Environmental Health. *Proceedings of Indoor Air 2011: The 12th International Conference on Indoor Air Quality and Climate*. Austin, TX. June 5-10, 2011.
 19. Ghosh, S.*, and Young-Corbett, D. (2011). Barriers to the Adoption of Prevention through Design (PtD) Controls among Masonry Workers. *International Council for Research and Innovation in Building and Construction Conference (CIB W099 Conference 2011)*, Washington, DC, USA, August, 2011.
 20. Weidman, J.E.*, Young-Corbett, D., Koebel, C.T., Fiori, C., and Montague, E.N. (2011). Prevention through Design: Use of the Diffusion of Innovation Model to Predict Adoption. *International Council for Research and Innovation in Building and Construction Conference (CIB W099 Conference 2011)*, Washington, DC, USA. August, 2011.

21. Forsyth, J. B.*; Martin, T. L.; Young-Corbett, D.; Dorsa, E. (2012); , "Feasibility of Intelligent Monitoring of Construction Workers for Carbon Monoxide Poisoning," *Automation Science and Engineering, IEEE Transactions on* , vol.9, no.3, pp.505-515, July 2012 doi: 10.1109/TASE.2012.2197390
22. Young-Corbett, D. (2012). Life Cycle Assessment (LCA) of Asbestos and Lead Building Materials in Schools: Goal and Scope Definition. *ICSDC 2011: Integrating Sustainability Practices in the Construction Industry*; Eds. Wai Kiong, Oswald Chong, and Christopher Hermreck; International Conference on Sustainable Design and Construction (ICSDC) 2011; Kansas City, Missouri, March 23-25, 2011.
23. Goldberg, A.* and Young-Corbett, D. (2014). Decision making in commercial construction. *Human Factors in Organizational Design and Management XI: Nordic Ergonomics Society Annual Conference 46*. Broberg, O., Fallentin, N., Hasle, P., Jensen, P.L., Kabel, A., Larsen, M.E., Weller, T. (editors). Copenhagen, Denmark. August 17-20, 2014.
24. Goldberg, A.* and Young-Corbett, D. (2014). Adoption Readiness of Prevention through Design (PtD) Controls in Concrete, Masonry, and Asphalt Roofing. *2014 Construction Research Congress*. Georgia Institute of Technology, Atlanta, GA, USA; May 19-21, 2014.
25. Dickerson, D. E., & Ackerman, P. J. (2016). Risk-based Maintenance Management of US Public School Facilities. In O. Chong, K. Parrish, P. Tang, D. Grau, & J. Chang (Eds.), *ICSDEC 2016 - INTEGRATING DATA SCIENCE, CONSTRUCTION AND SUSTAINABILITY* Vol. 145 (pp. 685-692). Arizona State Univ, Coll Avenue Commons, Tempe, AZ: ELSEVIER SCIENCE BV. doi:10.1016/j.proeng.2016.04.069
26. Dickerson, D.E. (2017). Current Trends and Stakeholder Perceptions of Radon-resistant Home Construction Engineering Sustainability 2017: Innovation and the Triple Bottom Line; Pittsburgh, PA. April 9-11.
27. Dickerson, D.E. (2017). Using the Environmental Relative Burden Index (ERBI) to Evaluate Pollution Prevention Options"Engineering Sustainability 2017: Innovation and the Triple Bottom Line; Pittsburgh, PA. April 9-11.
28. Dickerson, D.E. (2018). Total Worker Health® Approach to Improving Construction Worker Safety and Health. Institute of Industrial and Systems Engineers (IISE) Annual Conference and Expo 2018. Orlando, Florida. May 19-23, 2018.
29. Dickerson, D.E. (2018). Prevention through Design: Stakeholder Perceptions of PtD Solutions in Construction. Institute of Industrial and Systems Engineers (IISE) Annual Conference and Expo 2018. Orlando, Florida. May 19-23, 2018.

Awards, Recognition, Invited Presentations

1. Best Paper Award

IEEE Transactions Best Paper of 2012:

Forsyth, J.B., Martin, T.L., Young-Corbett, D.E., Dorsa, E. (2012). Feasibility of Intelligent Monitoring of Construction Workers for Carbon Monoxide Poisoning. *Journal of IEEE Transactions on Automation Science and Engineering*. 9(3): 505-515. (2011 Impact factor: 1.46) From the reviewers: "The selection is a very nice paper with a creative and highly practical innovation to protect construction workers from CO poisoning with an in-helmet sensor. The authors motivate their design, report the implementation details, develop an elegant model to filter out motion and to model reliability, and then perform a convincing user study."

2. Invited keynote presentations or lectures

- *National Conference on Prevention through Design*, National Institute for Occupational Safety and Health. August 23, 2011. Arlington, VA. Invited to speak on Prevention through Design in Engineering Education.
- *The Engineer of 2020 Workshop*, Purdue University. September 20, 2011. Invited to Speak on Prevention through Design.
- *Prevention through Design Workshop 2021*, Arizona State University. May 26-27, 2021. Keynote speaker on Prevention through Design for Health Hazards.

Service Activities

- Instructor, Certified Product Safety Professional program, Society of Product Safety Professionals®, Arlington VA (2022-present)
- National Institute for Occupational Safety and Health, National Occupational Research Agenda (NORA) Construction Sector Council (2017-present)
- National Institute for Occupational Safety and Health, National Occupational Research Agenda (NORA); Healthy Work Design and Wellbeing Cross Sector Council (2018-present)
- National Institute for Occupational Safety and Health (NIOSH) advisory committee on Prevention through Design (2008-2015)
- Member: American Society of Safety Professionals, American Industrial Hygiene Association, Human Factors and Ergonomics Society

EXHIBIT B:

Case History 2020-2024

1. Mary Lynn Baniecki v. Pardis Sabeti, et al., in the Superior Court of the Commonwealth of Massachusetts
2. Plaintiff Steven D. Heaton v. Defendant CWT Savannah Holdings LLC, d/b/a Westin Savannah Harbor Resort and Spa, In the State Court of Chatham County, Georgia
3. Plaintiff Dana Malphus vs. Aulick Chemical Solutions, Inc. UNITED STATES DISTRICT COURT DISTRICT OF SOUTH CAROLINA, FLORENCE DIVISION
4. TERRIAN LATHAM, Plaintiff v.AMAZON.COM SERVICES LLC, Defendant, IN THE UNITED STATES DISTRICT COURT NORTHERN DISTRICT OF FLORIDA PENSACOLA DIVISION (Case No. 3:23-cv-24702-TKW-HTC)
5. Plaintiff Michael Smith (administrator of the estate of Saulo Suarez-Bernal, deceased) v. Defendants Messer North America, Inc.,Messer Gas LLC, John Kline, John Doe(s) and John Doe Corporation(s), In the State Court of Gwinnett County, State of Georgia
6. Estate of Elias-Cabrera Plaintiff v. Defendants Messer North America, Inc.,Messer Gas LLC, John Kline, John Doe(s) and John Doe Corporation(s), In the State Court of Gwinnett County, State of Georgia
7. Plaintiff Rachelle Pollard-Fore vs. Defendant Honeywell International Inc., United States District Court, Northern District of Texas, Fort Worth Division (4:23-CV-0501-P)
8. Andrea Huffstetler v. Burkle North America, Inc. and Robert Burkle GmbH d/b/a Burkle Process Technologies and Stiles Machinery, Inc., United States District Court, Western District of Virginia, Danville Division
9. Plaintiff Courtney Mahn vs.Confluence Behavioral Health, LLC, Defendant, Vermont Superior Court, Orange Unit, Civil Division Docket No. 22-CV-03460
10. Plaintiff Estate of Malcolm D. Taylor vs. XPO Logistics Freight Inc, Mark Allen Fisher, Brabham Family Enterprises Inc. d/b/a Reds Rollen Garage, and Joe Doe; Defendants Circuit Court of Kanawha County, West Virginia (Case No. 23-C-490)
11. Plaintiff Martinez-Saldiviar vs. Hypertherm Inc., et al EIGHTH JUDICIAL DISTRICT COURT CLARK COUNTY, NEVADA
12. Plaintiff Mastrostefano vs. Defendant Focus Medical LLC, Commonwealth of Massachusetts Superior Court Department of the Trial Court (Civil Action # 2073CV00710)

13. Plaintiffs Brian and Robin McCully vs. Jenkins Restorations, Frederick 6th Circuit Court, State of Maryland
14. The Estate of Michael Earnheart v. Premier Restorations LLC and Accident Fund Insurance Company of America, Jurisdiction Claim No. VAO2000035040, Virginia Workers Compensation Commission
15. Annette Osborne vs. Nova Healthcare Group, LLC; Circuit Court of Scott County at Gate City, Virginia; Civil Action # CL 20000442-00
16. Plaintiff Kelly Anne Thomas v. Defendants CJS Enterprises d/b/a Tuscan Sun Spa and Salon, Sunshine Holding LLC, Cheri J. Satterfield, Steve L. Holbert, Sunlights Balayage Inc, Hair Systems Inc.; In the Circuit Court of Monongalia County, West Virginia
17. Plaintiffs MARK L. SMITH and LYNDIA SPENCER-SMITH vs. CAFÉ AT SOUTH STREET, LLC : RICHMOND STREET HOLDINGS, LLC; Case Number: PC-2019-7117 Filed in Providence/Bristol County Superior Court; In the State of Rhode Island Superior Court
18. Plaintiffs Zamd and Campbell vs. Lambright Pest Control Services UNITED STATES DISTRICT COURT FOR THE DISTRICT OF COLUMBIA
19. State of Vermont, Plaintiff vs. 3M Company et al, Defendant; State of Vermont Superior Court, Chittenden Unit (# 547-6-19)
20. Paraquat Products Liability, #3:21-md-3004-NJR, MDL No. 3004 (multiple cases)