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THE PARAQUAT POISONING PROBLEM

A former Syngenta scientist calls the failures to heed his warnings about the deadly pesticide "a conspiracy within the company to keep this quiet."

Sharon Lerner

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JON HEYLINGS WAS 34 when he found the notebook that would upend his life. A junior scientist at Imperial Chemical Industries, Heylings happened upon it in 1990 as he was trying to solve a mystery. Trained in toxicology, he had been brought to the company three years earlier to lead a team that would work to reduce the health risks of ICI products that contained the pesticide paraquat. He had spent much of that time testing formulations that did appear to be safer. Yet to Heylings's puzzlement, the company hadn't put them on the market. Curious about how ICI had arrived at the chemical concentrations in the version of the pesticide it was selling, he did some research in the corporate archives. There he came across the old book of notes that Michael Rose, a senior scientist at the company, had handwritten years earlier.

Heylings knew Rose and had seen his findings, which were known within the company as the Rose Report. ICI had used the report to justify the concentration at which it added a chemical called PP796 to

its paraquat products. But the numbers and graphs he saw jotted in the notebook didn't support the conclusion that Rose drew in his official report. "When I compared the data in his report to the original pharmaceuticals clinical trial data, I found they were different," Heylings told The Intercept. "You know, very different." While an accurate analysis would consider all the outcomes in an experiment, Rose had "cherry-picked," according to Heylings. "He took some data out, he put some data in."

The young scientist decided that he had to tell his bosses about his discovery — very carefully. "It's taking a risk to criticize senior managers of fabrication, you know?" he said recently. "This wasn't something to be discussed over coffee." So he wrote up a memo documenting the problems with the data and explaining that based on the evidence he had just found, the concentration of PP796, an additive intended to protect against poisoning, should be 10 times higher than the amount in the Rose Report — and 10 times higher than the levels in Gramoxone, ICI's bestselling paraquat product. He sent the memo to his manager, who assured him that he would send it on to the senior agrochemicals team. Satisfied that he had done the right thing, Heylings, a self-described "company man," stayed in his job for another 18 years.

Photo: Philip Hatcher-Moore for Le Monde

Heylings's 1990 memo and the Rose Report, first drafted in 1976, are among almost 400 internal documents reviewed for this investigation, which The Intercept conducted in collaboration with the French newspaper Le Monde. More than 350 of those documents were disclosed by Syngenta, the successor to ICI, and other defendants in the course of ongoing litigation over the companies' responsibility for personal injuries due to paraquat exposure. The nonprofit organizations Public Eye and Unearthed, an affiliate of Greenpeace, which have extensively researched both paraquat and PP796, supplied about three dozen more. Together, the thousands of

pages of scrawled notes, stained letters, and meeting minutes, many of which are marked “company secret” and “confidential,” tell the story of corporate intransigence in the face of a dangerous but profitable product — what Heylings describes as “a conspiracy within the company to keep this quiet.”

Syngenta maintains that the concentration of PP796 that Rose calculated — the concentration still used in many of the company’s products today — is safe. “Our detractors have willfully misrepresented and mischaracterized a limited number of documents, which ordinarily form part of an entire dialogue on product design, and focused on them, making false accusations related to the weight we give to cost when considering safety,” Saswato Das, a spokesperson for Syngenta, wrote in an email.

But in the more than 40 years since Rose made his consequential calculations, many of the company’s own scientists have questioned his assertions. And during that time, tens of thousands of people have died from paraquat poisoning.

The Speedy Killer

Paraquat is prized for the speed at which it kills weeds. The chemical begins to disrupt plants’ cell membranes and interfere with photosynthesis on contact, causing them to visibly wither within hours. Because it acts so swiftly, paraquat was heralded as an agricultural breakthrough when it was introduced in the 1960s. Since then, hundreds of millions of pounds of the herbicide have been used in the U.S. alone. More than 10 million pounds were sprayed on corn, soybeans, grapes, and other fruits and vegetables in 2017, the last year data was available. And paraquat use is now on the rise, according to data from the U.S. Geological Survey.

The problem with paraquat — or one of them — is that the chemical that so quickly and effectively kills plants is also extraordinarily toxic to humans. People who accidentally drink just a little bit often die soon afterward. A mere shot glass of the stuff is enough to end a life.

And unlike some other poisons, paraquat has no antidote. Because it is so remarkably lethal, thousands of people around the world have used the pesticide to commit suicide. Just two years after paraquat hit the global market in 1962, poisonings were reported in Ireland and New Zealand. Soon suicides accounted for the majority of paraquat deaths.

In 1968, ICI hit on a potential solution to what it dubbed its "paraquat poisoning problem" when a staff scientist suggested adding a chemical to Gramoxone that might induce vomiting. While the company initially chose not to pursue the strategy of adding an emetic to its products, in part because it seemed too expensive, in 1972, as reports of poisonings began to mount, ICI returned to the idea. That year, the U.K. Poisons Center received 59 calls about paraquat, as its director, Roy Goulding, told ICI scientists at a meeting held the following year. Six people had died from ingesting the pesticide, including two children, Goulding told the group, going on to plead for "something to be done in a hurry."

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The pressure to stop the paraquat deaths mounted along with the poisonings. In the first two months of 1974, two people in the U.S., a critical market for the company, had already died after ingesting the pesticide. A woman killed herself by drinking it. And a 17-year-old boy in Hawaii died after accidentally drinking paraquat that had been poured into a soda bottle. By then, the problem had also cropped up in other parts of the world, including the Netherlands, Germany, France, Denmark, and Japan. (Paraquat was also sprayed on marijuana fields in Mexico in the 1970s courtesy of the U.S.

government, which was hoping to kill the crops and instead created a massive “paraquat pot” health scare.) In Ireland, where 92 people died after ingesting paraquat between 1967 and 1977, a physician who watched a perfectly healthy man die after drinking paraquat dubbed the pesticide the “most deadly killer since the atom bomb.”

But perhaps the biggest motivation for ICI to start using a chemical that would make the body forcibly eject paraquat came from the U.S. Environmental Protection Agency. In 1975, ICI and Chevron Chemical Co., which manufactured, distributed, and sold ICI’s paraquat products in the U.S. until 1986, learned that the EPA was so concerned about the safety of the pesticide that it was considering subjecting it to a special review process that could result in its removal from the market. “The legal arm of EPA would jump at any good opportunity to bring formal cancellation action against Paraquat,” L. R. Stelzer, who worked for Chevron, which is also a defendant in the ongoing litigation, wrote to his colleagues at the time. Less than two weeks later, ICI embarked on a plan to add PP796 to Gramoxone.

The drug had been chosen because during human trials of its potential as an asthma treatment, subjects had reported that it caused vomiting. The company decided that PP796 should be put into Gramoxone at a concentration of 0.05 percent and set out to get the chemical patent protected “in all major countries throughout the world,” as it made clear in a document marked “company secret.”

The strategy would allow ICI to not only hold onto and expand its sales of paraquat in markets where it faced threats from regulators, but also to create a new profitable market for the emetic itself. Governments around the world, as well as the Food and Agriculture Organization of the United Nations, which oversees international pesticide standards, would ultimately come to require inclusion of PP796 in paraquat formulations at about that 0.05 percent concentration. Because ICI patented not only PP796 but also many other compounds that might have performed the same function, it would be able to sell PP796 to other pesticide manufacturers.

The only hitch? At that level, PP796 wasn't particularly effective in preventing people from dying.

Just one week after the company laid out its international strategy for introducing the emetic, a Chevron scientist named Richard Cavalli called attention to the fact that the science didn't support the company's decision to include the chemical at the planned concentration, as a document Chevron U.S. produced in litigation made clear. Cavalli had been told by ICI that people would throw up within 15 minutes of drinking PP796, but, he noted after looking at the data on people who drank the emetic, "as far as I can tell, no one has vomited within 15 minutes."

It was just a week later that Rose came up with the report that Heylings found in the archives, which provided the science that the company needed to justify its decision. In it, Rose states that humans were more sensitive to PP796 than the dogs and monkeys that were used to test the emetic and thus humans could be made to vomit with a lower dose of the drug.

Cavalli, however, didn't see evidence of that. "I am skeptical that EPA would approve this drug for use as an inert given the above-stated lack of information," he concluded. And, according to a 1976 memo from Cavalli, which was supplied by Chevron, Rose hadn't actually seen the human data that he wrote up in his report; the data was on microfiche, and all hard copies had been destroyed.

None of that stopped Rose from sketching out a curve that indicated that the 0.05 percent concentration — a dose that, as company officials noted in a document marked "secret" later that year, "would not result in too great an increase in the cost of Gramoxone" — would effectively prevent humans from dying of paraquat poisoning.

The EPA initially rejected the idea of adding PP796 to paraquat. "There are better ways of inducing vomiting — tickling the throat with a finger for example," an agency chemist wrote to Chevron in 1977. But by the next year, ICI had introduced the compound in several other countries, with the hopes that the new formulation

would result in fewer deaths — and produce data that would convince U.S. regulators that paraquat was safe enough to remain on the market.

In response to questions for this article, Chevron wrote in an emailed statement that “Chevron Chemical Company pioneered many product-stewardship programs that permitted customers to safely use its products, including Paraquat. These efforts included the first private poison-control hotline, the first child-resistant cap, applicator and farmer training programs, Paraquat poisoning-emergency treatment kits and physician guides, and product labeling that exceeded regulatory requirements.” The statement also said that “Chevron Chemical Company submitted all required animal and human clinical data regarding Paraquat to the United States EPA, which approved the emetic-containing formulation.”

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By 1981, evidence from the U.K. and Japan made clear that while PP796 was making some people throw up, it wasn’t the lifesaver the company had wanted. “No statistical evidence has emerged that the emetic has reduced the number of deaths with the product,” an ICI scientist named Peter Slade wrote in 1981, in a memo Syngenta released through the discovery process. “At best, only a few people have survived paraquat poisoning because of the inclusion of the emetic.” The results were no better in what was then Western Samoa. Although some people who drank the new “emeticized” version of paraquat there did throw up, “the early onset of emesis after ingestion of paraquat does not play a part in reducing mortality,” a “highly confidential” internal report on the Samoan deaths noted.

Slade warned his colleagues against misrepresenting the role of the chemical. “It is important that undue hopes should not be raised for what PP796 can achieve toxicologically, and equally, that registration authorities not be actively misled into thinking that the emetic formulation will ‘solve’ the paraquat problem,” Slade noted.

Although it’s not clear which company provided it, the EPA did receive information that suggested PP796 would make paraquat safer, which it cited in its 1982 decision not to move ahead with its investigation and possible ban. The decision allowed that future formulations would include PP796 and noted, “The added emetic will rapidly induce vomiting, thereby lessining [sic] absorption time and exposure.”

In fact, just a month earlier, an unpublished investigation by an ICI scientist named T. B. Hart and Amanda Bramley of the National Poisons Information Service had cast even more doubt on the idea that PP796 was saving lives. “We have not yet been able to evaluate fully the effectiveness of an emetic formulation in reducing mortality,” the authors wrote, after analyzing 262 paraquat poisoning incidents that had taken place in the U.K. between January 1980 and February 1982.

Others at the company began to notice the ineffectiveness of the emetic in Gramoxone too. “It strikes me that what we need is a potent emetic which causes vomiting within 5 minutes of swallowing a potentially lethal dose of paraquat. PP796 does not meet this criteria,” an ICI scientist named Lewis Smith wrote in 1984. Smith suggested increasing the amount fivefold, but that didn’t happen.

Unsurprisingly, around the world, people continued to die from drinking paraquat. Suicides and accidental poisonings were reported in China, India, Italy, France, and throughout Africa and South America, according to the Swiss nonprofit Public Eye. In Malaysia, where the pesticide was used to control weeds on rubber plantations, there were 253 deaths in 1986 alone. Paraquat also posed a particular crisis in Japan, where it was used to commit suicide and,

through paraquat-laced drinks put into vending machines, as a murder weapon.

A Basket of Options

By the time that Heylings arrived at ICI as a young scientist, the company had come up with another fix to what it described in a 1987 document as the "'business' problem brought about by suicidal/homicidal abuse of the product." Since adding the low level of PP796 hadn't stopped the poisonings, the company decided to develop less lethal formulations that it would keep secret unless asked by regulators to withdraw the product.

"The Executive approved the strategy of developing alternative formulations to a commercial state 'on the shelf' in order to provide a 'basket of options' to offer to Regions/Regulatory Affairs Section when faced with a paraquat regulatory crisis," the 1987 document explained. These options included a liquid formulation identified as "b," which was at least five times more dilute than the one on the market, and "c," a solid version that "may lead to reduced dose levels in suicide cases."

Although Heylings didn't know it at the time, ICI had already laid out a clear explanation for why it chose not to sell these safer versions of its pesticide: "The introduction of either formulation b) and c) on a global basis would destroy Group profit from paraquat."

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That profit was considerable. By 1987, ICI's paraquat products were in use in more than 140 countries. The company was selling 15,000 tons of paraquat per year, which was valued at 200 million pounds.

In 1990, an ICI manager named R. A. Morrison doubled down on the company's commitment to protecting the paraquat profit. It was possible to create a version with less paraquat per volume, as Morrison acknowledged in an April 1990 memo provided to The Intercept by Public Eye and Unearthed, but it would cost more to produce and ship. By volume, PP796 cost eight times more to produce than paraquat itself. Plus, he pointed out, increasing the concentration would require building new manufacturing facilities. While the company developed a more dilute version of the pesticide for sale in Japan, where paraquat faced possible withdrawal, it was deemed too expensive in other countries. "At this dilution level, formulation and packing costs would be increased and product usage by farmers would reduce very significantly because of bulk inconvenience and higher prices," Morrison wrote in October of that year, according to a separate memo provided by Public Eye and Unearthed. "We see no reason to change proactively from our current formulations."

In its emailed response, Syngenta denied that cost influenced its decisions about the concentration of the chemicals: "We reject any suggestion that in developing this product Syngenta and its predecessors had any motive other than to find the most appropriate level of emetic in paraquat to best address the risk from accidental and deliberate ingestion."

Syngenta also questioned the company's responsibility for paraquat suicides. "People take their own lives for complex social, environmental, or economic reasons," Das, the Syngenta spokesperson, wrote in an email. "Almost all modern innovations — buildings, bridges, railways, pharmaceuticals, automobiles, machines, and crop protection products — have been used for suicide. We believe that society needs to address the root cause and focus on mental health issues, not deprive the world of important technology, which has improved overall human wellbeing."

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The reasons people choose paraquat to end their lives do seem in keeping with the reasons they attempt suicide at other times and through any means. According to a 2009 study of 250 people who were admitted to one South Korean hospital after drinking the pesticide, the triggers included pessimism, family trouble, economic problems, depression, chronic diseases, gambling, school problems, and love affairs.

Of course, companies can’t be held responsible for anyone’s misery. But some research does show that banning particularly lethal pesticides can reduce the number of people who kill themselves. In Sri Lanka, the suicide rate climbed dramatically with the introduction of hazardous pesticides in the 1960s and has started to decline as the country began banning some of those pesticides, including paraquat, over the last two decades. “Means restriction works because suicidal impulses are often transient, lasting only minutes or hours,” Michael Eddleston, a toxicologist who specializes in pesticide suicides, wrote in The Lancet last year. According to Eddleston, there have been more than 14 million suicides from ingesting pesticides since the most toxic of these products were introduced in the 1950s.

The U.S. accounts for only a small part of that toll. There were 18 deaths due to paraquat between 1983 and 1992, according to the 1995 book “Paraquat Poisoning.” Part of the reason there are so few paraquat suicides in the U.S. is that people intent on killing themselves have far greater access to handguns.

A Threat to Business Objectives

After he confronted his superiors about the Rose report in 1990, Heylings did go on to work on a safer paraquat product that made it to market, a version of the pesticide known as Gramoxone Inteon. This formulation contained PP796 at three times the concentration laid out in the Rose Report and included another agent that made the contents of the stomach congeal so the body would be less likely to absorb the lethal chemical.

The new product slightly improved the survival rate of people who drank the pesticide. A 2008 study of 586 people who had ingested paraquat in Sri Lanka found that 63.3 percent of people who drank Gramoxone Inteon died, compared to 72.9 percent of people who drank the formulation of the pesticide that included the emetic at the lower concentration and had no gelling agent. Syngenta realized that the improved survival data could raise uncomfortable issues, some of which the company laid out in a list of possible questions the media might pose. The questions included: "Was the development of Gramoxone Inteon driven by your own doubts about the safety of Gramoxone?" Company representatives were instructed to answer "no."

In any case, the government of Sri Lanka was not persuaded by the 2008 study of Gramoxone Inteon and went on to ban paraquat the same year. It was also too late to change minds in Europe. In 2005, Sweden challenged the European Union's approval of paraquat based on both the "incurable" poisonings and another problem that had emerged: the link between paraquat exposure and Parkinson's disease.

Evidence of the connection first emerged in the 1980s. Canadian neurologist André Barbeau documented a "very strong" association between Parkinson's and the use of pesticides, including paraquat, in 1985. Farmers as young as 32 had been diagnosed with the debilitating neurodegenerative disorder, which is typically seen in older patients, as another doctor described in the journal Neurology two years later. The Swedish government called attention to a 2002 study showing that mice exposed to paraquat developed a condition similar to Parkinson's as well as a

1990 study that found that people who had been involved in chemical spraying had more than six times the chances of getting the disease.

While other countries were getting rid of the pesticide, paraquat use was climbing in the United States. The poisonings continued too.

In 2003, Syngenta embarked on a defense against that threat too. In an internal document produced in the litigation, the company laid out its strategy to address the mounting evidence of neurotoxicity, which it deemed "a threat to Syngenta's paraquat business objectives." Syngenta's global regulatory manager advised steps to "contain any potential impact on Gramoxone" and "shift the focus of serious PD research to other environmental factors." Nevertheless, in 2007, the EU Court of Justice responded by banning the pesticide.

While other countries were getting rid of the pesticide, paraquat use was climbing in the United States. The poisonings continued too. According to the EPA's Incident Data System, there were 181 paraquat poisoning incidents and 27 related deaths between 1990 to 2014. It was one of those deaths — of a 15-month-old boy who drank paraquat that had been put in a Gatorade container — that brought Heylings's attention back to the pesticide in 2018.

By then, Heylings, who had left Syngenta a decade earlier, had become a professor of toxicology and founded his own toxicology company, which had recently gotten a contract from the U.K. government to study how hair and skin could be decontaminated from various chemicals. One of them, by coincidence, was paraquat. Although Heylings's new company had gotten some contracts from Syngenta, he hadn't worked on paraquat for more than a decade. While he was reading through the recent literature, he found a page on the EPA website that documented several cases of paraquat poisoning, including that of the 15-month-old boy, who lived for 13

days after drinking paraquat before succumbing to kidney and liver failure.

He soon learned that Gramoxone Inteon, the slightly safer version of the pesticide that he spent years testing, had been taken off the market. With the details of the toddler's death on his mind, he reached out to his former employer and requested a meeting. In October 2018, he met with a handful of Syngenta employees and told them about his concerns that the concentration of the emetic wasn't effective. Heylings explained the data he had seen in the notebook and was convinced that at least some of the people he met with were learning of the PP796 problem for the first time. "These guys were, you know, mouth open, very edgy," Heylings recalled.

Syngenta invited him back for a second meeting at which the company shared an analysis of the PP796 data that acknowledged the "tiny number of people" involved in the research and the scientific shakiness of Rose's process. "In estimating the emetic dose in man Rose clearly recognised that for the emetic dose response to PP796 there was *'limited data available in man.'* He seems to have visually inspected the data and drawn his conclusions, rather than using any statistical procedure." Still, the report concluded, another scientific paper, which was written by two British poison experts and published in 1987, showed that the level Rose had calculated was effective.

Yet that paper, too, is questionable, according to Unearthed and Public Eye. In an unpublished investigation, the organizations found that the 1987 paper failed to disclose that the majority of research subjects, while presented as having taken Gramoxone, had actually ingested products that had higher concentrations of the emetic and lower concentrations of paraquat. The result was that, again, the emetic appeared more effective than it really was. "I was shocked," said Public Eye's Laurent Gaberell. "It's highly misleading to say the least. There's absolutely nothing in this study that can prove the effectiveness of the emetic in Gramoxone."

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At a subsequent meeting with five Syngenta executives, Heylings once again told the story of the old notebook and presented slides explaining that the original science that had set the level of PP796 in paraquat was flawed. After that, according to Heylings, relations turned chillier.

The toxicologist did have one last meeting with his former employer in April 2019. He said he hoped that it would lead the company to launch an independent inquiry into his claims. “Why not say, ‘Jon, I’ll tell you what we’ll do. We’ll get external poisons experts together and we’ll sit down in a hotel, and we’ll go through all of this, and we’ll let a chairman of an inquiry team make a decision.’ And I would have said, ‘Great! Happy with that!’”

Instead, Syngenta sent Heylings a document that flatly disputed his claims about PP796 and the Rose report. “There is no evidence of fabrication associated with the 1976 research report and simply no basis to believe the author would have reason to fabricate results,” the unsigned document said.

Later that year, Heylings approached the EPA’s chemical review manager for paraquat with his evidence, who told him that he should take up the matter with the Food and Agriculture Organization of the United Nations. The FAO told Heylings that it would revisit the concentration of PP796 in paraquat products, which is still at the level set by the Rose Report. But the international organization has yet to revise its specifications.

In a 2019 email, the EPA's paraquat review manager also told Heylings that she would include his detailed account of the problems with PP796 in the public docket on paraquat. But his memo wasn't included in the file of the publicly available documents.

When asked why the information submitted in 2019 hadn't been made public, EPA spokesperson Ken Labbe wrote in an email to The Intercept that "this information was mistakenly left out of the docket due to routine staff changes."

"The agency is quickly confirming no confidential business information (CBI) is included in the documentation provided by Dr. Heylings," Labbe added. "If there is no CBI, EPA will immediately post the documentation to the paraquat registration review docket."

Das, the Syngenta spokesperson, denied that anyone from the company had asked the paraquat review manager or any other EPA employee not to include Heylings's submission in the public docket.

In its email to The Intercept, the company also emphatically denied that PP796 was ineffective at the concentration in the Rose Report. As for the idea that a higher concentration of PP796 might make paraquat less lethal, "Today, eminent medical experts advise against high emetic levels based on concerns that they can increase toxicity," Das wrote. "Medical opinion has evolved in the thirty years since Jon first worked on this product."

According to Syngenta, the company has investigated — and dismissed — Heylings's claims. "Our scientists have invested hundreds of hours examining his concerns, corresponding and discussing them with him," wrote Das. "Heylings's argument that increasing the level of emetic improves the safety of the product is overly simplistic; the reality is complex and modern medical and scientific opinion does not support Heylings's viewpoint."

The Coming Fight

And so it is that more than 30 years after he found the notebook, Heylings, now 65, finds himself at war with his former employer. The one-time company man can expect it to be hard-fought. Over the past decade, evidence tying paraquat to Parkinson's disease has grown. Syngenta, Chevron, and other manufacturers of the pesticide are about to go to trial in the class-action suit in Illinois, which was filed on behalf people who developed the disease after paraquat exposure. Heylings has already been deposed in the litigation and said that he expects to testify as a designated expert for the plaintiffs in the trial, which is scheduled to begin in May.

Syngenta is also fiercely disputing the idea that paraquat causes Parkinson's. "The weight of the scientific evidence does not show any causal link between paraquat exposure and the development of Parkinson's disease," Das wrote to The Intercept. "We take these claims seriously and intend to vigorously defend against them."

Heylings, who described himself to The Intercept as "quite a civil person," said he's not backing down either. "If I decided to abandon this now, how would I feel in 10 years' time?"

Yet the professor is confronting a company that has vast resources to spend on defending its pesticide. Syngenta, which had more than $13 billion in sales in 2019, is now a subsidiary of ChemChina, China's national chemical company, which bought it in 2016 for $43 billion. It's worth noting that Switzerland, where Syngenta is still headquartered, and China are among the more than 50 countries that have banned paraquat.

"We should never have been using paraquat in the first place."

In the U.S., where the EPA is now reviewing its registration, paraquat use is still climbing. Last year, as part of that process, the agency proposed new safety measures for the pesticide, including prohibiting aerial application of paraquat for all uses except cotton desiccation; limiting the maximum rate at which it can be applied for

alfalfa; and requiring the addition of language about drift on its label. According to many independent scientists, those changes are not enough.

"We should never have been using paraquat in the first place," said Nathan Donley, senior scientist at the Center for Biological Diversity, who points to the pesticide's devastating impact on wildlife as well as humans. "The science is really clear on the link to Parkinson's." Yet Donley remains skeptical that the EPA will remove it from the market. The law that governs pesticide regulation, the Federal Insecticide, Fungicide, and Rodenticide Act, uses a cost-benefit analysis that allows the agency to overlook harms based on a product's economic benefit. And paraquat has become increasingly useful to kill weeds that have become resistant to another hazardous pesticide, glyphosate. Donley describes the ongoing replacement of one dangerous chemical with another as "the pesticide treadmill."

Meanwhile, people are still being poisoned by paraquat. In the U.S, the pesticide has caused at least one death a year since 2012, according a 2019 study by Donley. No one has a definitive tally of all the people who have died by drinking paraquat. But Eddleston, the toxicologist who has studied the pesticide extensively, estimates that there have been "tens of thousands of deaths from paraquat poisoning, possibly more than 100,000."

Syngenta says it is sorry for these losses. "We find it heartbreaking that people have been harmed through accidental or intentional ingestion of paraquat, a product that helps farmers produce food. We empathize with the pain of those who have lost loved ones. No one should ever have to deal with intentional loss of life of a near and dear one."

Heylings says he'll see them in court.