

► the phytobiome broadly, to encompass microbes, insects, nematodes and plants as well as the abiotic factors that influence all these.

Since then, she has visited companies, funding agencies and universities to call for a unifying phytobiomes initiative. She has teamed up with Kellye Eversole, a consultant based in Bethesda, Maryland, and the co-owner of a small family farm in Oklahoma, who has experience working on large agricultural genomics projects, including the US National Plant Genome Initiative. That initiative was launched in 1998 and continues to crank out databases and other tools for analysing plant genomes.

Leach hopes that the Phytobiomes Initiative will leave a similar legacy, but she is mindful that federal funding has tightened considerably since 1998. Still, she notes that the project can build on several emerging trends in agriculture. Industry has shown renewed interest in boosting plant growth by manipulating associated microbes (*Nature* 504, 199; 2013). Companies and farmers are also investing in 'precision agriculture', which uses high-tech monitors to track conditions in a field or even around individual plants, allowing farmers to water and fertilize in exactly the right places.

HIGH-TECH FUTURE

Eversole foresees a day when tractors will carry dipstick-like gauges that provide a snapshot of the microbial community in the soil. Data from the Phytobiomes Initiative would then help farmers to manipulate that community to their advantage, she says.

But first, the initiative needs to standardize protocols and metrics, the meeting's attendees determined. Kinkel says that efforts are likely to focus initially on cataloguing microbes and insects and their interactions with different crops and habitats. "We're where plant biologists were 150 years ago," she says. "We're still trying to inventory things."

Work has already begun along these lines: for example, a group at the International Rice Research Institute in Los Baños in the Philippines is fishing for microbial DNA in data discarded from an effort to sequence the rice genome. The goal is to determine which microbes prefer which strains of the crop.

Kinkel, meanwhile, has begun experimenting with manipulating carbon levels in the soil to alter the microbial population, with the aim of improving plant productivity. "If we can understand better who lives on and within plants, we have the potential to manage them to have healthier, more resilient plants," she says.

Projects such as these would move faster under an organized, cohesive framework, says Sarah Lebeis, a microbiologist at the University of Tennessee in Knoxville who is studying how plants manipulate microbial communities by secreting antibiotics into the soil. "Right now we're working as individuals," she says. "Having an initiative will give us focus and hopefully we'll progress further, faster, better." ■



Dong-Pyou Han (centre) confessed to fabricating and falsifying data on an HIV vaccine.

RESEARCH MISCONDUCT

Uneven response to scientific fraud

The case of jailed US vaccine researcher Dong-Pyou Han shows up inconsistent nature of penalties.

BY SARA REARDON

There is the scientist who serves time on charges of research misconduct. But on 1 July, Dong-Pyou Han, a former biomedical scientist at Iowa State University in Ames, was sentenced to 57 months in prison for fabricating and falsifying data in HIV vaccine trials. Han has also been fined US\$7.2 million and will be subject to three years of supervised release after he leaves prison.

His case had a higher profile than most, attracting interest from a powerful US senator. Han's harsh sentence raises questions about how alleged research fraud is handled in the United States, from decisions about whether to prosecute to the types of punishment imposed by grant-making agencies.

Han was forced to resign from Iowa State in 2013, after the university concluded that he had falsified the results of several vaccine experiments supported by grants from the US National Institutes of Health (NIH). In some cases, Han spiked rabbit blood samples with human HIV antibodies so that the vaccine seemed to have caused the animals to develop immunity to the virus.

In a confessional letter sent to the university just before its investigation concluded, Han said that he began the subterfuge to cover up a sample mix-up that he had made years before.

The US Office of Research Integrity (ORI), which oversees investigations into alleged misconduct involving NIH funds, barred Han from receiving federal grants for three years — the maximum penalty that it generally imposes on junior investigators. The case probably would have ended there had it not drawn the attention of Senator Charles Grassley (Republican, Iowa), who has a history of investigating misconduct in the biomedical sciences.



This story is the first in an occasional series on research misconduct in the United States.

"This seems like a very light penalty for a doctor who purposely tampered with a research trial and directly caused millions of taxpayer dollars to be wasted on fraudulent studies," Grassley wrote in a February 2014 letter to the ORI. The office can issue lifetime funding bans,

but former ORI officials say that such punishment is reserved for especially egregious cases, such as those in which human subjects could have been endangered.

In June of that year, after extensive media coverage of the case and of Grassley's reaction to it, the federal prosecutor in Des Moines, Iowa, pressed charges against Han. The scientist was arrested and his case brought before a grand jury. In February 2015, he pleaded guilty to two felony charges of making false statements to obtain NIH research grants.

Alan Price, a former associate director of investigative oversight at the ORI, says that criminal prosecution is unusual for a "medium-level" fraud case such as Han's. "In most cases, I don't think it would have been done. But Senator Grassley cares deeply about these issues and wanted to make that point."

The case has raised some concern among experts in scientific misconduct. The very few researchers who face criminal charges are not necessarily those who have caused the most harm to other scientists' careers, or to science generally. "We're so preoccupied with major cases and so subject to policy pressure, we've lost sight of the larger picture," says Nicholas Steneck, an expert in research integrity at the University of Michigan in Ann Arbor.

Grassley seems to agree — telling the Senate in July, "I worry that other cases may go

unnoticed or unaddressed if there isn't a public outcry". He argues that lawmakers would not need to involve themselves in such matters if some government agencies that oversee research grants could levy harsher penalties and had more capacity to investigate alleged fraud.

Most US funding agencies have an inspector-general who investigates potential misconduct and fraud. These officials can withdraw grant money and impose prohibitions on receiving government funds, and often refer cases for criminal prosecution.

But the Department of Health and Human Services (HHS), which includes the NIH and the ORI, separates these powers. The ORI cannot directly investigate suspected fraud or misconduct; it is limited to overseeing probes by the institutions that employ the researchers suspected of wrongdoing. In cases where evidence of misconduct or fraud is found, the ORI can impose funding bans or refer potential criminal cases to the Department of Justice or the HHS inspector-general.

The HHS inspector-general can initiate investigations of suspected research fraud or misconduct, but is often preoccupied with other matters, such as health-insurance

"It's questionable how much more is to be gained by jail time."

fraud. And it cannot impose funding bans or other penalties. The NIH and the ORI told *Nature* that they do not even track how many recipients of NIH grants have faced criminal prosecution.

By contrast, the inspector-general for the National Science Foundation has sole oversight of that agency's misconduct investigations, and is involved in several criminal prosecutions each year. Most of these concern researchers suspected of misusing grant money or of using plagiarized or falsified data to obtain funds, as Han did.

But David Wright, a former ORI director, says that the benefit of criminal prosecution is unclear. Formally barring a researcher from receiving federal funds is usually a professional death sentence, even if the ban is short, he adds. "It's questionable how much more is to be gained by jail time."

In reality, however, no one knows the general fate of scientists subject to funding bans, or whether the risk of such punishment deters people from committing misconduct. Price says that he and others at the ORI once tried to conduct a formal, anonymous survey of these researchers to understand how their careers had been affected. But the White House shut the project down, saying that it cost too much and that people were unlikely to respond. ■