

**The Drug War's Fungal "Solution" in the Amazon**  
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Before starting, I would like to thank Don Pollock for inviting me here. A couple of years ago myself and Sharon Stevenson were lucky enough to receive a grant from the John D. and Catherine T. MacArthur Foundation. In order to study a interesting and sometimes clandestine research project that is presently on hold, but which could have, and indeed still could still have a negative effect on the biota un the Amazonian regions of Colombia, Ecuador, Peru, Bolivia and Brazil.

I am speaking of the recent planned deployment of "biochemical" or "biological" agents called "mycoherbicides," fungi that have been designed to infect and kill drug plants, such as coca, poppy, and marijuana, with a special emphasis on the proposed use of mycoherbicides in Colombia in 2000, and their possible clandestine use in Peru during the 1980s and the present situation.

So, to start with I should describe what mycoherbicides are. They are rust or mold-like fungi that attack mainly plants, although we shall see that they can also attack other biota including mammals.

I prefer to characterize the activities of mycoherbicides as "biochemical" rather than "biological," because in all cases, mycoherbicides attack their targets, or even non-target organisms – plant or animal– through the synthesis and secretion of fungal toxins, called "mycotoxins". These compounds, which the fungus itself is immune to, are synthesized and secreted to burst the cell walls of the target species and dissolve the cell's contents, which are then absorbed by the fungus. The fungus then reproduces itself and moves into the physical space of the target cell and starts the process over again until it has killed the host or is itself killed. To summarize, mycoherbicides are fungi - living biological organisms that act through the chemicals they secrete.

In order to provide context, at this point it would be useful to take a quick comparative look at the methods used to eradicate drug crops.

The first method is manual. In this method, plants are removed by destroying them physically, for instance, pulling them up by the roots. This technique has been successfully used in the US, and by US-funded para-police, para-military forces that I consider to be mercenary, such as UMOPAR and CORAH in Bolivia and Peru respectively. Even though the actors involved in these operations may disgust us by having sold themselves to a foreign power (in this case, the United States) with an aim to damaging

the well-being of their compatriots, the manual eradication they perform causes the least amount of environmental harm, but exposes the eradicator to the hostility of local farmers.

The second method is chemical. A chemical is mass-produced in a laboratory, mixed in a formulation with other additives, and applied to the target most often in the form of a spray. Below is a brief series of herbicides used by the US government, starting with the mixture that was called "Agent Orange" and used in Vietnam, and ending with the present-day favorite, Glyphosate - which with other additives is being used today to defoliate wide swathes of the Amazon in Southern Colombia.

All of these chemical herbicides have known toxicity, ranging from the mutagenic and carcinogenic breakdown products of Agent Orange, to the effects of Glyphosate on aquatic life and soil microorganisms, not to mention the collateral damage caused to nontarget plants and animals by drift. So these are the truly chemical herbicides.

Below them, are the major Fusarium mycotoxins, the active ingredients of the Fusarium species and the primary subject of today's lecture.

The concept behind the use of these organisms is that their spores are to be mass-produced in laboratories; these are then applied over the target species, where the spores germinate, spreading toxic mycelium that will attack the targets. The concept, according to the proponents of mycoherbicides, is that these fungi are specific and will only attack the targets they are designed for, a concept that has not been supported by the scientific evidence. Also, allow me to emphasize that while mycoherbicides are organisms, living entities, their activity against their targets is mainly chemical - produced through the chemicals they synthesize, and they do not attack through mechanical means. Above are illustrated the major classes of mycotoxins found in Fusarium.

What do we know about mycotoxins in general?

Most, if not all fungi produce mycotoxins. These chemicals may be part of a defense mechanism for the organism or may be offensive, or both. Some well-known mycotoxins that have both deleterious and positive effects are those from ergot, a fungus that can inhabit rye, whose infestations and contamination of bread have led to the poisoning called "St. Anthony's Fire," in which large groups of intoxicated people have died, after experiencing hallucinosis, and loss of feeling in the extremities. This was a particular problem during the middle ages and was solved by separating the purple-black fungal sclerotia from cereal which it was inhabiting. In fairness to ergot, I should point out that in the modern age, mycotoxins isolated from ergot have a wide range of medical uses: ergotamine alleviates migraine headaches, and ergonovine has saved the lives of countless women who have taken it to control post-partum hemorrhage. So far, there are no such positive uses of Fusarium mycotoxins.

Another thing we know about mycotoxins in general is that their production by fungi is very dependent on environmental circumstances and available nutrient sources. Thus, it is often possible to take a fungal strain that is known to produce high amounts of a given mycotoxin, cultivate it on a given media, and find no detectable mycotoxins. The opposite is also true. Some fungi that produce small amounts of mycotoxins in the wild can be induced to produce larger amounts -or even different mycotoxins in the controlled conditions of a lab. This caveat becomes important when trying to wade through the mycotoxicological literature in which at certain times a given species isolated by certain scientists have been found to contain compound X, but other scientists have only found compound W, Y, and Z! As is often the case in academic minutiae, and especially in the world of mycology, these debates can rage for decades until one side or the other dies off.

### **Fusarium mycotoxins:**

What do we know about Fusarium mycotoxins? So far, Fusarium mycotoxins have had an entirely negative history. So negative, in fact, that when I was working with mycotoxins in the 1970s and early 1980s, I was permitted to work under DEA license with psilocybin, ergot alkaloids, and without any license for the very toxic Amanita toxins, the GABA-mimicking mycotoxins, but I was not permitted to work with the Fusarium toxins. Why not? The Fusarium toxins were considered to be weapons of war!

And what do we know of Fusarium as a genus? The first written description of a Fusarium rot of com comes from a Spanish friar in Mexico during the 1600s. The botanist Link first described the genus in 1809. Fusarium became associated with the rot of stored potatoes by German scientists in the 1850s. However, this should not to be confused with another rot of living tubers caused by yet another species of fungus, Phytophthora, the fungus that caused the great Irish potato famine during the 1840s.

In the 1890s, there were reports of horses, cows, and pigs losing hair and hooves after eating Fusarium-infected grain in Nebraska. This was the first report of the toxicity of the species. Various species of Fusaria were then shown to attack many crops, including cotton, banana, sugar cane, and cereals, and even humans.

Also, in this timeframe, in 1916, the first report of Fusarium infection (Fusariosis) in humans was published in an Argentine medical journal, in which a patient suffered from Fusariosis of the nose, apparently with a symptomology of the protrusion that emulated syphilis!

During the last years of the Second World War until 1949, something something truly tragic happened. - a Fusarium sporotrichioides infestation of overwintered grain caused the death of hundreds of thousands of people in the USSR after they ate contaminated bread. This focused research on the mycotoxicology of Fusarium species. Much later, it was determined that a series of chemicals called quinones, specifically the trichothecene mycotoxins were mainly responsible; these are a series of highly-stable compounds that, unlike many others, are not degraded by heat, such as the heat used in baking bread.

The trichothecenes were so-named because they had been first isolated from the morphologically-similar genus *Trichothecium*. Trichothecene mycotoxins and their analogs have been detected in all members of the *Fusarium* genus, including *Fusarium oxysporum*, as well as other related genera.

During the 1950s, Soviet scientists studied the causes of the epidemic that had killed off so many of their compatriots. The results of some of this work were published in 1958 in Soil Microorganisms and Higher Plants by N. A. Krasil'nikov, of the Soviet Academy of Sciences. This was translated into English by the Israel Program for Scientific Translations in 1961. In this work, Krasil'nikov showed that the *Fusarium* mycotoxins were not only the agents responsible for the Russian epidemic, but that wherever large amounts of *Fusarium* and hence its mycotoxins had been found in the soil, subsequent plantings would yield poor or no results. In other words, besides poisoning humans who ate the infected grain, the mycotoxins also contaminated the soil. And since many of these toxins are not very water-soluble, and are not substantially washed away by rain water, they can keep the ground poisoned for years.

By the early 1960's, due to the interest in the chemical warfare potential of trichothecenes, the US military and others started to investigate the toxins of *Fusarium*. They published the results of their investigations into the trichothecene mycotoxins, often outside normal channels of the scientific literature.

We can see that US government-contracted scientists first repeated the Soviet work (Army Biological Labs-Tupenevich); did detection, analysis, and decontamination work (Army Armament Research and Development Command); applied trichothecenes to various mammals' skins (Army Medical Research Institute of Infectious Diseases); researched protection against them in biological or chemical warfare (National Research Council); measured trichothecene induced "deep necrotic ulcers" on rat skin (Materials Research Lab - Australia); determined the  $LC_{50}$ 's (the Lethal Concentration in the atmosphere at which 50% of the tested animals die) of trichothecenes in aerosols in mice (Ft. Detrick); noted trichothecene liver toxicity (Ft. Detrick); determined how to apply it in drinking water (Lawrence Livermore National Lab); determined general animal toxicity (USAMRDC); trichothecene antibody protection (Southwest Foundation for Biomedical Research); trichothecenes applied as aerosols (Ft. Detrick); dosed monkeys (Ft. Detrick); determined trichothecene antibodies (Vestar Research); and, an enzyme immunoassay for trichothecenes (Biometric systems). I am detailing this, because I want to show beyond any reasonable doubt that *Fusarium* and its mycotoxins have been long known for their toxicity and there is a known relationship between *Fusarium* and biological or chemical warfare - the latter using compounds extracted from the genus.

So, how did *Fusarium*, with such a known history of toxicity come to be proposed for a massive application throughout the Amazon basin by US government representatives?

In 1964, a coca wilt epidemic broke out in the Coca-Coca coca research plantation on a Hawaiian Island. During this time, dead plants were removed from the field and

immediately replaced with healthy seeds or seedlings. Many years later, in the 1980's *Fusarium oxysporum* was identified as the wilt organism. Its dispersal throughout the research plots eventually resulted in the termination of the breeding project.

During the 1970s, I was lucky enough to have had the opportunity to work with Tim Plowman when he was still at Harvard. Dr. Plowman eventually wrote the Monograph on the genus *Erythroxylum*, the genus to which coca belongs.

Because he was on top of coca research, Plowman knew, of course, about the problems in Hawaii, and hypothesized that the disease was fungal in origin. But, he wanted to know if the disease was caused by a contaminant on the seeds and seedlings brought in from Latin America, or was it something that was endemic to Hawaii and then mutated - changed hosts and started to chew on Coca-Cola's coca plants. At the time, Plowman was sending seeds and seedlings from Latin America to restock the plantation. In 1974, he diverted to me some of the same seeds and seedlings that were to be sent to Hawaii for cultivation.

Plowman did this to determine if the seeds and seedlings developed the same coca wilt disease when grown in other places besides Hawaii. They did not. All of the seeds and seedlings grew to maturity in the San Francisco Bay Area and other places where other researchers were growing these seeds and seedlings. The disease only showed up in Hawaii.

Based upon the fact that all of the seeds and seedlings grown in Hawaii became contaminated and wilted, Plowman hypothesized that the fungus in Hawaii was indigenous to Hawaii and had merely mutated to attack coca, and was not brought in with the seedlings, as some researchers still allege today.

The reason that this is important is that proponents of *Fusarium* like to believe that the disease was Peruvian in origin -- that it came on the seeds to Hawaii-- and therefore could be reapplied in the Amazon basin as a "natural, local" disease, thus circumventing any arguments that its importation from the US would be in violation of laws regulating the importation of pathogens.

Also in the mid-1970s in the Bay Area, A.H. McCain and D.C. Hildebrand of U.C. Berkeley were working with another strain of *Fusarium oxysporum* as a mycoherbicide against Cannabis funded by the DEA. And indeed, at the time there was speculation in botanical and mycological circles that *Fusarium oxysporum* was also responsible for the epidemic in Hawaii. The Cannabis work proved to be inconclusive, and because of the Paraquat scare at the time the work was phased out, only to be taken up later by other scientists.

Although they deny it, by 1983 at the latest, the Central Intelligence Agency (CIA) was funding research on *Fusarium* and coca, in both Hawaii and Peru. CIA-contracted scientists isolated *Fusarium oxysporum* from coca in Hawaii. And they were also working with the Hawaiian *Fusarium* in Peru. What exactly they were doing? We do not know. The CIA has not been forthcoming, either through the FOIA or during interviews of their press officers, but luckily personnel from other uSG entities have been quite forthcoming.

In 1984, a year after CIA had started funding research in Hawaii, a Fusarium epidemic of coca started in Peru, according to David Sands, the scientist who later repeated the CIA's clandestine work openly for the Agricultural Research Service of the USDA [photo]. Sands and others say that the epidemic in Peru was "natural." Again, the very year after my sources place the CIA-paid scientists with Fusarium and coca in Hawaii and Peru, an epidemic starts in the Huallaga Valley! An amazing coincidence!

By 1986, the Agricultural Research Service of the USDA was openly developing biological agents to kill coca, including moths and fungus. The USDA/ARS program was to repeat the clandestine work of the CIA, "legitimizing" it so that it would no longer be considered clandestine, and could be openly Congressionally funded in the future. Other, still clandestine work was being done by DOE in Washington State.

By 1987, the first Peruvian press reports documented that something was attacking the coca in the Upper Huallaga Valley. What it was, they did not know at the time.

Also in 1987, USDA/ARS took over the Hawaiian site. During the next year, The scientist Sands isolated a strain of Fusarium oxysporum which he called "EN-4" from *E. novogranatense* growing in Hawaii. The fact that it was first isolated from a species other than *Erythroxylum coca* illustrates some of the problems of mycoherbicide selectivity. According to their proponents, mycoherbicial strains, or "formae specialis" of Fusarium oxysporum will only attack certain species of plants, and this is cited used as "evidence" of their safety, although in British studies using the same strain EN-4, it attacked other species of plants quite unrelated to coca.

Because this strain was isolated from *E. novogranatense* and not *E. coca*, some scientists developed an entirely novel and unheard of concept based entirely on wishful thinking: to wit, that this mycoherbicide is "genus specific," instead of "species specific." However, there are over two hundred species of coca at risk, and of these only four produce cocaine in amounts large enough for extraction. Some of these other species have medicinal and other uses. Thus, by the scientists' own "genus specific" definition, the EN-4 strain would also attack all of these! So, it could not be considered to be so specific!

By 1989, the scientists researching Fusarium knew about the problem of Fusarium in immunocompromised subjects. In a letter to DEA on March 10, 1989, one of them states: "this fungus is only a problem in immunocompromised patients." Fusarium, not just the mycotoxins it produces --can be very dangerous and infect immunocompromised animals, including humans. And how do we define "immunocompromised?" AIDS patients, certainly, but also undernourished people, even people with very bad colds, and definitely people fleeing enemies in a war - the Colombian situation. All of these could risk becoming infected if saturated with the constantly mutating fungus under those conditions. Even in first-world hospitals, immunocompromised patients with Fusarium infections have a less than 50% chance of survival. One medical paper reads: "Fusarium in the foot: Remove the foot!"

From March to October, 1989, the counternarcotics "Fire Base" with its airstrip at Santa Lucía was built in the Peruvian Upper Huallaga Valley, allowing entry of large resupply aircraft. US-funded antidrug operations had been previously based in the town of Tingo María, in the southern part of the Upper Huallaga Valley or possibly through a large Palm Oil plantation near Tocache. At the same time, the US started a chemical herbicide test in the same general area, working with the chemical herbicides Tebuthiuron and Hexazinone, and perhaps other things. These herbicides were sprayed from planes with accompanying helicopters. Several chemical herbicides kill off certain fungi that keep pathogenic fungi like Fusarium in check. So the application of these chemical herbicides would have helped the spread of the Fusarium epidemic.

By 1989, Peruvian campesinos began complaining about helicopters and planes spraying something, after which their crops die. These complaints continue to the present. This was not unnoticed by the US Embassy in Lima. Many of these complaints ended up as reports cabled from the US Embassy to Washington, DC. Here are some examples:

1990 - "IN THE LAST WEEK REPORTS HAVE BEEN CIRCULATING OF A GREEN FUNGUS ATTACKING PLANTS (COCA INCLUDED) IN THE UHV. WE HAVE BEEN TOLD THAT THE U.S. IS BEING FINGERED AS THE CULPRIT IN SOME CIRCLES. MORE ON THIS LATER.." 1990LIMA18575 DOS/JB

1993 -In a debriefing of the US-funded Peruvian National Coordinator for Human Rights (Coordinadora) about their 1993 Annual Trip to Peru's Huallaga Valley Jungle Region "THE DELEGATION WAS STRUCK, HOWEVER, BY THE DEVASTATION CAUSED BY THE FUNGUS PLAGUE THAT IS WITHERING COCA CROPS. THEY WERE ASSAILED AT ALMOST EVERY STOP WITH ACCOUNTS OF U.S. DEA AIRPLANES SPREADING "FUNGUS PODS" OVER THE COCA FIELDS.... 93LIMA08060 DOS/ JB.

1996 - February 1996: A Peru Monthly Narcotics Report obtained through the Freedom of Information Act, under the heading " Plant Disease Attacks Coca," states: MEANWHILE, REPORTEDLY 3000 FARMERS IN THE TINGO MARIA AND LEONICIO PRADO AREA,... HAVE HAD TO SCRATCH FOR OTHER MEANS OF EARNING A LIVING, INCLUDING PANNING FOR GOLD, WHEN A PLANT DISEASE, "SECA-SECA", WHICH HAD PREVIOUSLY ATTACKED COCA PLANTS BROKE OUT AGAIN IN ALTERNATE CROPS PLANTED IN FORMER COCA BEDS. [State Department-JB FOIA response #199804417]

Last summer, my colleague, investigative reporter and long-time resident of Lima, Peru, Sharon Stevenson and I went to the Huallaga to investigate these reports. She had written the first article on these reports for the Miami Herald in 1991, breaking new ground. Wherever we went in the Huallaga, we were immediately barraged with dozens of reports of helicopters spraying coca fields, at which point, coca and neighboring plants died. There were so many reports, that this had to be true, or did it?

I wasn't so sure. In the 1980s and early 1990s, I had spent six years covering the Salvadoran conflict. Many eyewitness reports concerning aviation had proved to be

untrue there. One very good example is that of the A37 plane that is fitted with bombs and multi-barrelled "miniguns" that fire extremely rapidly, and make a distinctive noise like a wounded cow wailing. In El Salvador these planes used to dive firing their miniguns at a given target. However, in spite of this, many peasants used to believe that the plane's machine guns extruded from its rear. That is why, they reasoned, that one heard the noise of the machine guns firing after the plane had pulled out of its dive and was swooping upwards. Dead wrong! The real reason was that sound travels more slowly than light, and what they perceived was an illusion! This caveat was strongly in mind when analyzing the Peruvian Huallaga situation.

Reports of helicopters spraying a whitish-tannish-brownish dust when hovering over coca fields were very interesting in light of my Salvadoran experience. It is true that CORAH, the US-funded, practically mercenary, anti-coca and poppy police would often surveil coca fields from helicopters by hovering over the fields. This would raise much dust and detritus, simulating what appeared to peasants as spraying. None of the peasants described helicopters with fixed spraying devices hanging below them, and many stated that they thought people inside the helicopters were manually throwing out something while it hovered - something nobody would do with a toxic herbicide.

And also, in the case of Peru, there HAD been a US spray program using chemical herbicides that had lasted a year in a limited area around a place called "La Morada" (see map) in the Upper Huallaga Valley. This involved Tebuthiuron and Hexazinone and who knows what else, but was normally applied by small crop-dusting planes, often while helicopters hovered protecting the perimeters. That could have explained some, but not all of the reports.

Now, in fairness, I should say that my colleague Sharon Stevenson believes, as do many others, including Peruvian government officials, that an herbicide was being and still is being aerially sprayed in Peru --and that it was sprayed for many years. People who believe this have strong arguments and a considerable amount of as yet unanalyzed physical evidence.

My position is that if Fusarium was applied in Peru, it was done so secretly by the CIA in the early and mid-1980's, and has since spread. I have no hard information on whether other things have been sprayed since the US spraying test program ceased, but, I must recognize that it is possible. While there are samples to substantiate these allegations, their clarification would require huge grants and a lot of time in the field. Such work needs to be done, but for lack of funding will probably not be done, the result being that we will never know.

However, there is no doubt that there was a huge Fusarium epidemic in the Huallaga, and whatever its source, and we should study it to determine what would happen if Fusarium were to be applied in other places. What are the lessons of the Huallaga Fusarium epidemic?

The first lesson is about " non-selectivity". We heard repeatedly that when Fusarium attacks coca, it also attacks other plants. The many reports of other nearby plants being affected were very disturbing. These reports came from so many sources, including some very competent agronomists, that they cannot be discarded.

After the Peruvian epidemic, almost everybody reported what I call the "sick soil syndrome". Farmers and agronomists said that the soil simply did not produce like it used to, that it was "poisoned". This is very reminiscent of what the Soviet scientist Krasil'nikov reported in the soils after the Russian Fusarium epidemic, and may be due to an excessive amount of residual mycotoxins from the epidemic. These may take several years to dissipate.

During the late 1980s, Peruvian investigator Enrique Arévalo finished a 6-month investigation of the fungus for the Upper Huallaga Agrarian Cooperative in Uchiza, and later a series of other research funded by USDA and the "Peruvian" government agency, CORAH (actually completely beholden to the US). He wrote that the Huallaga Fusarium attacked up to 70% of the coca plots in some areas. He also noted that it attacked other plants. He and his colleagues followed the epidemic's course, and worked rather secretly at the Jungle University in Tingo María, Peru, which eventually led to him being run out of town, charged by the local farmers with spreading the epidemic, and rescued by the US Embassy, which provided a plane and paid for moving expenses.

One of the more interesting experiments that the Arévalo team did, his former student and colleague Oscar Cabezas told us, was to extract Fusarium mycotoxins as a fraction from the coca-killing strain of Fusarium oxysporum and apply these in different dosage levels to various plants, coca and non-coca. As a lesson in the potency of these mycotoxins, all of the plants that received this aqueous mycotoxin fraction died, proving that the Fusarium mycotoxins from at least one of the coca-killing strains are non-specific - they will kill or impede the growth of many plants, not just the target plant. Apparently, USDA, which had been funding him, showed no interest in publishing this data.

On June 2, 1991, the Miami Herald published Sharon Stevenson's article entitled: "Peru farmers blame U.S. for coca-killing fungus." This was the first article in the non-Peruvian press on the issue of Fusarium in Peru.

A Congressional document titled the "Potential for Biological Control of Coca" was printed in November of 1991. To give some idea of the politics of the researchers, Dr. David Rosen, Prof of Entomology, of the Hebrew University of Jerusalem, Israel argues:

"Finally, efforts should be made to persuade local populations to abandon coca-chewing as a way of life." This anti-coca attitude on the part of US, British, and Israeli researchers, and government agents is correctly perceived as cultural genocide by Andean residents. Is this the real end-goal of these governments, including ours?

In the spring of 1998, the Drug War's Fungal Solution? was published by Jim Hogshire in Covert Action Quarterly. This ground-breaking article from CAQ (edited by Sanho Tree)

was considered such a threat to the established order that ONDCP gave David Sands a copy, and Sands wrote up a rejoinder to it, which the ONDCP circulated. While the Hogshire article was mistaken about a genetically-engineered fungal product, it was correct about the intent of the US government's plans to use mycoherbicides.

1998 brought the passage of Senate bill S.2522, the Western Hemisphere Drug Elimination Act, authorizing \$23 million for three-year "Master Plan for Mycoherbicides to Control Narcotic Crops." A year later, "Plan Colombia" is framed, largely through State Department response to the many letters from the Right on the Hill to the Executive. There is no evidence for the myth being foisted by the State Department that Plan Colombia was Colombian in origin. An integral part of Plan Colombia as it sailed through Congress was that the Colombians would use mycoherbicides, specifically Fusarium against the coca crops. This was inextricably tied to \$1.6 billion in emergency bailout funds for the "Plan Colombia" antidrug/counterinsurgency strategy. It was a simple deal: Colombia uses mycoherbicides and would be rewarded with US funds.

The US scientist, Dr. David Sands, who had earlier isolated strain EN-4 from coca for the USDA, and now with his own company, Ag/Bio Con, with a retired Air Force General at the helm, started to sell selected Congressmen the concept of using his company to supply the Fusarium for Colombia. No doubt the several million dollars that Plan Colombia was offering to pay for the mycoherbicide development and application was a factor in the creation of this company.

In the spring of 1999, the US decided that it would look better for US policy if the UN handled the mycoherbicide program in Colombia. The first US approach was through the United Nations Drug Control Program (UNDCP) in which they got UNDCP to propose a project to establish a research station to conduct field trials for eventual large-scale application of the fungus. Although the UN representative in Colombia, Klaus Nyholm, said the draft agreement was "not what the Colombians want...It was an American interest...it wasn't my idea," it certainly reflected what the US State Department wanted. The proposed agreement turned over results of at least 12 years of mycoherbicide research by the US Department of Agriculture's Agricultural Research Service (ARS) and the agreement openly took political cover under the UN umbrella. A May 1999 "Action Request" by Secretary of State Madeleine Albright pushed the UNDCP to get other countries to ante up "in order to avoid a perception that this is solely a [US government] initiative." At the same time, there was an equally unsuccessful US ploy to attempt to foist a large part of Plan Colombia funding on the European Community several months later.

There were many troubling aspects to the UN proposal. It maintained that Sands' strain of EN-4 already existed in Colombia, which is convenient since introducing a foreign pathogen to the country could present a problem under international law. UN representative Nyholm, however, said there was no EN-4 in Colombia, and there was no evidence of any Fusarium epidemic on coca there. The UN proposal admitted that fungus development, large-scale production, storage, and application techniques for Fusarium

already existed; and now, it said, all that was needed were "large-scale" field trials to compare different formulations and application rates, and assess the environmental impact. Yet it didn't specify how they would have measured the safety of these trials. Nowhere in the draft is any noninvolved monitor established to oversee research and development in Colombia.

This is no small matter in Colombia, home to the world's second most diverse biosystem - - one that is uniquely vulnerable to the potential threat posed by the massive spraying of a toxic, mutative fungus in vast swathes of jungle characterized by very sensitive and poor soil.

In the spring and summer of 1999, Sands received nationwide attention for Ag/Bio Con, when he -- along with Colonel Jim McDonough, a former top aide to US drug czar General McCaffrey, who had taken a new job as Florida's top drug official -- tried to sell another strain of *Fusarium oxysporum* to control Florida's burgeoning marijuana industry.

The concept was not well received, as Florida has a history of imported organisms taking over the environment. David Struhs, the head of Florida's Department of Environmental Protection, reacted with a strongly cautionary letter saying: "Fusarium species are capable of evolving rapidly ... Mutagenicity is by far the most disturbing factor in attempting to use a Fusarium species as a bioherbicide. It is difficult, if not impossible, to control the spread of Fusarium species. The mutated fungi can cause disease in a large number of crops, including tomatoes, peppers, flowers, corn and vines, and are normally considered a threat to farmers as a pest, rather than as a pesticide. Fusarium species are more active in warm soils and can stay resident in the soil for years. Their longevity and enhanced activity under Florida conditions are of concern, as this could lead to an increased risk of mutagenicity."

And it is this ability to mutate that causes so much concern. Promoters of mycoherbicides state that a *forma specialis* - or a special form of the fungus - can only attack a certain species - or in the case of this one, a certain genus. But, here is the rub: if the same *forma specialis* organism mutates and attacks another species or genus, it becomes another *forma specialis* (its name just changes), even though it is the same organism, just attacking a different plant.

And there is another rule of thumb in mycology that should be taken into account by those who would consider applying massive doses of Fusarium or other mycoherbicides to wide swathes of our planet: the more fungal material applied, the greater the level of mutation!

To be fair, I should also mention that most mutations go nowhere - they are dead-ends, it is only the .1% that are aggressive that need concern us.

But it is not only mutation that is a problem. Fusarium can absorb snippets of DNA from other organisms. These are called transposons and could be used to synthesize novel mycotoxins or unpredictably change the behavior of the fungus.

Having been rebuffed by the state of Florida - mainly on the mutation issue - failing even to convince the state authorities to initiate a simple experiment in a quarantined test site, Dr. Sands and his small company of two apparently set his sights on Colombia.

Through his Congressional connections, Dr. Sands arranged a January, 2000 face-to-face meeting with President Andrés Pastrana in Washington. Just as he had sold the concept to the Congressmen – whose aides could not correctly pronounce the word "mycoherbicide" and definitely not "Fusarium oxysporum"– he sold Pastrana on it. Pastrana then set up meetings to clinch the deal in Colombia.

Colombian Environmental Vice Minister Claudia Martínez was ordered by the Colombian ambassador in Washington to receive Dr. Sands. In Colombia, Sands seemed to be more appropriately classified as a free-lance businessman, hawking his company's version of a fully developed fungus field-ready for "precision delivery from high altitude" application by large C-130 cargo planes -- as the following illustration, from his literature, shows.

This only frightened the Colombians more. One scientist who was present at the meeting said that this reminded him of "Dr. Strangelove." Indeed, when one looks at what this is – grass seed– one wonders how far and wide migratory birds would distribute it. Birds migrate from Colombia to the US through the target area. And, what of the effects on these birds? Two Colombian scientists who attended Sands' Bogotá presentation said he first presented himself only as a scientist, not mentioning his company Ag/Bio Con. His goal seemed to be to find four hectares anywhere in Colombia to use for a field trial. The State Department here in Washington was less than pleased at his freelancing as they correctly thought it would blow their own UNDCP "cover" program.

I should point out here that I have asked USDA for a sample of the EN-4 strain which was to be used to inundate southern Colombia. USDA would not give it to me, stating that only an "institution" could receive it. If it is so safe, why can't anyone be able to receive it?

In March of 2000, Rep. Benjamin Gilman, R-NY, tacked on an amendment to the pending aid bill requiring President Clinton to certify that the Colombian government "has agreed to and is implementing a strategy to eliminate Colombia's total coca and opium poppy production" using, among other means "tested, environmentally safe mycoherbicides." Arm-twisting by the US Congress to make Colombia use the fungus even before it has been tested for environmental and human safety raises the fundamental issue of informed consent by the Colombian people. The program could easily be construed as having a non-peaceful purpose - after all, there is a war in Colombia, thus contravening the international Biological Weapons Convention and morphing it from "biocontrol" into "biowarfare." While both the US and UN stridently object to the latter term, the secrecy surrounding the project -- the lack of independent monitoring of the US fungus development, the lack of media exposure to the project, and the classified nature of the development program in its early years -- leave serious questions unanswered.

When Sharon Stevenson and I visited Colombia in late March to early April, 2000, the UN proposal had already landed in the Ministry of Environment, which was to approve its

use. At a meeting with ranking officials, however, it became clear that the Ministry had little information to go on in making their decision. The vice minister of the environment and her aides, gathered around the conference table, were asking us to supply them with information. Neither the US government nor the UN agency pushing the plan had given the Ministry the detailed documentation available on the genesis and development of *Fusarium oxysporum* that they would need to help decide if it was safe to apply. Ministry staffers were reduced to trying to cull information from the Internet. What they had found there was evidence that *Fusarium oxysporum* could mutate to attack other plants and could be dangerous to animal and human health.

In response to the pressures, the Ministry of Environment came up with a series of three counterproposal, calling for back-to-basic research on "native micro-organisms with biocontrol potential" in the coca zones. The final proposal ruled out the use of the unpredictable and dangerous *Fusarium* as a biocontrol agent. As one USG official said: "They'll just study the whole thing to death...They won't come up with anything...at best, some good science will come out of it."

During the first months of 2000, a US Nobel laureate (who has asked to remain unnamed) wrote Bill Clinton raising concerns about the relationship between mycoherbicides and biological warfare, and its implications in Foreign Policy.

June, 2000: Plan Colombia passes Senate. House language wins out over the more environmentally-friendly Senate language. At this point it looks like the mycoherbicide program was "on" for Colombia.

But, also last June, mycoherbicides were the subject of a National Security Council (NSC) meeting in DC, prompted by a letter to Clinton by the US Nobel laureate we mentioned earlier. Concern was raised because mycoherbicides would be viewed in some quarters as biological warfare, and there was fear of retaliation. Not much later, decisions were made to terminate the US pressure for the *Fusarium* project for Colombia.

The BBC interviewed Rand Beers and Dr. David Sands here in Washington, during mid-August, 2000. Here are some selections from the Sands interview:

**SANDS:** This fungus is the closest thing I've ever seen to a silver bullet ... I have seen it take out 99% of plants in a field. I think that's incredible and I think people should know that this technology exists ... This would be a green kind of warfare ...

**BBC:** Okay, but we're talking semantics here. You call it green warfare. Other people call it biological warfare. That is semantically correct, it is biological warfare.

**SANDS:** That can be right. It's biological warfare or green warfare. I just want you to understand my opinion is it's a good thing if it's done to eradicate something that the entire world feels is noxious.

**BBC:** What happens if consent is not forthcoming ... I put to you a hypothetical - you never get consent - what should happen then?

**SANDS:** You're saying that two countries [Colombia and Afghanistan] that knowingly are unleashing a chemical, a drug, on our children, an addictive drug, that they are consenting to do that and they are not consenting to do biological control, I think they should suffer the consequences of that decision.

**BBC:** Which means that we should go in without consent.

**SANDS:** I think somebody should.

**BBC:** And it should be treated as an act of counter- terrorism?

**SANDS:** Well it's a pretty- high stakes game. Just go to any rehab clinic and check it out yourself.

**BBC:** You're saying yes?

**SANDS:** Yes.

An August 22, memo justifying President Clinton's grant of a waiver for the congressional human rights conditions, stated the United States will not support the use of mycoherbicides against the Colombian coca crop unless "...a broader national security assessment, including consideration of the potential impact on biological weapons proliferation and terrorism, provides a solid foundation for concluding that the use of this particular drug control tool is in our national interest..."

Reports of Fusarium spraying emanating from the Sucumbíos region of Ecuador on the Colombian border appear, but I investigated these by telephone and later by an on-site visit and determined these to be untrue, but based on rumors being spread about the possibility of Fusarium being used across the border in Colombia.

On September 5 and 6, I was a member of the Ecuadoran delegation to the Andean Committee of Environmental Authorities (CAAAM) in Lima, Peru. CAAAM is part of the structure of the Comunidad Andina, a multinational organization comprised of Bolivia, Colombia, Ecuador, Peru and Venezuela. After two days of considerable debate, CAAAM declared its "rejection of the use of the fungus Fusarium oxysporum as a tool for the eradication of illicit crops in the territory of the Member countries of the Andean Community."

A few days later, when I talked to US officials, who brought up the CAAAM statement in the La Paz US embassy, they acknowledged that Fusarium was definitely now off the table for Colombia or anywhere else in the Americas.

Also in La Paz, Bolivia, in early September, UNDCP head Pino Arlacchi, who, when interviewed while receiving a medal from Bolivian President Banzer, stated that the

Fusarium mycoherbicide program was over for Latin America, and that the UNDCP was no longer pushing it. He explained that it had never been on the table for any other South American country except Colombia, where it was rejected.

#### Epilogue (12/19/2000)

Since the December 8, 2000 lecture, a few relevant events have happened. Immediately after the lecture, one of the attendees, Richard Baum of the ONDCP "Supply Reduction Office," responded to the speaker. He said that the mycoherbicide program was not over, but was merely "on hold." In a lecture at SAIS at John Hopkins University in October, 2001, a Mr. Brad Hittle of the ONDCP also indicated that ONDCP had not yet thrown in the towel on the Fusarium issue.

Unfortunately, mycoherbicide research was part of Bush's budget last year - albeit a secret part. Newsweek's Mike Isikoff first reported it. There are those who are suggesting that a similar mycoherbicide investigated in Uzbekistan should be used in Afghanistan.

But there still exists a danger that this may be used – rather – abused, in the Amazon basin, without the consent of those living there.

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