

HEDGE VETIVER: A GENETIC AND INTELLECTUAL HERITAGE

Mark R. Dafforn

National Academy of Sciences

Washington, DC, USA

Abstract

Recent research on the genetics, distribution, and taxonomy of vetiver grass (*Chrysopogon zizanioides* (L.) Roberty; syn. *Vetiveria zizanioides* (L.) Nash) provides a context for clarifying its origins and diversity. Current evidence helps us begin to unravel the genesis of nonfertile vetivers, while their ancient diaspora ensures they are a heritage common to us all. Vetiver technology itself is in the public domain, which yields another fundamental advantage to users. While proprietary opportunities exist, our principal of sharing benefits the public good, and continuation of this tradition is encouraged.

Introduction

I would like to thank the organizers of this Conference for allowing me to summarize current understanding on how vetiver came to be the vetivers we are using around the world, and what that may mean to users. The results of recent genetic and taxonomic research are already under discussion by several colleagues here, notably Bob Adams of Baylor, Pattana Srifah and her colleagues at Kasetsart University, and Umesh Lavania of CIMAP, so today I wish to present a summary of what we have learned about vetiver grass since we met here in 1996, and an overview of how that affects vetiver users, especially in the context of current concerns over “intellectual property rights” (IPR).

What did we know about our vetivers in 1996? We knew that their wild relatives came from the Asian subcontinent, south of the Himalaya Mountains along the Ganges plain. We knew that the nonfertile vetivers seemed common in southern India and Sri Lanka, and that for a very long time they had probably been known throughout tropical Asia. We also knew that the vetiver used for both oil production and hedgerows had been scattered around the tropics for centuries. These too seemed to be the nonfertile “essential-oil” types which—although they occasionally sent up flowering culms—are termed “non-flowering” in the traditional literature, to distinguish them from the fully fertile wild “*khus*” vetivers of the north. That is very little knowledge.

In 1996, most of us also knew very little about the vetiver plants that we personally were using in hedges. In almost every case, our plants came from traditional, in-country sources such as essential-oil plantations, herbal and botanical gardens, or other planted sites. Most of our knowledge about the plants came from what we had learned about them ourselves. A few had names, but these names usually reflected merely the location where the plant had been found; they did not have broader botanical or agronomic context. In the language of plant genetic resources, we had scores of uncharacterized accessions, often several in a single country. We did not really understand our germplasm: growth habits, tolerances to soils, pests, or plagues, or even any latent potential of different plants to set fertile seed.

As many of you remember, at the conference in 1996 I put out a call for dried, nonviable samples of vetiver leaf so that Dr. Adams could run DNA fingerprints on them. The response was incredible! Within a few months, over 120 vetiver samples were received from around the world, and they continue to arrive. To me, this seems an extra-ordinary example of “participatory research”, where everyone contributes and everyone benefits. To me, this shows that we are a community, working together for common benefit and for the public good.

What a difference four years can make, when more than 100 people put their heads together, just as several hundred of us are putting our heads together here in Thailand, and just as several thousand of us put our heads together in Vetiver Networks. None of us is as smart as all of us, and the tradition of sharing among vetiver users has had a tremendous positive impact on speeding the validation and

acceptance of the Vetiver System around the world. What I wish to emphasize today is that all of us have valid claims to vetivers, but that none of us can lay claim to ownership of the plant itself, nor to the knowledge of its uses such as has been generated by the people here at this Conference, and by those who came before us. I believe this status quo of sharing is not only proper but also serves the best interests of vetiver advancement.

Genetic Uniformity

What have we learned since 1996? At the core, we have learned that you—the vetiver user, and the generations of vetiver people before us—knew what they were talking about in terms of vetiver. All samples submitted to us as hedge vetiver were indeed *Vetiveria zizanioides*, and your designation of a plant as fertile or nonfertile was confirmed in every case by their genetic clustering into distinct types (*Molecular Ecology* 7 (1998):813-818). This indicates highly sophisticated botanical and traditional knowledge of vetiver among users. Further, all samples fell genetically into the expected specific taxa, but DNA fingerprinting also confirmed the recent botanical judgment of JeF Veldkamp of Leiden University and 200 years of prior speculation that species of the genus *Vetiveria* overlap indistinguishably with the chrysopogon grasses, so that our vetiver is properly *Chrysopogon zizanioides*, the renaming of which, by the way, changes nothing in practice for the vetiver user (*Austrobaileya* 5 (1999):503-533). Still requiring botanical exploration, however, is assessment of the physical variability of the distinct types discussed in this lecture, both among themselves and within the context of the broader genus. Vouchers, please. Exciting, and perhaps definitive, research beckons here!

Not surprisingly, high genetic diversity in south Asia was found in our analyses, especially among seedy wild and hybrid types of *C. zizanioides*; this is consistent with sexually reproducing populations (see Fig. 1). Clustering results also confirm field observations that fertile vetivers are self-evident and, interestingly, no seedy types outside their native range were submitted. This may reflect previous preferential introductions around the tropics of essential-oil clones over more conveniently transported seed, with subsequent reselection of these types for use in hedges.



Fig.1. *Chrysopogon zizanioides* (Syn. *Vetiveria zizanioides*) is known from *all* countries shown above, including warmer areas of Japan, China, New Zealand, Australia, France, Argentina, Chile, the United States, and Canada (British Columbia), with the current exceptions of Iraq, Syria, Jordan, Libya, Chad, Morocco, and Western Sahara. The wild (seedy) type is native and largely restricted to the area around the

Ganges Plain and south (hatched lines, above), with nonfertile types dominant in southern India and Sri Lanka. These vegetatively propagated essential-oil types are traditionally grown in the area inside the arc but have long been pantropical. DNA analyses find nearly 90% of all samples outside south Asia, represented by more than 30 countries (gray areas), fall into a single genetic cluster we call the 'Sunshine' type. Based on this sampling preponderance and historical evidence, heritage 'Sunshine' cultigens have long been pantropical and are likely found in most tropical areas. Other nonfertile genotypes have also now been identified outside tropical Asia. These selected materials greatly increase known cultivated diversity outside the region. Boundaries approximate. *Credit:* Adapted and used with permission from Adams, R.P. and M.R. Dafforn. 1998. Lessons in diversity: DNA sampling of the pantropical vetiver grass (*Vetiveria zizanioides*) uncovers genetic uniformity in erosion-control germplasm. *Diversity* 13(4)(1997-1998):27-28.

Most surprisingly, many samples from around the world proved to be the same general genotype, showing only minor variations using high-resolution analyses. In our first round of testing, for example, almost all samples (88%) from outside south Asia (n=60) were a single nonfertile type that is collectively called 'Sunshine', after the first-named cultivar of this type. (It was the U.S. Department of Agriculture that named it for a small town in Louisiana, USA, where a gentleman of French heritage, Eugene Le Blanc, had received it from his grandmother around 1960.) The French, and probably vetiver too, have been in Louisiana for over 200 years, and 'Sunshine' itself may have been there that long as well. This same essential cultigen is called 'Monto' in Australia, where Paul Truong (after intensive research with the plant over many years) has received governmental approval for unrestricted use; it is called 'Vallonia' in South Africa, where it arrived with Maxime Rob ert's grandfather from Mauritius a hundred years ago. Further DNA analyses have also revealed almost a dozen other nonfertile clones; one of special interest is common in Sri Lanka and also appears in Africa (Malawi) and the Americas (Mexico).

Now, because this one 'Sunshine' type seems to be everywhere, because it is ubiquitous ("Vetiveria ubique" as John Greenfield would say), most of us outside tropical Asia are working with essentially the same nonfertile vetiver. This forms a common bond among us. We know the plant with which we are working, we can compare research results, we know that we can depend on this clone to perform as described. We know it is closely related to the other nonfertile vetivers examined thus far, including those still in Asia. Much the same useful types of research results have been accomplished locally in Thailand, where DNA fingerprinting has clarified relationships among Thai germplasm, and a great deal of field-challenge experience has been gained with their ecotypes, adding another level of confidence to vetiver work. Hedge vetivers are amazing plants, robust and ideally suited to their task. I believe that, anywhere in the world, we can use our "local" vetivers with confidence. And because of our commitment to this plant and what it does for people and the environment, we now know we share a common heritage in the plant as well as in the usage.

This genetic uniformity of vetiver across the tropics also means we share a potential challenge. Although our hedge vetivers are remarkably free of pests and plagues, if a threat arises that can harm one plant, it could harm them all. This is the "Bad News" of genetic vulnerability that Bob Adams discussed so candidly in his talk. Thankfully, we have also learned—from the sharing of DNA samples from around the world—that a great deal of genetic diversity exists in vetiver. The distribution of this diversity outside south Asia appears to be by happenstance: a desirable genotype could exist almost anywhere, purely by serendipity. The history of vetiver demonstrates that no one country or individual existing today can claim responsibility for its particular occurrence in a given location, wherever that may be. The vetivers are there today because of people-past, and today they are in the "possession" of the people who use them for protecting their livelihoods and landscapes. This seems as it should be. We all share the potential genetic vulnerability of vetiver, but we also all share its potential resolution. *If* a common danger arises to our vetivers in current use, it is my fervent hope that access to global genetic diversity is not blocked by misplaced greed on the part of countries or commerce under the guise of "Intellectual Property Rights".

Vetiver's Genesis and Diaspora - A Summary of Speculations

How did vetivers come to be scattered to so many tropical outposts? Vetiver was a desirable plant long before it was used in hedges, as John Greenfield will outline in his forthcoming book on vetiver. We know that water scented with vetiver root is used in religious rituals, and the plant is often found near temples and shrines in south and southeast Asia. The roots, when moistened, also serve as cooling screens when hung over windows, an ancient custom in the region. Further, the plant is used medicinally and as an insect repellent. For these reasons, vetiver seems to have long ago been spread by travelers, merchants, and emigrants throughout the vast trading region stretching from India through Malaysia to Indonesia, and perhaps beyond.

A second, more expansive vetiver migration came during the period of the early oceanic transits between Asia and Europe, when all sorts of economic plants were shipped among every tropical port. Much like the beleaguered English transportation of living breadfruit trees from the South Pacific to the Caribbean, it seems likely vetiver was purposefully collected and transplanted as a potential commodity. (These exchanges—wheat, rice, maize, potatoes, tomatoes, banana, groundnut, cassava, and so many others—today form the backbone of human agricultural security.) Since vetiver probably formed part of colonial economic-plant introduction, somewhere the records probably still exist. Though these plant exchanges began in earnest around 1500, and continued an ancient human tradition, two “hard” dates currently stand out for vetiver: 1809 and 1843. In 1809, the first chemical analysis of vetiver oil was done in France on extracts from roots imported from the Indian Ocean island of Réunion, where vetiver is not native. Second, since 1843 a vetiver perfume called *Kus Kus* has been produced continuously in New Orleans, Louisiana, which in 1803 was purchased from the perfume-loving French by the recently independent United States, where perfumery was then considered elitist and undemocratic. Vetiver occurs in all the old French colonies, and it most likely arrived in Louisiana when it too was French. Vetiver is still most-popular there among people of French descent. The important point is that by 1843, at the very latest, vetiver was in Louisiana at the extreme terminus of global trade routes, up a river as far from home as on earth vetiver could be, literally 180E removed from south Asia. Widespread vetiver introduction undoubtedly continued over the next two centuries. We know the British carried it to Fiji a hundred years ago (although it was probably already there), and to the Caribbean and Malaysia as recently as the 1930s. Other vetiver clones also came to Malaysia from Indonesia about this time, and there are also records of introductions to Indonesia from India in the 1890s. I have no idea how often these cross-introductions occurred, but if other economic plants are any indication, they were early and frequent. Curious, then, the level of genetic uniformity we have found in vetiver.

There was another, later movement of vetiver out of south Asia of which we are aware, although its scope is unclear. Asian sugarcane workers in the late 19th century, who predominantly came from southern India and Sri Lanka, brought along their traditional plants to the many places they migrated (such as southern Africa and the Caribbean), both for vetiver's fragrant roots and the ability of hedges to create permanent boundaries. When John Greenfield worked in Fiji in the 1950s, it was the Indian population there who was familiar with vetiver, and in the 1980s they helped him make a Hindi-language vetiver video to bring back the knowledge of hedges to India! One would think this germplasm exodus from vetiver's heartland would be reflected in pantropical diversity, but we have not yet been able to unravel any clear genetic signal of its occurrence.

Curiously, there is currently no historical evidence for two other potential routes of ancient vetiver distribution. Unlike sugarcane and citrus and other Asiatic plants, Spanish scholars of the Islamic Moors have found no evidence of vetiver arriving in Europe from the Moghul Empire or earlier via greater Arabia and North Africa (and thence to the New World following the Conquistadors and their multitude of plant introductions). In fact, the one place on earth in which vetiver seems historically scarce to non-existent is the fragrance-loving Middle East and North Africa. Another route for which there is no evidence of vetiver transport is via the Indo-Malaysian trade with the Philippines, and from there by Spanish galleon to the New World and Europe.

But in any event, we know that by at least 150 years ago vetiver was spread widely around the tropics. In recent decades, vetiver has been found still growing near cane fields, on oil plantations, around old

civil-engineering works, near abandoned house sites, in botanical gardens, and, with surprising frequency, in the home gardens of people both rich and poor throughout the tropics, grown as an ornamental, a medicinal, an insect repellent, and a fragrance plant.

Now, how did one genotype come to dominate in our testing? Although there could have been only one germline of “non-flowering” vetiver to start with, the diversity in our DNA analyses seem to show otherwise. It does seem very likely, however, that when the colonial powers intensified their great plant transportations in the 17-18th centuries, they started with just a very few vetivers, perhaps from only one location (I suspect Java), and these were repeatedly propagated and moved to new locations over the decades. This creates a “bottleneck” effect, narrowing the genetic diversity available, and thus Perhaps only one clone of vetiver came to be widespread in all the colonial economic botany kits. Dutch, French, English, and others. However, the other known route of vetiver migration out of south Asia, via cane workers, seems less likely to have distributed genetically uniform germplasm. During the great emigrations of Hindu and Tamil sugarcane workers around the tropics in the late 19th century, it is doubtful they all somehow took only one genotype of vetiver with them from their homelands. (It is not unlikely, however, that they consistently selected traditional, desirable types to bring along; although this is untested, these might generally have been genetically similar.)

It could be, however, that the pantropical uniformity we see today was not cemented in place until more recent history. Although this is merely speculation, it seems plausible that what we call the ‘Sunshine’ type—which was perhaps already spread to botanic gardens and experiment stations a century before—was the genotype selected for the great plant redistribution undertaken by the Dutch, French, British, Americans, and others in the 1930s and early 1940s, when access to Asian plantation commodities such as rubber and quinine (both actually from South America) was threatened and then blocked by war. In the United States, for example, old newspapers relate that vetiver was planted in five states on over a thousand hectares. Why vetiver, which was hardly a strategic material? Because in that time of great war, perfume – along with other "luxuries" such as chocolate or nylon stockings or cigarettes – was one of the great symbols of peace and prosperity. It was a morale thing. Somewhere, records of this great diaspora of plants probably still exist. This is not unlikely, given the love of bureaucrats for documents. In the 1970s, for example, the NAS found such records in the US. Archives for the guayule plant (*Parthenium argentatum*), a rubber substitute. I wish someone would track down similar records for vetiver, for they might explain much of what we see in today’s global distribution of traditional vetivers.

Although this discussion of the vetiver diaspora may contain details that are inaccurate or misdirected, and many clues are missing, the broad picture is clear. The traditional, nonfertile vetivers—now commonly used around the world as a hedge against erosion—probably arose among the peoples of south India and Sri Lanka, and were spread by them through trade, religion, and migration centuries ago to the peripheries of tropical Asia and the Indian Ocean, where subsequent selection could have also occurred. Sugarcane, from Indonesia and propagated vegetatively like vetiver, reached Europe 1 000 years ago; surely, vetiver by that time had been spread at least throughout tropical Asia. The genetic ecotypic variation found in Thailand suggests it could have been much longer. By two hundred years ago, vetiver had a pantropical distribution, at least in some scattered locations, because of introductions by vetiver-oil producers and colonial authorities, and the later migrations of sugarcane workers. By one hundred years ago, vetiver seems to have been fairly uniformly distributed, although perhaps thinly, across the tropics, occurring in most if not all countries. It is possible that the ‘Sunshine’ (essential-oil?) genotype was then reselected in the World War II period as a “strategic material” for perfumes, which is why we now find it almost everywhere we’ve looked. There is no evidence that vetiver was ever hoarded or restricted, or pilfered or stolen. Except perhaps among the handful of top-quality oil producers and perfumeries (a story I wish they would reveal!), vetiver’s heritage is one of sharing, more like ancient crops such as rice or bananas or maize than like modern quinine or rubber.

Genetic Diversity

The DNA fingerprinting studies by Bob Adams at Baylor University, in which so many of you participated and which Dr. Adams has discussed in detail, have shown that all of the nonfertile vetivers that we tested are closely related, and seem to have affinities with those of southeast Asia (Malaysian samples), Sri Lanka, and southern India. There were two (seemingly) nonfertile specimens from our small sample of tropical Asia itself. The first is ‘Karnataka’, which originally came to Malaysia from that state in southern India. The second is from Sri Lanka, where it seems to be a traditional cultivar that we are calling ‘Kandy’. Of exceeding interest is that this same genotype is also found in Africa (in Malawi), and in the Americas (in Mexico). I cannot imagine a common thread among these three identical plants on three different continents in three distinct cultures except for their shared DNA (DNA that is very similar to Thailand’s ‘Sri Lanka’ clone as well). But, somehow, vetiver does link those places together, much like it has networked us all together, and just as hedges tie together landscapes.

A handful of other nonfertile vetivers—‘Huffman’, and ‘Capitol’ in the USA, for example—are genetically so similar to ‘Sunshine’ that high-resolution fingerprinting is necessary to distinguish them. I have wondered if these all might have come from one mother clone that underwent minor nonsexual genetic changes – “somatic mutation” – over the course of repeated vegetative propagations (much as spontaneous genetic “sports” from plants are often the source of desirable new – and patentable – diversity). However, Dr. Loren Rieseberg, an evolutionary geneticist at the University of Indiana, has told Bob Adams that a high level of genetic similarity is also a common pattern when differing genetic lines undergo similar mutations at the same genetic location, and are then “fixed” by humans through selection. In this regard, Yue-Wen Wang of National Taiwan University, who has now joined the Vetiver Identification Program’s DNA fingerprinting activities, told me three weeks ago that he has selected from fully fertile seed, after two sexual generations, a plant in which only 1 seed of 1 200 was fertile, and that single seedling grew only feebly in growing medium. Vetiver’s subtribe of grasses, the andropogons, often show low fertility, and Dr. Wang’s simple, ongoing, and as-yet unpublished experiment may show that nonfertile vetivers have arisen thousands of times in history, all showing similar genetic patterns because of parallel (or even convergent) evolution. You may be helping vetiver evolve today! And these may come to represent a new generation of hedge vetivers. We shall learn much more from experiments such as these, and from your own generous submissions of tissue samples during this Conference. Let’s keep this collaboration going.

So, currently, the most likely explanation for the existence of the nonfertile vetivers that are used for their essential oils and in hedges is through multiple selection of heavily rooted, low/nonfertile ecotypes, rather than the less-likely notion that all nonfertile vetivers arise from one ancient mother plant. These multiple origins most likely occurred early-on and most often in what is now India and Sri Lanka, but they could have occurred anywhere in tropical Asia, and on occasion perhaps elsewhere. Although it seems likely—given our current sample distributions and ratios—that the ‘Sunshine’ types predominate almost everywhere that vetiver is found (that is, throughout the tropics), our research also indicates there is probably an abundance of related genetic diversity available for future testing, if the need arises.

‘Sunshine’ on Intellectual Property

Traditional vetivers were pantropical centuries ago. As all of you know, there is enormous controversy these days over the concept of genetic “ownership”. In preparation for this talk, I asked many experts about the international status of vetiver. How does it fit into the commercial framework of the World Trade Organization (WTO) and its genetic-resource provisions under Trade-Related Intellectual Property (TRIPs) agreements, the World Intellectual Property Organization (WIPO) and its sister organization for plant variety protection, UPOV (International Union for the Protection of New Plant Varieties), and how is vetiver use affected by the UN Convention on Biological Diversity (CBD) and the joint “International Undertaking on Plant Genetic Resources” by the Consultative Group on International Agricultural Research (the CGIAR, or CG system) and the Food and Agriculture

Organization of the United Nations (FAO). Regrettably, I learned that most rules are still being worked out in international fora, so according to my reviewers I cannot give a final answer to most of these questions, because no one knows. Although they all assured me that somehow traditional cultivars of vetiver would be protected from “privatization”, the laws are not yet finalized.

So, I will not go into details on all these acronyms and the struggles surrounding them, but I will try to make the case that our hedge vetivers cannot be usurped by commercial or legal or nationalist greed. “Intellectual property rights” are a vexing and perplexing problem, but I hope that vetiver is ignored as a pawn of other interests such as genetic ownership of pharmaceutical or crop plants, for most of us are using long-entrenched traditional germplasm in traditional ways in countries where vetiver has occurred for centuries. Under the CBD, plants are under the sovereignty of the countries where they were found before the CBD ratification date in December 1993. The traditional vetivers we already have and use in our respective countries around the world today were usually in-place centuries before then. We all still have moral obligations to share the knowledge and benefits of vetiver, but the vetivers we use are under the “sovereignty” of the countries in which we have been using them since 1993. Thus, I believe that, by international convention, all of you can use your heritage ‘Sunshine’ types—as well as the other traditional essential-oil clones already spread around the tropics—with a clear conscience and without fear of usurpation by commercial interests or by national claims of “biopiracy”, the taking of someone else’s genetic “property” without permission or compensation.

This does not solve the problem of “access” to global diversity if some pestilence should attack these vetivers in farmers’ fields around the world. An important future assurance for us may reside in the CG system. Participating countries – almost every country on earth – have now neared final agreement on access and benefit sharing of CG materials in accordance with the CBD. They have worked very hard in the past few years, in conjunction with the FAO, to guarantee that their genetic resource policies conform to the spirit of the Convention on Biological Diversity, which seeks to ensure both access to plants and return of benefits to the people and nations that developed them—just as this Conference is returning global knowledge to vetiver’s ancient residence. In time, appropriate international mechanisms will be in place to facilitate global access to vetiver genetic diversity, if need be. The CG system has collected thousands of plant varieties over the past several decades. Our DNA fingerprinting has shown that a primary vetiver clone already registered in the CG system is a ‘Sunshine’ cultigen and, in time, the CG may in fact become a global repository of vetiver diversity.

This may be a good time to emphasize that many countries around the world are still debating what types of plant protection laws they will devise under the WTO and related agreements such as the FAO/CG “International Undertaking”. [NB: In July 2001, as part of political maneuverings having nothing to do with vetiver, national delegates to FAO/CG suddenly and—in my opinion—unfortunately voted to drop *Vetiveria* (and many other genera) as genetic resources to which all countries could have facilitated access.] Many nations are also writing completely new sets of IPR laws (termed *sui generis*, or self-generated) to satisfy compliance with WTO requirements to allow genetic ownership. Please, if you are interested in these issues, pay attention to learn what is happening in your country. Many good and capable people are opposed to excessive restrictions – both commercial and national – on living-heritage resources, so you will not be standing alone. Although I believe these laws will not affect current vetiver use, I could be wrong, and when the hundreds of other traditional plants of the world are considered, it is for the common good that you help ensure your countries’ laws protect the user of traditional germplasm like vetiver. The value of vetiver to us here is in its use, not in restricting its use!

Now, in spite of all my disclaimers, and acknowledging the fact that all the dust has yet to settle on plant ownership, here is how I see private “ownership” of the traditional vetiver clones with which we all are working. This is my perspective, and has no legal weight, but I believe everything favors protection for the user of traditional vetivers in hedges. There are several key words used to justify commercial claims of intellectual property, such as “discovery” and “novel” and “nonobvious”. It is my opinion that none of these can be applied today to the vetivers that exist outside of tropical Asia. All these vetivers have already been discovered by those who long ago selected and transported the clones, and these plants cannot be novel because they are identical to the plants from which they were long ago purposefully propagated, and the utility of the genotypes is obvious, which is why someone selected them in the first place. And at this time no one can claim to have bred a new variety from

nonfertile parents! The same logic applies to the status of vetiver under UPOV plant variety protection (PVP) laws. Although our traditional vetiver clones indeed fit even the most robust PVP standards of *distinct, uniform, and stable*, we can show that they were also pre-existing. No one alive can claim they created these varieties, and any smart lawyer knows that it can be shown that your traditional clones were out “in the field” prior to any intellectual property or plant variety protection claims. They should never even raise the question, for it would be foolish for lawyers to lay claim after-the-fact to the demonstrable prior existence of these genotypes. Incidentally, one aspect of submitting samples to our Vetiver Identification Program is that it creates an unambiguous record of your vetiver clone. No one else can claim it as theirs, and restrict you from using it. Of course, because vetiver is not a weed that spreads on its own (especially not across oceans!), any vetivers outside south Asia were transported there for a purpose, so they were “discovered” long ago, and they are not “novel” because they were vegetatively selected from pre-existing clones, and their uses were obvious then and now. Thus, I do not believe you, either, can make restrictive claims on your planting materials. You could trademark your *name* for it, in order to certify to customers that you are using a particular cultivar of (high-quality!) vetiver, but you cannot claim exclusive rights to use of the living germplasm itself.

Incidentally, it does seem likely that any country joining the WTO will somehow allow intellectual property claims on “novel” natural chemicals and DNA sequences that have a particular specified use (although how this will be done will vary by country, as noted above). A pesticide patent, for example, has been filed in the United States on extracts from vetiver; in fact, over 500 US patents already mention vetiver. Although none of these patents seem to impinge on our rights as traditional users, sometimes it seems in recent years that patent believers have become a little overreaching in their grasp, a patent on vetiver to restore hair loss is obviously precluded by “prior art”! Whether we agree or disagree with the system that allows patenting naturally occurring constituents of life is immaterial here, for such detailed claims do not affect us as general users of the plant. We use vetiver as a whole plant, we use traditional clonal material, and we use it in a traditional way. The only thing covered by the intellectual property protections—by the patents and PVP claims—are *new* ideas or techniques or materials that (in the United States, at least, which has the most liberal interpretation of what is patentable), that are not obvious to people practiced “in the art”, that is, already familiar with the topic. We are all practiced in the art! A first principle, then, is that there can be no legal restrictions on the use of a pre-existing plant in the same way it has been used for centuries.

I am sorry to have gone into so much detail on this unpleasant topic. I could follow the old advice to let “sleeping dogs lie” but many of you have expressed apprehensions. I know it has been of general concern, when I believe it should not be. I believe that on examination of the international status of traditional vetiver cultivars, even the most materialistic and nationalistic would clearly see that we vetiver users “ain’t got no dog in this fight”! If there are any lawyers in the audience, I hope you are disappointed. I hope you walk away from vetiver (like a dog with its tail between its legs), for there is no profit for you here. The ground rules for plant intellectual property rights will not, I believe, be settled on a hedged battlefield! I repeat: The profit in vetiver is in its use, not in controlling its use!

This seems a good place to remind everyone that, with vetiver now in field use throughout the tropics, it is more important than ever that you acquire your vetiver locally. This is not just because nations can now claim “sovereignty” over all genetic resources within their boundaries, but because I believe top-quality germplasm can already be found in most if not all countries, so why risk the transport? In the rare cases when you must exchange germplasm internationally, *please* do it following your national phytosanitary and plant-introduction regulations. This will not only ensure that all the “paperwork” is in order, so that in 20 years you can tell your children that you did things right, in accord with national and international standards, and with respect for the plant and the people before you who put their energies into creating, transporting, and maintaining good selections of vetiver, but also because vegetative grass germplasm can carry any of a hundred viruses, mycoplasmas, bacteria, insect eggs, etc., many things not visible to the naked eye. Don’t fool yourself; you can’t tell by looking, and you could be introducing new pests and plagues of vetiver, or maybe of maize, or rice, don’t risk it! Good vetiver is everywhere. Leave it to national phytosanitary professionals to approve international germplasm movements, please.

In summary, I believe that people around the tropics currently have access to top-quality planting

materials. Scientists are networking together to ensure there is a reservoir of genetic diversity in case Bob Adams' "Bad News" of genetic vulnerability becomes a problem. And don't worry about "ownership" of vetiver genetic resources. Because vetiver already so well-suits our purposes, and is already so robust and well-adapted in so many situations, we can use what we have, and in the foreseeable future there would be *no motive in hoarding vetiver, nor profit in genetic "improvement"*. Why restrict or pay for something that doesn't have added value? The money to be made with vetiver, as Aldo Miranda so clearly stated yesterday, is by providing better service cheaper!

I also want to repeat that people can choose a distinct name for any unnamed cultivar they are using (so long as it is not misleading), and can even trademark that name if it is something different from a name already in use. This can be useful for keeping track of propagule dissemination, but I don't believe it would give them any commercial advantage because excellent genotypes are freely available as propagation materials. Further, any proprietary, named varietal would be compared to the "gold standard" set by the 'Sunshine' types of vetiver. No one would pay a premium; the novel name would merely serve to ensure the qualities of your material.

The profit to be made from vetiver will come not from intellectual property but from providing services more cheaply or efficiently. So, stick with your traditional germplasm, and propagate, propagate, propagate!

Traditional Vetivers and the Vetiver Tradition

Given what I have learned at this Conference, it seems likely that the "Bad News" of genetic uniformity and vulnerability is only a perceived problem, based on our ignorance. I believe Dr. Lavania is absolutely correct when he says there is tremendous vetiver diversity available. The traditional vetivers, especially the nonfertile cultigens of the 'Sunshine' type already in use around the world, are the vetivers we all should use. They are incredibly impressive plants. Since our research has shown that they are all so similar to one another, and are so distinct from the wild seedy types of vetiver, they form a stable foundation on which we can build by continuing to share our research and techniques and other knowledge, both new and old.

But when I learned this month that Yue-Wen Wang apparently has selected, in two generations, a low-fertility germline from seedy north-India vetiver, a new layer of subtlety became apparent in the guidance of His Majesty King Bhumibol Adulyadej to use extreme caution to select only vetiver ecotypes that do not produce seed. Especially in tropical Asia, where there are many fertile vetivers, by rejecting seedy vetivers you are not only enforcing vetiver's reputation as a well-behaved landscape plant, you are also perhaps continuing that great tradition of plant domestication that is one of the noblest accomplishments of humanity.

This new avenue to vetiver diversity may help reduce the potential genetic vulnerability that our DNA fingerprinting has uncovered in traditional clones. Let me caution, however, that this work should remain experimental, and that new selections from seedy material *should not* be put into general field use: we do not know how stable their diminished fertility might be, and reversion to full fertility might be a possibility. Please, continue to use the tried and tested traditional varieties in which we have so much confidence. This is just common sense, and it also avoids that human rather than natural obstacle of intellectual property I have discussed in this lecture. Further, although the potential new vetivers have a hypothetical promise to combat hypothetical problems, *they would also fall fully under new legal regimes of ownership*, including prior informed consent, material transfer agreements, plant variety protection, and perhaps even patenting. If, in the future, someone wishes to flood vetiver users with a torrent of intellectual property claims, so be it. We will cross that bridge at that time. But I hope they remember, although the legal protections for genetic intellectual property expire after a couple of decades, the animosity and divisiveness they inspire can last for generations.

I should point out that the most rigid of the plant variety protection laws still require that eligible varieties have at least one unique distinguishing characteristic. In time, this will surely become coupled with DNA profiles, but I think not yet. Nonetheless, DNA fingerprinting, herbarium vouchers,

and accession forms are all added assurance that your traditional varieties will not be subjected to intellectual property claims. As I said, the mere fact that you (and those before you) selected these clones means they are not novel but they are already discovered and their utility is obvious. Let me remind you here that the purpose of our Vetiver Identification Program is to help you understand more about the vetiver clone you are using, and to document the history and diversity of the plant in case we should ever be faced with a “genetic failure” to pest or plague among the clones in common use. We use only dead leaf tissue and so have no IPR claims, nor do we wish you to make them based on our work! What we are doing – in addition to providing vetiver users with a genetic context for the own vetivers – is publicly documenting the existence of perhaps dozens of distinct germplasm lines of traditional vetivers that were long ago scattered around the tropics. Whether they have undergone further genetic selection over the centuries, we do not know, and it is unlikely we will ever know from where they came. But they exist today, and form a common reserve for the future.

I believe my discussion of this shared genetic resource also applies to vetiver technology, how we use the plant. The traditional, fairly widespread notion of simple boundary or erosion-barriers was elaborated into a technology – “a scientific method of achieving a practical purpose” – by sugarcane growers and colonial agricultural services, and later most especially by John Greenfield and then Richard Grimshaw, and now by all you in this audience and the thousands of other vetiver workers around the world. All have published freely their knowledge of this ever-expanding technology, which means it is in the public domain. This technology is still developing; who knows, someone may find a way to make profit from a new innovation in sanitation or remediation but – as with the plant itself – I believe the money will be made by providing vetiver services – propagation, installation, maintenance – not by secrets, nor by privatizing the plant or the techniques themselves.

Common Heritage

We seem to be on the trail of resolving any potential genetic-uniformity problems in cultivated vetivers. For the time being, we are all blessed with top-quality vetiver already available worldwide. For all of us, and by convention, this is a gift to all of us from those who came before. I firmly recommend vetiver users stick with your tried and true traditional “hedge” vetivers in all field use. You have every right to use them, and they are the best available! How fortunate we are.

For those who will follow us, what can we do for them? You from tropical Asia: you are sitting on an abundance of natural and human-selected vetiver diversity. Collect it. Grow it. Characterize it. The Thais have already uncovered variable disease resistance, for example, by comparing the materials they have. Form national research networks among scientists, and engage them with users. Find colleagues to run DNA fingerprints. Perform as sophisticated botanical, agricultural, and cultural analyses as you possibly can. Keep field notes. Recruit students. Enlist NGOs. Publish. Develop new applications. Improve current installations. Share your information with users, and make it relevant to them! That speeds up everything!

For those of us in the rest of the world, who are working on a narrower base of genetic security, continue to search out and test “new, preselected” material, someone in the past has already done the hard work of finding a good genotype for you! Find out who those people were, and what they were looking for in selecting vetiver. Like our colleagues in the vetiver heartland, create new scientific understanding of this marvelous resource. Try novel approaches. Vetiver is today a hot research topic. Experiment. Compare results. Share knowledge. Tie together the historical and functional roots of vetiver and create a web of knowledge that helps all vetiver users, just as the thin green lines of hedge vetiver are tying down the soil, and binding the earth – us all – tighter together.

Today’s vetivers, and our knowledge today of vetiver, are a precious endowment. Indeed, vetiver has never left the traditional communities of users but, rather, we have all joined them, and the benefits have been shared directly – are being shared today, in all directions – with those whose heritage maintained the germplasm for hundreds of years, and with those in the tropics today, often the same people, who most need knowledge of vetiver technology. Today it seems there is equity among all hedge-vetiver users, with none benefitting at the expense of others. The benefits of this common

heritage belong to all of you, and to thousands of others throughout the world. If we willfully continue on the path we've taken, we can continue to contribute and share in hedge vetiver: a genetic and intellectual heritage common to us all. This essence of my message today has perhaps best been summarized in the opening address of Her Royal Highness Princess Maha Chakri Sirindhorn, who declared:

“The benefits of vetiver are general and global”.

Acknowledgments

I would like to thank Bob Adams (Baylor; now Bishop Museum), John Barton (Stanford), Calestous Juma (Harvard), Jerome Reichman (Vanderbilt), Hope Shand (RAFI), and Henry Shands (USDA) for reviewing pre-presentation drafts of this paper, and for gently correcting my many naive statements. I am also grateful for the specific insights of Jim Duke (USDA, ret.), Umesh Lavania (CIMAP), and two otherwise-anonymous US Patent and Trademark Office patent examiners. I have also received many valuable inputs from my many colleagues at the National Academy of Sciences and in The Vetiver Network. A special thanks goes to Joy Boyer of the Ethical, Legal, and Social Implications of Human Genetic Research Program at the US National Institutes of Health, who as a companion and fellow-traveler has spent many long hours indulging me in discussions of the core implications and responsibilities of our new-found genetic knowledge. In spite of their best efforts, however, all errors of fact and opinion remain unwittingly my own.