THE VETIVER NETWORK

TVN NEWSLETTER

NUMBER 20 APRIL 1999

Vetiver and Disaster Mitigation

We have evidence from those countries that were effected by Hurricanes Georges and Mitch that where vetiver grass hedgerows were planted damage to road structures and landscapes were minimized. Prior to these two 1998 hurricanes, that impacted the Caribbean, The Vetiver Network learned of cases in Natal (South Africa), Philippines, and China that clearly demonstrated that vetiver provided excellent protection against cyclones and typhoons.

We have also learned from the Latin America Vetiver Network that vetiver will be used extensively in the rehabilitation of agricultural land and roads in Honduras. These natural disasters, although creating mayhem in the countries concerned, do offer opportunities to use the most appropriate technologies for the protection against future catastrophe. The Vetiver Grass Technology (VGT) is one such technology. We know that it will do the job of stabilization and rehabilitation. In addition it is a very low cost labor intensive technology. Its application in the disaster zones will not only provide a very good long lasting solution, but it could also provide employment for tens of thousands of people who have lost their jobs.

FIRST ANNOUNCEMENT

Vetiver and the Environment

The Second International Conference on Vetiver To Commemorate the Sixth Cycle Birthday Anniversary of His Majesty the King of Thailand

Phetchaburi, Thailand, 17- 21 January 2000
See Page 61 for details

This newsletter provides more feedback from users, and it demonstrates the impact that regional and national vetiver networks are having on accelerated adoption rates. Technology innovation and promotion requires good organization and leadership. Readers will see the impact of people such as Ed Balbarino (VETINETPHIL), Liu Xu (CVN), Criss Juliard (Madagascar), Joan Miller (LAVN), Paul Truong, Diti Hengchaovanich, Ken Crismier, Ngwianmbi Simon and others whose work with vetiver are significantly impacting their areas of operation. I would like to make special mention of Ken Crismier who, accompanied by Paul Truong and Diti Hengchaovanich, visited Vietnam twice in the last six months and has now generated a lot of interest in vetiver in that country. Ken has carried most of the cost himself, including the publication of "Vetiver Grass – A Hedge Against Erosion" in Vietnamese. It is people like him who see the potential in the technology, and who does something about it, that make our vetiver initiative work. Another was Kevin O'Sullivan who sadly died last year – a tribute to him appears later in this newsletter – Kevin brought the technology to the poor of Oaxaca, Mexico, together with some excellent ideas on involving communities with the technology.

During the past few months a number of good vetiver related publications have been produced. Special mention is made of two technical papers by Diti Hengchaovanich (highway stabilization) and Paul

Table of Contents See Back Page

Truong(pollution mitigation) that have been published by the Pacific Rim Vetiver Network (PRVN). The latter has also published the proceedings of the First International Vetiver Conference in Thailand. The Chinese Vetiver Network has published the proceedings of CVN's international vetiver conference held in Fujian Province in October 1997. LAVN, MVN, SAVN have produced newsletters (accessible on our home page at www.vetiver.org). VETINETPHIL is about to publish a new bulletin on vetiver in the Philippines. It is good to see that the networks and people in those networks are now taking initiatives that will make The Vetiver Network (TVN) redundant in the not too distant future – this is how it should be. Electronic Internet communications assures this devolution as it allows instant lateral communications between partners.

New networks are being developed in Vietnam (Crismier, Truong, Hengchaovanich), Seychelles (Barker) and Cameroon (Simon) with minimum support from TVN. We hope that other people will take initiative in other countries to establish networks. If readers want to get involved please contact TVN and we will help where we can. TVN unfortunately has been unable to raise funds to support existing and new networks, so you will have to raise funds locally – difficult but correct!!

In December 1998 The Vetiver Network awarded US$ 50,000 in prizes to winners in seven categories of awards (see below). There were some excellent entries. Awards were decided on quality, field performance, and the impact of the work on the vetiver initiative as a whole. Paul Truong (Australia) and Diti Hengchaovanich (Thailand) led the pack. Overall those countries in the Pacific Rim Vetiver Network made significant contributions to vetiver technology. ***Dick Grimshaw***

TVN Research and Development Awards -- 1998

The Vetiver Network announces the recipients of its 1998 Research and Development Awards totaling US$50,000.

CATEGORY 1. SOIL EROSION PROJECTS. First Prize: (second and third prizes not awarded) shared equally between: *Liyu Xu (China), Alemu Mekonnen (Ethiopia), Paul Truong (Australia), Edwin Balbarino (Philippines), Joan Miller (Costa Rica), Department of Land Development (Thailand)*

CATEGORY 2. IMPROVEMENT OF EXTREME SOILS. First Prize: (Second prize not awarded**)** shared equally between: *Zhang Jing (China), Paul Truong (Australia).* **Third Prize:** *Ngwianmbi Simon (Cameroon)*

CATEGORY 3. WATER MANAGEMENT. First Prize: (Second prize not awarded*): shared between Jano Labat (Zimbabwe), and P. A. Dalton, R. Smith and P. Truong (Australia).* **Third Prize:** shared equally between: *Project CAP (Madagascar), Stang Consult (Zimbabwe)*

CATEGORY 4. POLLUTION CONTROL. First prize: *Paul Truong and Dennis Baker (Australia).* **Second Prize:** (Third Prize not awarded)**:** *Xia Hanping and Ao Xuixui (China)*

CATEGORY 5. FARMERS SUPPORT PROJECT. First Prize: *Kevin O'Sullivan(Mexico)* **Second Prize:** *NOBS (El Salvador)***. Third Prize:** shared equally between: *Zhang Jing (China), B.B. Ghaley and Karma Tenzin (Bhutan)*

CATEGORY 6 DISASTER PREVENTION. First Prize: *Diti Hengchaovanich (Thailand).* **Second Prize:** *Xia Hanping and Ao Xuixui (China).* **Third Prize:** *Ngwainmbi Simon (Cameroon)*

CATEGORY 7. BASIC SCIENCES. **First Prize***: Diti Hengchaovanich (Thailand) and N.S. Nilaweera (Malaysia).* **Second Prize** (Third Prize was not awarded): shared between *Paul Truong (Australia) Robert Adams and Mark Dafforn*

SPECIAL PRIZE FOR TECHNOLOGY INITIATIVE. *J.Phiri (Malawi) Development of an improved "A" Frame for leveling.*

Congratulations to all prize winners. All have had their work and ideas published in TVN newsletters and web site over the past three years. Thank you for sharing your research and innovative development approaches with us. May you all innovate further with this unique technology. In addition to the above awards some 50 "Certificates of Appreciation" were presented to persons that had contributed significantly to the promotion of the technology. These are the people who do a lot of the daily work that receives little recognition. Thanks to all of you we progress! ***Dick Grimshaw***

A Tribute to Kevin O'Sullivan

Dr Kevin O´Sullivan arrived in the southern Mexican state of Oaxaca in 1990 to work with communities and small farmers. He touched the hearts of many throughout Oaxaca and from his friends discovered that the loss of soil and its fertility was the most serious and basic problem in almost all regions of the State. In searching for solutions, he remembered vetiver grass. Through friends, he found a source of the grass in the neighboring state of Chiapas, brought the first slips to Oaxaca in his rucksack on the bus, and started giving it away and talking about it.

Kevin was a founder member of *Soil Water and Seeds of Oaxaca* (SASO), an NGO set up to seek alternative solutions to combat erosion of soils and the loss of native seeds and traditional knowledge, and through which the grass is being promoted. SASO, with the support of *the Oaxaca Commission for the Defense of the Ecology*, started the *Program for the Control and Restoration of the Soils of Oaxaca* in April 1995 with the participation of communities and local farmers groups, research and education centers, NGOs and state and federal government agencies. Now there are more than 50 nurseries and demonstration sites throughout Oaxaca and vetiver is spreading in 7 other Mexican states.

Winning the first prize of the TVN 1998 awards for farmer support is just recognition of the work of this remarkable man. Kevin died in January 1997 and his ashes rest in the first vetiver nursery which he set up. He is still working with us. ***Nick Dolphin***

Vetiver Network Appoints Representatives for Europe and The Far East and Pacific Areas

The Vetiver Network has appointed Cornelis des Bouvrie of The Netherlands to formally represent the Network in Europe. Paul Truong of Australia has been appointed representative for the Far East and South Pacific. These appointments have been made as part of a devolutionary process, as well as to save our precious funds. Cornelis' main role will be to help TVN to raise additional funds, and Paul's will be more technical and promotional in his region.

Vetiver Grass Hedgerows Likely To Be Key Solution For Stabilization Of Central American Watersheds

Tom Throw of Texas A&M University (email: **t-thurow@tamu.edu)** leads a Soil Management Collaborative Research Support Program in Honduras. The pre- Hurricane Mitch results are written up in Technical Bulletin No. 98-2 April 1998 (Technical Bulletin No. 98) available from: Department of Rangeland Ecology and Management, Texas A&M University, College Station, Texas 77843-2126 USA. **Full paper on web site at www.vetiver.org**.

This research shows the effectiveness of vetiver grass hedgerows (in conjunction with mulch) on slopes ranging from 55 - 63% slopes for reducing runoff and soil loss. The reductions are very significant. (Note the research was carried out on micro catchments of between 0.12 and 0.27 hectares — these are much larger and more "real" than the standard 22m x 2m plots that are generally used. The standard runoff plots are never able to replicate water movement and accelerating velocities of water similar to that occurring on farmers' fields. Thus in the table below the more realistic data from small fields show the significant impact of vetiver hedgerows as compared to other practices and in particular shows that mulching alone is not the total answer (Editor)

Tom recently emailed me the following comment and feedback from farmers following the Hurricane Mitch devastation.

QUOTE
I don't have any recent pictures of our catchments and the surrounding areas, but I have some good quotes from the local farmers. I think USAID Frontlines may do something with them, but feel free to use them as well if of interest to people in the Vetiver Grass network. **They tell the story best**. I'll send by regular mail some of our publications that give an overview of what we are doing in southern Honduras. Briefly, I think the combination of **mulch and vetiver grass is indeed a winner**. Most of the erosion that occurs on these steep hillsides is associated with landslides. Mulch helps break the raindrop impact, but what is really needed is some mechanism to tie the soil into the hillside. Much research in the tropics only uses small plots (USLE size — 22 m by 2 m) at largest. Such small plots show that leaving crop residue is a good solution — such plots, however, do not detect the much more important aspects of soil erosion that occur on a field

Estimates Of Soil Loss During The 1995 Wet Season As Affected By Catchment Size And Management Practice, Los Espabeles, Honduras.

Catchment Characteristics Area			Management Practice	SoilLoss (tons/ha)		
Area (ha)	Length (m)	Slope (%)		Actual	USLE	RUSLE
0.272 field	70	63	Mulch	19.7	671.6	74.4
0.004 plot	22	55	Mulch	0.5	293.9	34.3
0.122 field	60	57	Slash and Burn	92.0	1019.1	111.6
0.159 field	60	55	Vetiver Contour Strips & Mulch	0.7	447.1	52.1
0.004 plot	22	55	Continuous Bare Soil Fallow	760.6	1896.0	927.4

scale. It is an expensive and logistically imposing challenge to do field level work, but these field level data show best the realistic and important benefits of using a live barrier such as vetiver grass. Below are the quotes. (Throughout the text below, LUPE refers to the USAID Land Use Productivity Enhancement project that was implemented in conjunction with the Ministry of Natural Resources. The LUPE program ended in Dec. 1998.)

Cupertino Galindo, hillside farmer, Los Espabeles, Honduras
I am 84 years old and have seen many hurricane storms. I was happy to work with LUPE to install rock terraces on my farm10 years ago because I know the benefits of keeping soil and water on the field. During the hard drought of last year, my neighbors envied me because my terraces produced enough basic grains to feed my family; the deep soils behind the terraces held enough scarce water to fill the heads of the maize and sorghum with grain. The heads of my neighbors crops did not fill because their crops ran out of water before the grain could develop. Their soils had washed away in previous years and could not hold enough water for the dry times. Now during this horrible flood, my fields have remained intact while many of my neighbors without conservation have lost their whole crop. Neighbors took refuge in my house during the flood because they were afraid their (unprotected) fields would slide and crush their houses. My neighbor lost part of his house that way.

Questioner: If rock walls are so good, why doesn't everyone build them in their fields?

Cupertino: I am not sure you know how hard it is to build rock walls on these hillsides (60% slope)? It is damn hard to lift rocks and carry them on the hill and put them into place! LUPE organized a crew of farmers to work together therefore it was not so hard on any one person. They provided food to keep up our energy and allow us not to have to seek work off-site to earn money to buy things like sugar, cooking oil and beans. They also gave us sardines in cans. They did not have enough funds to help everyone get rock walls established. In fact, they ran out of money for the effort when the walls were only half way across my field. Everyone in these hills who had rock walls built has maintained them because we value them, but it is too insurmountable of task to start on your own.

Miguel Gomez, hillside farmer, Los Espabeles, Honduras.
I have worked closely with LUPE and have seen the benefits of vetiver grass or rock barriers positioned on contour in the fields. Vetiver grass is easier to establish but we needed help in getting good grass into these hills. LUPE helped us establish plantations from which farmers could take grass and plant on their own. There were concerns about competition with crops and concerns about not being able to use fire or graze livestock during the dry season. There were concerns about having to prune the vetiver grass at a busy time of the growing season. These concerns have proven not be so serious in our experience over the past several years since we established vetiver. The fact that these sites held the soil during this flood has convinced many that having vetiver in our fields is good.

Forests are good too. Down the road there are very steep hillsides that had landslides which closed the road every time we would have a big rain. About 15 years ago a GTZ project reforested these hillsides. You see now that the forest had no landslides, but cropland on gentler slopes has covered houses. But people have to eat. Maybe forests should be replanted on exceptional slopes and projects should help us establish conservation structures on our fields.

Martin Guido, hillside farmer, Los Espabeles, Honduras.

I like my rock terraces — once soil accumulated behind them I planted fruit trees and make more money than growing basic grains. I grow basic grains on adjacent fields and am gradually extending my rock walls there. The field on which I left crop residue and did not burn according to LUPE recommendations washed away anyway. I need terraces on all my land, but during the dry season when there are not crops to tend, I must send my sons to work (out of the region) in the melon fields and chicken factories and thus do not have the manpower to make much progress on my own.

Simeon Gomez, hillside farmer, Los Espabeles, Honduras
On my field with vetiver grass contours the hillside remained perfectly in place. The fields without grass contours have had their crops and soil washed away. I have been trying to use vetiver cuttings from this field to plant on my other fields that are several kilometers away, but it is hard to transport the amount that I need. Now I have lost my crops and some soil on those fields, but I need to plant vetiver to save what is left. Does the project have a truck I can borrow to transport cuttings?

Hector Santos, former LUPE technical specialist.
When people realized that the USAID-LUPE project was terminating, and that no follow up was considered in the near future, they were very discouraged. In the situation these farmers, LUPE technicians that visited them were a source of hope and courage to continue with the hard work of stabilizing their hillside fields. People know it is important to conserve soils, but their primary concern is what they're going to eat this afternoon, tomorrow at the most. They have to work off-farm instead of installing the rock walls or Vetiver because they need the cash. They don't have time to think what will happen in ten years. A hurricane like this puts them in a great hazard for surviving next year. They lost their crops and don't have the money to buy their maize. That is the reason why they continue working on the hillsides. They do not have any other option, they need to feed their families. The farmers feel that now that LUPE is gone, they are abandoned on their own, orphans of the people who were showing them a light at the end of the tunnel. Just the technicians visiting these farmers gave them a sense of importance and pride, and the hope that we all need to keep working everyday towards a better living.

Downstream, the shrimp farmers are now realizing how much sediment from hillside farming goes into the rivers. This sediment eventually gets to their ponds, reducing their efficiency and increasing their costs. They don't think it is fair, they want a remedy, they are exploring solutions through the government, but the country is poor, and there are many needs. END QUOTE

I*t is interesting to note that in Ethiopia farmers say the same thing: "vetiver hedgerows are very effective, terrace building is costly and backbreaking!!" — Dick Grimshaw*

Letters, Feedback, and Vetiver Chat

From Dale Rachmaler As a professional agronomist with 25 years of African experience with USAID, I would like to add support to the growing use of vetiver grass as a means to stop soil erosion, safeguard infrastructure against degradation, sequester heavy metals, promote revegetation of native species on denuded land, provide missing organic matter in tropical low fertility soils to mention a few uses.

It is not often that you can persuade rural folks to try something new and then see it work in a very short period of time. Planting a tree today is super but it takes years and years to become established and longer to provide beauty or wood. Vetiver on the other hand begins to impact the environment within the first year and from then on. Once established it cannot be burnt out, it does not spread, i.e. it stays where you put it, it cannot be flooded out (remains viable even after 12 months underwater), it provides forage, mulch and its leaves can be used to weave baskets, hats and other artisinal goods. It sequesters heavy metals and is ideal for reclaiming mine tailings, it can grow in the full range of soil ph 3 -11. Its essential oil is used in perfumes and has such a complex chemical nature that it has yet to be synthesized.

There have been few technologies that I have seen over the years that have so much to offer.

From Noel Vietmeyer — Vetiver Grass and Greenhouse Gasses
Vetiver grass, *Vetiveria zizanioides*, offers a way to benefit the earth's atmosphere as well as its surface environment. This tropical grass sequesters large quantities of carbon dioxide from the atmosphere — it may, in fact, be the ideal plant for the purpose. But hedges of vetiver also stop soil erosion, rejuvenate degraded lands, keep pollutants in their place, and much more. Nobody yet knows how much greenhouse gas vetiver can remove, but is likely to surpass anything generally imagined.

A rough estimate can be gained from measurements made on a closely related grass, *Andropogon guyanus*. In 1995, CIAT (a respected international agricultural research institute in Cali, Colombia) reported that this species and another deep-rooted African grass grow so widely and so prolifically in the savannas of South America that they "may remove as much as 2 billion tons of carbon dioxide from the atmosphere yearly." *Andropogon guyanus* roots penetrate 1 meter into tropical soils and CIAT scientists found that the plant sequesters

as much as 53 tons of carbon dioxide as organic matter per hectare per year.
Vetiver roots, by contrast, are more extensive and penetrate tropical soils to depths of 5 meters and beyond. Its rate of absorbing the gas is likely to be at least twice that of its botanical cousin. Back-of-the-envelope calculations suggest that a single vetiver plant may absorb 2 kg of CO2 a year. International efforts to propagate vetiver grass are underway in more than fifty countries. To give one example, the Chiang Rai Land Development Station in northern Thailand produces new vetiver plants at the rate of 100 million a year, which means that its annual output of plants might be removing 200 million kg of carbon dioxide. According to CIAT, that's as much CO2 as emitted by 40,000 gas-guzzling cars, each driven 20,000 km. Vetiver's many advantages include the fact that it:

- Thrives in acid, tropical soils that now support little or nothing;
  Is adapted to widely different conditions and climates;
- Thrives in the tropics where the year-round heat fosters tremendous biomass growth;
- Produces root matter rapidly;
- "Buries" CO2 so deep as to keep it out of the atmosphere for decades;
- Benefits the soil and surroundings;
- Provides multiple benefits in addition to any greenhouse-gas removal;
- Is easy to use and understand;
- Can protect roads, pipelines, natural-gas wells and other installations;
- Can stabilize spoil from mining and other industrial operations; and
- Is adapted to the most erosion prone, hunger prone and forest-depleted regions.

These days, interest in planting vetiver is widespread throughout the tropics. People want to plant it for their own benefit — it doesn't have to be done for them. Small amounts of funding can therefore be put to immediate use without overheads or delays. The funds can produce huge multiplier effects. They can, for instance, be used to establish nurseries, which then go on producing planting materials in a self-sustaining manner into the foreseeable future. Vetiver seems like an exceptional tool for sequestering CO2. It can be propagated by the millions in tropical lands, and could be used **to trade off** against considerable volumes of emissions made elsewhere in the world. All in all, this remarkable plant has the ability to turn large amounts of greenhouse gases into underground solids — all the while benefiting local soils and environments. Vetiver hedges will likely hold their stored carbon for decades. They will also benefit the lives of millions in the parts of the world that most need help.

From Alemu Mekonnen, Ethiopia. Greetings to you. After the long rainy days in Ethiopia, of course good for my project, I am writing you this letter. I have succeeded in completing our planned activities on vetiver grass promotion for my project area and distributed the grass to other projects outside ours. I have applied the technique you advised me i.e. early planting, and found successful for better survival (99%). I am very much pleased with it.

Included are photos from one of the project sites where vetiver is planted for soil and water conservation, gully control and for roadside stabilization. I hope you will like it much. The altitude is 3200 masl, the soil is wet and the average temperature at this rainy day's is -2ºC and during dry season 23°C. The plants are raised in polythene tubes.
I am also sending you a videocassette; you will see and admire how vetiver is serving the poorest of poor farmers in the region, particularly the women households. There you see women carrying the seedlings & planting. This has encouraged me so much to work more on Vetiver, for this poor country to solve the problem of land degradation on large scale.

We had an award ceremony on 17/08/98 for 12 farmers received a Quintal (100 kg) of fertilizer each from the project. I will let you know the exact number of beneficiaries, the area covered and other related issues next month Sept. or the beginning of October1998.

I am now busy in propagating the grass in all the old nurseries and have recently established three nurseries. My goal is to produce 2.5 million clumps of vetiver grass, of which 75% will be containerized in polythene tube.

The videocassette I sent you is not edited. You can select the best part and edit it. I like particularly the vetiver in solving the gender issue, because it is easy to be used and propagated by women householders. In the past because of their poor physical strength they were not participating in SWC programs which dealt with engineering SWC (stone, soil bund). But now, thanks to the Vetiver grass that is gender sensitive, they are now conserving their land easily with less labor and input.

From Fesseha Gedamu Ethiopia ***weaf@mail.telecom.net.et***
Women Empowerment and Assistance Forum (WEAF) is at the moment working on soil conservation projects and it is felt that the construction of soil conversation structures are very difficult for women and are planning to introduce the use of vetiver grass to the project. We have already allocated a nursery for the production of vetiver seedlings on a largscale. I will give you a feed back on its progress in the future.

From Nat, Fiji. I am from Fiji and

am a lecturer in Soil Science at USP School of Agriculture which is located in Apia, (Western) Samoa. I am involved in the Pacific Land (PFL) Network of which Tony Dowling is the regional network coordinator.

I understand that vetiver has been in Fiji for quite some time - since the 50s if I remember correctly. It's use is now being re-encouraged via the Pacific Land Network and the Agriculture Department's efforts. I understand that from Fiji it has been introduced into the Solomons. I heard that some Tongans were also interested in getting vetiver from Fiji but I am not sure whether they finally obtained some planting materials or not. Vetiver is also doing well in PNG as I have seen it on PFL plots in PNG.

With regard to our PacificLand project, I have been talking recently with some top people in the Agriculture Dept. here - Acting Director, Head of Research, Head of Extension, Head of Forestry and others - telling them about vetiver and the need to try tit out in Samoa. Those I talked with sounded keen and I will be discussing quarantine requirements and other matters with the relevant authorities. However, an Australian consultant that was here recently (he's the one that allegedly introduced vetiver into the Solomons), suggested that I ask Pacific islanders (including Fiji, Solomons, etc) to write us of their experience with vetiver - to help the Samoan authorities finalize their decision on whether to go ahead with my proposal or not - regarding the introduction of vetiver.

For the above reason I would be very grateful if you could share the results of your study with us.

(If anybody working on the south Pacific is interested please get in touch with Nat. Looks to me like a promising vetiver development.
There is an article in Newsletter #15 page 26 that wil answer most of your queries ……. Editor)

From Joachim Boehnert, CIERs-ES, Caixa Postal 77, Nova Venecia – ES CEP 29.830-000, Brasil 31 31.08.98.

After some delay, we finally have finished our small publication about "Capim Vetiver - a Barreira Vegetal contra a Erosao: perguntas & respostas e proximos passos".. For your information I am enclosing a copy with this letter.
The small booklet was published with 1000 copies. If you need some more, please inform me via email. I will send copies to the members of the Vetiver network in Brazil, an NGO network for alternative technology (REDE-PTA), and colleagues from my service (DED - German Development Service), here in Brazil. Any new member in Brazil and/or Africa (I got a request from Mozambique) can contact me for copies here in Brazil, as long I am here (until the end of 1999).

Mainly to avoid a double-effort of publications, I was sending an 'open letter' to the members of the Vetiver network, the NGO-network REDE-PTA with 31 NGOs and 25 German colleagues from the DED, inviting comments and suggestions. Nobody answered me!

To me this shows two things:

- that it was the first time that this articles from the Book "Vetiver Grass - A Thin Green Line Against Soil-Erosion", Nacional Academy Press, 1993," was translated into Portuguese; and
- that the interest for Vetiver, despite the need and potential for Vetiver in soil & water conservation in Brazil, is still very limited.

Nevertheless, maybe this small booklet can help to extend the use of Vetiver in the state of Espirito Santo and Brazil ….

From: Julio Alegre, ICRAF-Pucallpa, Peru
j.alegre@cgiar.org

I would like to communicate some of the progress that we have done with Vetiveria in the humid tropics of Peru (Yurimaguas, Pucallpa, Iquitos) and arid areas (Ica, Huancayo, Cajamarca). Now the Peruvian government is very interested to get the planting material for the arid areas of Peru for soil conservation in the areas along the main road that crosses from Chile to Ecuador. We do not have enough material to supply it but we are investigating the propagation of this material in the humid tropics of Peru with many farmers and they can sell it.

As you now the *Vetiveria zizanoides* is planted by native people from the Amazon region (locally known as pachuli in Peru and Brazil). In Iquitos, Peru the roots are used as a medicine (a lotion with alcohol to avoid lost of hair) and in Brazil they prepare a lotion and perfume. Also dry roots are used to protect clothes from being destroyed by insects.

Four years ago I brought with me just 10 slips from Nairobi, Kenya, and propagated this material and I have distributed to several places in the Amazon and the arid regions of Peru. According with the DNA analysis that has been done the species from Iquitos, Peru and the one I brought from Nairobi were the same species (*Vetiveria zizanoides*) being the ones that do not produce seed.

Now I have implemented in the region of Pucallpa, some conservation technologies with agroforestry systems and I have included vetiveria mixed with legume multipurpose trees under contour row. Farmers are propagating the vetiveria and are still in the process of testing the benefits for soil conservation on steep poor acid soils (Ultisol). We have produced several colored tripticos (short bulletins) and one is exclusive for Vetiveria. I will send you by mail a set of these bulletins

for inclusion in the Boletin vetiveria and the World Bank technical reports.

In all the literature and reports mentioned that this *Vetiveria zizanoides* does not produce seed but recently in Pucallpa, some plants started to produce seeds (very few plants). I have collected the seeds and I have done some germination test and until now (20 days) none of the seeds have germinated. Do you have this experience. In the Yurimaguas (2,200 mm annual rain) area where I started to propagate vetiver four years ago, up till now no plants have produced seeds. However in the new area of Pucallpa where we have less rain (with 1,800 mm annual rain and only 3 months of drier periods) some plants are producing seed. I hope this is not a problem because one of the main characteristics that we are disseminating is that will not become a weed. Please advise. Please send me training materials about vetiveria. *(this limited seed productionthat is raised by Julio is often a common occurence, but all evidence indicates that the seeds are sterile, and if a few germinate they are not a problem -- most do not survive. .... Ed)*

To: Edwin Balbarino (VETINETPHIL) (email: vnp-ed@mozcom.com) from Robert A. Arevalo.

We are currently undertaking several coffee plantation activities for upland areas and I feel that the vetiver technology will be a big help to protect slopes and prevent erosions. I wish to include also vetiver in our large scale commercial coffee nurseries which we are setting up in San Juan, Batangas, Aritao, Nueva Viscaya and Palawan. We are now producing cloned coffee planting materials in coordination with Nestle Philippines for upland planting. Can you please advise me where I can secure the initial vetiver planting materials for multiplication purposes.

To: Edwin Balbarino (VETINETPHIL) From: Bro. Alois Goldberger, Regional House Ubbog, Bangued, Abra, 2800

I am enclosing some pictures from our river control work as well as the protection of irrigation canals. In our mountainous areas we use Vetiver to control gully erosion, as well as for contour lines, for protecting the rice terraces. Thank you in advance for your assistance in our Vetiver work here in Abra.

Ed Balbarino responds to Dominic Ackerman.

Vetiver *(Vetiveria zizanioides)* has been used in the Philippines for several years now. A network (VETINETPHIL - Vetiver Network Philippines) has been formed in 1997 with about 300 members who are users, researchers and promoters of the Vetiver Grass Technology. VGT is now used in the highways, irrigation canals, dams, upland farms, mining sites, site development projects and other projects that require soil erosion control, embankment stabilization and land rehabilitation. We have now 8 vetiver production farms nationwide and about 40 nurseries operated by private businessmen, farmer organizations supply vetiver planting materials anytime and any place in the Philippines. We are also producing Vetiver Technology Guides for free. I am confident to tell you that if you need a technology to stabilize earthen dams, VETIVER is the answer.

From Mike Pease (Coordinator EMVN) mikepease@mail.telepac.pt):

Early Establishment of Vetiver.

Vetiver has a built-in dormancy factor so that, depending upon weather conditions, new plantings may not show aboveground signs of growth for up to 8 weeks. Old leaves die off and appear as 'dried straw', old roots similarly tend to die off and are primarily retained at planting time purely for anchorage, hence the standard recommendation to leave say 10 cm of roots on new slips.

Early establishment can be critical to successful vetiver hedge establishment especially under stressful climatic conditions and where topographic circumstances are such that plants must be established with good new rooting to resist flooding and erosion. This particularly applies to such circumstances as steep slopes of cuttings and embankments on highways, dam walls, and disturbed lands around construction projects.

The following lists 4 methods of reducing the period between planting and firm establishment of vetiver hedges.

'Manure Tea' Two slightly different approaches to 'manure tea' are described

(a) Horse tea container. Use a 40 gallon drum and cut the end (bottom) out that does not have the drum "cap". The cut end will now be the top of the drum. Place 3 or 4 bricks in the bottom of the drum and place the cut out "bottom" on the bricks. This enables you to fill the drum with manure, but keeps it out of the very bottom from which you draw the tea. Get some pipe with an "L" elbow in it and a tap and screw the pipe into the "cap" hole. Then stand the whole contraption on a couple of concrete blocks, so as to be high enough off the ground to permit you to get a bucket under the tap when drawing off the tea. Fill the drum with dry horse manure, then fill with water and leave for a day or two. You can then draw off all the tea. Refill with water and repeat. You can get about seven cycles before you have to replace the horse manure. Of course, pig or cow manure will do just as well.

(b) When multiplying and roots have been cut back soak (submerge) the plants in "cow tea" for 6-8 days. Cow tea consists of dried cow dung and water, although one

can use up to 25% pig manure. When doing the soak drill, cut the leaves back to 40cm. and observe the new growth. When new leaf growth appears from the center of the plant and you see the beginnings of a new tiller, then it is time to replant the tiller. The process can cut back the dormant period 2-4 weeks. The Chinese originally developed the technique for rapid multiplication in the 1950s. However, they used just water.

Sand Pots In this method, a horticultural pot of any convenient size is used, three quarters filled with sand. Slips are divided into 1 or 2 tillers and planted in the sand to a depth sufficient to just cover the crown. Plant the tillers about 5 cm apart. Length of roots is not of great significance. A small quantity of fertilizer or manure is desirable. Water well. Leave for about 4-6 weeks and plant the individual tillers in the nursery close together, at normal nursery spacings, i.e. 30 cm.

Strip Production This method is ideal for producing lengths of planting material in one section for planting on steep slopes**.** Use as a base heavy duty, black polythene sheeting. Create depressions in the sheeting about 10cm high with bricks or boards and about 1m long and push the sheeting into the depression. Half fill the depression with soil, ideally mixed with some potting soil or manure. Then cover with a layer of fly screen, the stronger the better. Above the fly-screen place a layer of potting soil or planting mix and plant individual vetiver tillers at about 5-7cm spacings into this mix. Apply some fertilizer, Diammonium phosphate is ideal, and water frequently. The vetiver roots will grow through the screen and will bind into a solid strip. After about 10 weeks cut the strip which is now bound together by the fly screen from the depression into convenient lengths for handling, 30-40cm. These strips can then be planted on the slope to create an immediate hedge.

Individual Pots Plant three good quality tillers in small size pots, 3 tillers per pot, using potting soil. When the plants are sufficiently well grown, with 3 actively growing tillers, usually after about 4-6 weeks lift from pot and plant in the field at 10-15 cm spacings. This method is ideal for steep slopes such as on highway embankments and cuttings.

From Duncan Hay (Coordinator of SAVN) Email: c.za" hay@inr.unp.ac.za.

It hasn't helped that I have been appointed a director of the INR and have had to take on some rather unplanned responsibilities. My personal engagement in vetiver **will not** be effected.

I have raised R 120 000 for establishing community operated vetiver nurseries, as well as to supplement David Jobson's (Mpumalanga Vetiver Project) existing funding which is good news. I have also had fruitful discussions with African Gabions, a subsidiary of a huge Italian company specializing in engineering stabilization. They want to explore complimentary technologies and vetiver is an obvious choice. We are going to run joint seminar sessions in Cape Town, Johannesburg and Durban targeting engineers and the mining sector. David Jobson returned recently and I will be meeting with him next week to develop our joint strategy for next year. It is my firm intention to move the funding of SAVN within South Africa as of some time next year, and will be approaching funding agents early in the new year. We need to stand on our own feet sooner rather than later. That is not to say that any amounts allocated from TVN will not be gratefully accepted!

Tony Tantum also reports that they had about 150 mm of rain over a short period at one of the mines near the Kruger National Park where he is carrying out rehabilitation. Where vetiver is established the soil has held but in areas without, gullies up to 2 meters deep have formed. I have asked him to get photos.

To all the wise men from Duncan Hay Does anyone have any idea what kind of nasties one is likely to find in the mine tailings from an antimony mine? Tony has been approached to carry out some stabilization at a mine and needs some preliminary information before they take samples. Any information greatly appreciated.

From: Ken Kramer, Soil Conservationist, Saipan Field Office, Email: saipanfo@ite.net . SUBJECT: Vetiver activities in the Pacific Basin.

My purpose in writing to you is to inform you of the activities in which vetiver grass is being used, and to describe the progress that has been made to disseminate the vetiver technology in the Pacific Basin. Until fairly recently, I was unaware that the Vetiver Network existed; nevertheless, I have been promoting the use of vetiver throughout the Mariana Islands from the United States Territory of Guam to the Commonwealth of the Northern Mariana Islands (CNMI). A variety of vetiver called, Louisiana Sunshine, was extensively tested by Robert Joy, NRCS Plant Materials Specialist, at the NRCS Plant Materials Center in Molokai, Hawaii; and then, it was released to the Plant Materials Site on Guam, where it was further tested for many years. All this testing was designed to select a strain that can only be propagated by the direct intervention of humans; signifying that the seeds are not viable, and it can only be propagated by digging it up, pulling it apart, and planting the slips. The first, major use of vetiver on Guam was in the Ugum Watershed Project, where I assisted Robin DeMeo and Colleen Simpson (both from NRCS, Guam), in planning and planting vetiver in the

badlands of southern Guam.

On both Rota and Saipan in the CNMI, I have established Plant Materials Sites to propagate and maintain a place for useful erosion controlling grasses (vetiver); propagate and maintain several species of pasture grasses; and to use the site as an information/educational tool to teach farmers and ranchers what plants are available to assist them. In 1994, I introduced Louisiana Sunshine vetiver to Rota, where it was planted at the Rota Plant Materials Site and in the badlands on Rota. Plantings of vetiver were conducted in the Talakhaya Watershed in experimental trials to determine which kinds of vegetation were best adapted to growing in the nutrient poor, acidic, low organic matter, Akina Badlands Complex soils.

In 1996, vetiver was brought to Saipan, from both Rota and Guam, and established at the Plant Materials Site located in Kagman at the Department of Lands and Natural Resources' Division of Plant Industry. From this source of vetiver, several farmers have experimented with it, including Clifford Sakamoto, who used it for gully erosion; and Jesus Sablan for sheet and rill erosion. In addition, it is used in the Lau Lau Watershed Best Management Practices (BMP) Demonstration Project.

To date, the Lau Lau Watershed BMP Demonstration Project remains the best demonstration of vetiver technology in action in the CNMI; it is sponsored by the CNMI Division of Environmental Quality (DEQ) and funded through an EPA 319 grant for non-point source pollution. Susan Burr, a Marine Biologist at DEQ, and I have worked on this project from its conception; moreover, the project has been a model of cooperation between the CNMI government and the USDA/NRCS. The vetiver is planted at the top and bottom of a 2 acre site donated for use by Donald Flores, a member of the local Saipan & Northern Islands, Soil and Water Conservation District (S&NISWCD). The project location is characterized by steep (24%) slopes, volcanic, acidic, poor soil, consisting mostly of saprolite parent soil material, in an area in the Lau Lau Watershed, above Lau Lau Bay, which is a popular tourist attraction for scuba divers. In August of 1997, Robert Wescom, NRCS Forester, Guam, and I conducted a resource assessment of the Lau Lau Watershed with the purpose of documenting the existing conditions, identifying sources of non-point source pollutants that are adversely affecting the surface and marine water quality, and to implement a small demonstration of the conservation practices required to control, reduce, or prevent non-point sources of pollution. Vetiver vegetative row barriers are an integral component of this revegetation effort. Other BMPs include the use of mulch from the Lau Lau Golf Course; a ground cover of the nitrogen fixing legume, siratro, *Macroptilium atropurpureum*; tree planting with *Acacia auriculiformis*; and wattling, or the installation of live fascines, with *Gliricidia sepium*, otherwise known as the madre de cacao.

The last of the vetiver for this project (150 ft. of vetiver on the contour) was planted on September 12, 1998, at the top of the slope with the assistance of: Susan Burr, Jack Olesch, Kimiko Link, and Brian Bearden from DEQ; and Tom Pritchard, an Agriculture Teacher at the Marianas High School, and his agriculture students. These students and their teacher are Earth Team Volunteers with NRCS, and as such, they have helped us implement this project. Without the help of these 23 Earth Team Volunteers, the Project would not have succeeded as it did; and by assisting us, they learned about their island environment and the ways to preserve and protect it for future generations. This was an educational aspect of the project that has engendered a deeper respect for the environment for all those concerned with it.

The latest news concerning the use of vetiver, comes from Brian Bearden, DEQ Engineer, who is considering the possibility of to incorporating vetiver into the earth moving, permitting process. Finally, a major project is under consideration to encircle the Puerto Rico Dump on Saipan with vetiver grass to filter out the sediment, and, perhaps, absorb some of the nutrients.

From Nick Dolphin – SASO, Oaxaca, Mexico

I met a friend today to whom Kevin O'Sullivan gave a few clumps of vetiver in1995. He is planning to use the grass in bales for making houses. Apparently, people in the village where he lives were interested in using straw bales but these have proved too expensive (fortunately). *(There is an interesting web site at: www.cohousing.org/structm/msgo562.html that promotes straw housing, vetiver straw should be excellent as it is long lasting and insect resistant -- a possible area for practical reserach .. Ed)*

From Joan Miller – Coordinator LAVN Email: hamilton@sol.racsa.co.cr

Just wanted to thank you for getting out the certificates of appreciation to the "other deserving individuals". We just got a letter from one of the recipients today and he says:

"I don't have the words to tell you how grateful I am for the honor that you have awarded me a certificate so beautiful and that signifies much for me. Never did it occur to me that I might receive such an award and nonetheless I accept it with great happiness and with the promise to continue to advance in the dissemination of the Vetiver Technology..." He's been working with communities and projects, making copies of

the video, giving out booklets, etc. In the mean time he's been trying to finish up his thesis on Soil Characterization in a National Park, but he's got great interest in development and implementation alternative technologies for small, subsistence farmers. He's been one of our very active, independent workers in the field.

From Calvin Bey — Vetiver Network Haiti.
Email: cfbey@erols.com

The photos were taken before Hurricane Georges. The damage due to Georges was minimal on the site. In fact, we do not know how much rain was received at that site. And apparently there was not much wind. We have some flimsy structures that were not damaged at all. This surprised me. There was essentially no accumulation of soil at the vetiver line. I now have a rain guage at the site with someone to record each rain event. I do not have the contrasting "after-Georges" photos.

We do have one valley, away from the garden area that drains a watershed of 100 or more acres. Our next major vetiver project on the site will involve putting vetiver in that valley. Then when we get some heavy rains, I expect to see some significant soil accumulations. The site is so badly eroded that there is really very little soil left, so it may take some time to see the effects.

We will be extending the work to other groups in 1999. It seems to go painfully slow at times, but it is moving forward and many that visit the site are impressed. In a few years this will be a real showplace. Our next plans call for putting in orchards, forest trees and more edible bushes, vines, etc. I am building a good network of others who are working in the tropics and am encouraged that vetiver can be a major help in soil erosion and for storing water. Both are critical on our site.

From Ken Schlather e-mail: ks47@cornell.edu phone: (607) 844 4460

As a follow-up to Roland's (Roland Bunch) message on soil erosion/ landslide damage caused by the recent hurricane Mitch in Honduras: I was able to visit limited areas of the southern part of Honduras in mid-December and had observations similar to those of Roland. I too wish to point out that I have not been in the North part of Honduras and so cannot speak about conditions there. A team of FAO people did go to the North and I believe they prepared a report but I have not been able to obtain a copy yet.

I must admit I was impressed (and dismayed) at the apparent inability of mulch alone to protect agricultural soils from catastrophic rainfall events (a conclusion already very well documented prior to this storm, by the way, by researchers from Texas A&M university in S. Honduras as well as by the FAO project in Lempira Sur in Honduras).

The presence of trees or rock walls (where the rock walls began 30-50 cm below the soil surface), and in some cases vetiver grass, very clearly reduced landslide damage, in terms of frequency. Indicating that the soil needs to be tied into the hillside, again information that Texas A&M and FAO have already documented.

Other points:

- Deforestation clearly increased susceptibility of slopes to landslides as most of the slides occurred on deforested slopes. From the few cases we were able to document there appears to be a correlation between landslides and length of time that a field was without forest.

- There were large variations in the pattern of landslides, indicating that there are underlying causes, which should be identified (see section on damage assessments for details). Some of the possible causes of variation include parent material of the soil, slope angle, percent of forest cover. It may be possible to determine some of these causes using high resolution
- satellite photos or aerial photos combined with information in GIS databases and local observations.
- Landslides frequently occurred on the edges of fields that had soil conservation measures implemented but which were located next to fields without soil conservation measures. This would indicate one or both of a lack of training in how to drain runoff off the fields and lack of cooperation between neighboring farms. These should be addressed in any future programs.

I'll be happy to send copies of any information I have on storm damage and future needs related to soil conservation in Honduras to any of you.

From Criss Juliard (Madagascar) <cj@chemonics.mg> to Mark Dafforn.
Email: VetiverNet@aol.com.

I am delighted to have established contact with you. As you might suspect, your report (Vetiver Grass – A Thin Green Line Against Erosion) was perhaps the most important document I read on Vetiver; well written, documented, and extremely useful. About 125 copies have been distributed in Madagascar. It, along with a series of other publications on vetiver, documents, drawings, and pictures have moved the vetiver agenda to a point where it has reached "critical mass:" — engineers are using it!

Last year when Dick Grimshaw came in October/November, there were not many vetiver users, although the plant had been around for decades. It was brought here from La Réunion for the essential

oil business, and was used sporadically by several road contractors 25 years ago. Tom Bredero (known here as Monsieur Vetiver), mentioned in your report, was murdered here in 1994/5, and not very much happened after his untimely death. The project that I manage fortunately was able to build on the strong foundations he laid. We were able to mobilize people and resources since we are both an agricultural intensification and an agriculture feeder road project. For both, we have the funds and the manpower to protect watershed basins, hillside erosion and hillside agricultural plots.

Our objective last year was to build up the capacity of private suppliers to produce large quantities of quality vetiver. We succeeded, as we now have a network of 15 suppliers, from relatively small NGOs to relatively large nurseries capable of producing a million plants. There are approximately 12 ha. of vetiver nurseries at the moment.

We then set our sights on developing the market, and have been lucky in finding receptive ears among the potentially principal consumers of vetiver. The World Bank financed roads, as well as the European Union, the Ministry of Public Works and Min. of Rural Development have all stipulated that vetiver clauses must be included in all contracts. We have used the media effectively to promote the technology and it's multiple uses. We have trained the ag. extension service, members of the Water and Forestry Ministry, Boy Scouts, the Peace Corps and have organized "journées du vetiver" for schools in areas where we rehabilitated roads. We have a vetiver network, a newsletter, brigades of committed people, and a Vetiver NGO.

On the application side, we have conducted interesting experiments, none scientific. But based on approximately 800,000 plants planted, we have reached the following observations about vetiver usage in Madagascar:

- vetiver planting must be done from plants that are grown in nurseries in polybags. Transplanting should not be done from bare root tillers (since there is a high mortality rate), but always through tillers that are several months old which have already experienced primary root growth;
- multiplication is quicker and more reliable if tillers are first soaked in "cow or pig tea", a mixture of water and manure for 7- 10 days. The manure should be preferably female manure since it contains greater amounts of hormones that accelerate root growth. The
- ''pralinage" process reduces the resprouting time by about 4-5 weeks.
- spacing should not be more than 10 cm, and preferably 8 cm to establish rapid hedgerows. We calculate a minimum of 10 plants to the linear meter or 10,000 plants to the km.
- In Madagascar vetiver should be planted only between November and April; which is the rainy season, the warm season, and days are longer. Planting during short, cool dry days reduces success rates down to 40%.
- Farmers will not buy plants commercially. To get people started in an area, initial stock must be given and used by demonstration farmers. Even after that, individuals will not pay for the plant. The technology will spread mostly through uses along roads, railroads, irrigation canals and publicly funded projects. Plantation owners are the best vectors of extension.
- While the technology is easy, training must be continuous, and supervision constant.

Vero, who is responsible for our road program, is more a road engineer than a vetiver agronomist who has seen the advantages of biological protection for hillside stabilization and cost reduction for maintenance. Road maintenance is how we got involved with vetiver. The rural roads that we rehabilitate are turned over to rural associations that manage the maintenance of the roads. We had to find a way to reduce maintenance costs for these associations and reduce the destruction of rural roads during cyclones and rainy weather usage. Vetiver presented the ideal technology - inexpensive, simple to apply and lasts for a very long time.

From Criss Juliard <cj@chemonics.mg> to Mike Pease (Portugal) and Dick Grimshaw.

Your picture of the cliffs of Lagos (Portugal) are exactly what our roadside looks like in Bealanana (Madagascar), the 50 km stretch we have worked on for three years in the North. Dick visited the place. We are planting more than 1/4 of a million plants along the worst stretches. Plants in polybags are the ONLY way to work on such terrain, just as you said, since they contain good potting soil to help the plants during the difficult first two months.

I was interested in your comments about Almond orchard and vetiver. One of the things that almonds don't like is water. In fact, many newcomers to the Algarve plant flowerbeds under almond trees then water them religiously. The almond tree subsequently dies. Almonds have to go through a drought period to survive. Too much humidity destroys the roots. On the other hand vetiver rings could be used around fig, alfarubera and citrus orchards. Grape vines are also very receptive to vetiver rings. I planted vetiver around my grape vines here in Antananarivo, and have seen more than a doubling of production this year. It is phenomenal.

The good news about Ambato Boeni is that the government has provided funds (about $500,000) for the road

you worked on, but only parts are going to be done in vetiver. The not so good news is that Bernard Crabe's trials with vetiver have not been convincing. I am not sure how they planted trial plots on the digues, but apparently the latest rains carried off the plants on their demo digue. I am told they planted bare root tillers, which I think is a mistake. As I may have told you, we have completely abandoned the transplant of tillers, and require that only rooted, vigorous 6-week-old plants be used for erosion control. This is reflected in our contracts, and in all of our presentations and training. We don't recognize suppliers who provide plants as tillers, but only those who sell in polybags. In a road site planted last year, we put down potted plants for 10 meters, and then direct tillers for 5 meters. This year, the potted plants are all up and about a meter high. The tiller plants are about 25 cm high, dry, brown and about 30% died.

CAP ROADS: Results of vetiver on our roads have been good, especially to protect cement works, culverts, bridge abutments, drains, and gabions. We have also been successful in protecting areas where fill dirt has been extracted. Where we have not been successful enough is on steep hillside stabilization. The earth is often too fragile. Heavy rains wash away or bury the planted material even if it has been rooted. For the time being, we are acquiring about 30% more plant material than we need so that we have adequate replacement, and we avoid the trap of increasing spacing under the pretext we have insufficient plant material..

We are using three types of contracts for planting vetiver for:

- construction firms that are/have done satisfactory rehabilitation work and for whom we amend their construction contract to include planting vetiver. They buy the plant material under their contract;
- construction or landscape firms that provide the labor, transport and organization, and we provide the planting material. This cuts down on per meter cost;
- associations for which we provide the technical support and the plant material.

For the first two, we have prepared "public tender" contracts that conform to government contract format and regulations. These are complex documents (legalese left over from the French), and I would like to find simpler models. Do you know how I could get a hold of a Ministry of Public Works sample contracts to compare what is included. As I mentioned to Mike Pease, I think the contents of contracts, and having clauses that define exactly how to plant vetiver is critical to assure quality application of the technology. Such clauses for our supervisory engineer who signs off payment vouchers describe how the ground has to be prepared, how deep the furrow has to be, the mixture of fertilizer, quantity per meter, heeling, what the planting material has to look like, how to dispose of the plastic polybags, how to count and control linear meters (we pay by linear meter, what about you?). But we still seem to run into problems. Do you know anyone else who has prepared such documents. It would be interesting to compare.

From: Criss Juliard (Madagascar) <cj@chemonics.mg> to Joan Miller (LAVN Costa Rica).
Below are responses from Criss Juliard to a series of questions from Joan Miller.

Q. To what do you attribute the extremely high mortality in the planting of unrooted slips?

A. Poor soil, inaccessibility to watering, drought, or heavy rains. All of these factors enter into the problem but they may be particular to Madagascar. Direct, unrooted plants are a "quick and dirty" way of planting. It can work, and you can reduce the incidence of mortality. But since most of our work to date has been in isolated and hard to get hill sides, or dirt roads, hand watering cannot be assures, plus it is expensive. We have a rainy season, but it is not always constant. If you have 7 or 8 days of no rain after planting the slips, you risk losing a part. Since we are trying to instill a bioengineering technology that is simple but rigorous we thought it would be better to encourage planting from rooted source. Potted, rooted plants have an edge because they don't go through the drying out phase, they have a little ball of good soil to get started, and the plant does not go through a shock.

For your information we have had lower mortality rates in some areas. Last year we reached 85%. But that is still too high. I want 100% success rate or close to that as possible, otherwise people will focus on the weakness of the technology, or say it doesn't work.

I would say that if the land is relatively flat, rains are relatively sure or watering is easy, the soil is not too erodible, and you plant 2 - 3 tillers per plant, then go ahead and plant directly. In steeper, poor soils, or when protecting cement works, river embankments, watersheds or eroded soils, go for the pots. When participants are given the option, they will go for the cheaper and easier - which are direct tillers. In our work, we wanted to reduce the choosing of an option that tends to have a higher failure rate, so we encouraged rooted, potted plant material. In our roadwork, we require it.

Q. Do you see this same mortality in the plantings of unrooted slips in farmer's fields ?

A. No, as mentioned above, farmers, on relatively level lands, are more likely to take care of the plants

than if we are protecting a large watershed basin or a steep slope (on one, we have to lower the labors costs to plant the vetiver. In that instance we don't dig trenches, we dig holes at 45 degrees slants, and plug in the plants, just like a cork).

Q. What size container do you use in the nurseries and do you have any guidelines on the potting mix?

A. We have clear guidelines. The pot cannot be less than 15 cm high and 10 cm circumference. (We actually go out and measure randomly in each lot of delivered plants). There has to be 2-3 tillers per potted plant. It must be 6 weeks minimum in the pot, roots must be protruding, the plant must be vigorous, and the tillers will have been soaked in "cow tea" or "pralinage " for 5-7 days, which is a mixture of water and a bit of cow manure. The soaking stimulates and accelerates root growth.

The potting mix should be composed of 1/3 soil, 1/3 manure, and 1/3 sand. It must be firmly compacted. The plant must not be planted more than 3-4 cm from the crown, must be watered daily, and the nurseries must weed the pots, and place plants in the sun. Pots should be preferably black polybags, although we have used clear plastic that comes in rolls and have no bottoms. This is to be discouraged, but in Madagascar they are less than the price of black nursery bags.

Q. Do you have any cost data that you could share with us on: **(i) nursery costs, (ii) per linear meter planting costs, and (iii) years 1 and 2 maintenance and supervision costs**

A. (i) nursery costs Land rental, soil, bags, water, labor, plant material, capital immobilization per 10,000 plants runs about 5 cents per pot. They are sold at farm gate at about 8 cents per pot. Black polybags are cost about 1 cent when ordered in large quantities. A reasonably well organized operation should be able to produce 200 to 300 pots per day per person, provided the soils are well mixed, the tillers are well , and there is an assembly type operation.

A. (ii) per linear meter planting costs. Isolated areas, $1.50 to $1.80 per l.m.; in more accessible, $.40 to $1.00 per l.m. N.B. these prices do not include the price of the plants. As I may have mentioned before, it is better to have two separate parties and suppliers; one for the plants, and one for those who plant. We insist on a minimum of 10 plants per l.m. and in some places we are putting in 12-13 per. Our theory has been to be oversupplied with vetiver, and not to skimp on the plant material. Plus, I have wanted the hedge to form in one rainy season. I don't want to chance growth over two or three years. We want instant gratification!! People here need to see the effect this year, not 2-3 down the line. A well-organized crew can plant about 150 l.m. per day on difficult grounds, and up to 200 on easier soils.

A. (iii) years 1 and 2 maintenance and supervision costs. I don't have these since there is very little on our part. If you plant the plants close together (10-14 per l.m.), and the weeding is done at the nursery and one time after planting (2 months), then the only maintenance we have had to do so far is to cut the plant back one or twice a year.

From Criss Juliard (Madagascar) <cj@chemonics.mg>.

I have been sending you a lot of copies of things. I will also send you more pictures. But here are three of handicrafts that have been made out of vetiver roots. Not bad! The producer wanted to know if you could post them on the vetiver web site.

We are extremely busy, more so than ever before. We are mostly operating on the Infrastructure component, with Vero and her crew trying to accelerate completion of roads. Massive vetiver planting needs a lot more organization than I had expected, especially when compressed within several months. The number of contracts that have to be written, negotiated, then followed, and provisionally accepted, then definitely accepted, the modifications, replacements, and unexpected. Up in Bealanana, we had two contractors sign contracts to plant 100,000 potted plants each. We had provided a supply base of 240,000, but rains washed out one bridge and swelled another river so that one of the firms had to hand carry and ford 55 tons of vetiver plants to the plant site, while their proposal expected to all be done with trucks. Labor costs, time to completion and mortality rates all increased geometrically. Then we could not get money to the place because of isolation. Workers refused to work. It is not only technical issues that we are confronted with.

I just came back from the Bekobay road, the place where you visited and really gave us an eye opener on bioengineering. This place you would be proud. We have planted close to 240,000 plants on the site, and found some nifty ways to protect eroding curves, large erosion canals, and bridge embankments. There are over 100 culverts on the 42 km stretch. Each is now protected.

We have put in over 1 million plants, most of it in pots. That's more than 100 km of vetiver hedgerows. Most of it was financed under our road rehabilitation contracts. We have a vetiver clause in all new contracts. We find, as I may have said before, that a separate company should grow the vetiver from the ones who build the roads, and preferable separate from the ones who plant

the vetiver since these people should be more agro oriented than cement pourers!

The three docs round out the contract for establishing a vetiver nursery according to specifications and standards we have established for Madagascar. Unfortunately they are in French, but the requirements regarding size of pots, mixture of potting soil, the state of the plant before it can be accepted as a vigorous plant is well defined. There is a lot of extra language in the contract clauses, but that is the way we have to construct a "public contract" under public contracting regulations. You might cut out a lot, but things like litigation, and payment schedule can be eliminated or adapted to the country applied. *The contract documents are posted on the web site at* ***www.vetiver.org***

From: Md. Abu Syed, Asst. Conservator of Forests, Dhaka Forest Extension Division, 33 Bailey Road, Dhaka 1000, Bangladesh. Email: Farid Uddin Ahmed farid@citechco.net

Thanks for sending me the Vetiver Network Newsletter No.19, August 1998. I am really sorry for delayed response. I hope you will be glad to know that I have some very encouraging results in using Vetiver as a hedge crop in "Participatory Strip Plantations" (Plantation along rural earthen roads, embankments, railroads, regional and national highways). In rural earthen roads Vetiver arrested 26 cm sediment (on an average) along a 6 km planting strip (along rural earthen road). On the other hand performance of main plantation species is also excellent with vigorous growth. Participants are delighted as they are now getting plenty of Vetiver thatching materials and fuel materials. Now I am preparing a detailed technical paper on the project. Any type of printed/ electronic material would be of much help to me for consultation and reference. I hope you will help me in this regard by ensuring a few materials (prepared on specific Vetiver research project like mine)

From: Emil to Joan Miller.

Sorry for the delay in updating you on my Nicaraguan trip. Bill Schaller was unable to make the trip, so I was there by myself from Feb. 3-10. I traveled the Pan American Highway from our meeting in Zamorano to my workpost with the Universidad Nacional Agraria in Managua. This was a good opportunity to see the havoc that Hurricane Mitch wrought on the highway and areas along it. I spent most of my time in Managua working with UNA professors on curriculum assessment and a restoration plan for several rural communities (El Ojochal, Los Apantes, Las Quebradas, and Los Mangles) in Telica, a near the Casitas volcano in León. I did spend a couple of days in the field looking at the damage and talking with residents, municipio officials, and representatives of relief agencies. I was especially interested in finding out how the soil and water conservation measures implemented in a couple of the communities (mostly with Dutch assistance) held up during the hurricane. Unfortunately, the practices were employed much less extensively than I had anticipated. And although one of the local officials who had been involved with the conservation work told me a few of the farms in the area had experimented with grass hedges, we didn't find any vetiver strips. Our time was limited, and some of the areas are still relatively inaccessible. They showed me mostly gandul (pigeon pea) strips and stone rubble terraces in areas that weren't subjected to the torrents of run-off from the denuded old volcanic cones in the area.

It's unlikely that any conservation measures could have averted all the damages inflicted by such a volume of rain in such a short duration. One of the old volcano cones, Cerro Olivo, was owned mostly by a coffee cooperative and was pretty well covered by shaded coffee plantations, native forest vegetation, and extensively grazed pastures. The vegetative cover reduced the erosion on the cone, but the areas below still had huge gullies and a lot of deposition as a result of the volume of run-off.

Let's hope the area won't have to endure another assault like Mitch for least another century. But if the relatively good colluvial and alluvial soils around the foothills and basins surrounding these cones are to be made and kept productive, reforestation of the slopes and use of extensive grass barriers on the foothills will be essential. There is definitely a role for vetiver in any long-range plan. And while it isn't likely that any agency would sponsor the costs of grading and shaping the steep walls of the new gullies—many 2-3 meters or more in depth and some 25-50 meters wide—vetiver could play a role in stabilizing these as the steep walls slough off naturally.

From: Philippe Grandjean (Madagascar) - Ph_Grandjean@compuserve.com

I intend to send you a review of our Vetiver plantations this year in Marovoay and surroundings, it will be around end of March and in French. Brief news from the projects : New applications of Vetiver have started on the hill sides as an attempts to help control erosion on the tanety, results will be available at the end of this year as the hedgerows were only established in January. Brochures in Malagasy prepared by Project CAP/ Chemonics have been distributed to about 20 Water User Associations (WUE) in January 1999 and Vetiver plantings along canals/drains are now routine items listed in rehabilitation contracts between FIFABE and WUA.

F*rom Piet Sabbe, BOSPAS, Quito, Ecuador, "piet sabbe" <bospas@hotmail.com>*

The Vetiver program goes on as

before. Even better, I have set up a small company called BOSPAS — independent from Fundacion Golondrinas. One of the activities of BOSPAS is to promote and distribute Vetiver and provide technical assistance in the application of the grass.

In the last two months I attended several fairs and congresses. As a result there are some interesting requests from coastal authorities. The effects of el Ninio are still there, one and a half years after the catastrophe. A 'Programa de Reconstruccion de la Costa' was set up by the government — their main focus was to get the road system working again. And to a certain extent the roads are indeed passable again. But still very vulnerable to new landslides when another rainy season comes. Now they realize that they should work on the causes of the disaster...but there is no money.

I have been approached by an institution that wants to set up a pilot project in soil conservation with Italian money. They look for a cheap solution.

Answering your questions:

Positive success stories??. Beside our own field of 10 hectares I cannot mention any success stories yet. Neighbors are very reluctant in applying Vetiver. It needs more time apparently. Only Patricio Fuentes is 100 % convinced and works with it.

Problems that have emerged from the technology and its use??
We are still in the phase of 'discovering' the use of Vetiver, and it is too early to see problems. Hopefully, with the upcoming program on the coast, we will be able to learn more.

Research needs **I have been very busy planting batches of Vetiver at altitudes** ranging from 3000 m asl to 1000 m. Vetiver does grow up to 2,600 meters, as the literature mentions, but the difference is enormous between a plant at 2,600 m and one at 1000 m. My conclusion is that Vetiver does not have the vigorous growth and strength that is needed to be able to form a hedge above 1,200 m. The higher up in the mountains the lower the performance of Vetiver. At 2,200 m the plant doesn't grow higher than 40 cm., does not form culms, has no deep root system, etc. In brief all the elements that are the reason to use Vetiver grass are absent. I am always surprised to read reports about people who say that they successfully used Vetiver at 2,000 plus meters. I believe these people never came down the mountain to see a real grown-out Vetiver hedge that is holding up 40 cm of sediment in just 2 years. At least I have never seen this kind of situations above 1,200 m here in Ecuador. Mr. Marcelino Pita of DFC (Desarrollo Forestal Campesino) in Riobamba states clearly that in his area (3,000 m to 1800 m) Vetiver is not performing well. Another grass, Milin *(Palaris tuberosa*) is doing very well at that altitude. Also King grass, but this grass tends to become a weed if not controlled. I remember from one of your personal reports from China that you may have found a grass *(Achnatherum splendens – jiji sao … Ed)* there with similar characteristics to Vetiver but growing at high altitudes (or in temperate climate *??). (A. splendens grows under very hot summers, and survives very cold winters of north China. Altitude is not the problem, high summer temperatures are critical to good growth, same with Vetiver … Ed*). Did anything new come out of this discovery ? It could be of great value for the Andes region. For my own experiences I do not promote Vetiver anymore in the Andes region. I focus on the coastal zones now (1,000 meters and down to the seashore). Our experimental site is at 1,000 m and we are very satisfied with the grass, but even here we see a difference in growth and strength between the batches I planted at the same time in Chone (Ecuadorian coast - 60 m) and on our site. The plants in Chone were double in diameter and one meter higher in just 10 months time. Conclusion : research is needed to find out precisely in which countries Vetiver can grow to what altitude and still show the strong characteristics that are needed to call it a 'hedge against erosion'. (*Readers working with Vetiver at high altitudes might like to respond direct to Piet, please copy to TVN … Ed)*

From: Jim Maynard Email jmaynard@cnmailsvr.nmsu.edu
Just an update to let you know I'm still plugging away out here in New Mexico. I have Vetiver in culture and am working out the protocols for disinfestation and in a couple of weeks will begin some work on establishment of embryogenic callus. Once I get those things worked out I can begin working on the development of a cold tolerant variety.

I am still working with erosion and streams in the pinion-juniper and am hopeful that someday in the future that Vetiver will be available for rehabilitation in these temperate areas.

From: Joseph Boonman <Boonman@compuserve.com>
My only direct experience is from S.W. Uganda, where a colonial officer must have been working hard at the grass, of which you can still see the remains on contour lines. On the Congo side of the border, Vetiver was grown for the oil in the roots. Both events I date back to the 1950s. See my 1993 book, published by Kluwer.

I think the general situation is in brief the following:

- In East Africa there are quite a number of satisfactory (in the eyes of the beholder) grass al-

ternatives for contour lines and terraces.

- Livestock people want the above-ground parts for feeding.

- I have the working hypothesis that subtropicals do not fare too well at the Equator and vice versa. They head too late because of lower vigour – or the other way round - at widely distant latitudes.

- There is apathy towards grasses among the donor institutions now in love with projects promoting legumes, whether these are herbs or trees. I do not know whether we should be very sorry about the grasses being left out, because affairs of this type are not only ephemeral but can be lethal. CSIRO, the one-time leading global contender on the tropical-herbaceous legume platfom, has virtually closed down its legume work. Seed sales were no more than 200 tons annually, that is 2 tons per scientific worker. Grasses continue to be sold unabated, but these are the species that existed before CSIRO opened its doors. Others institutions may soon follow the CSIRO lead.

- Grasses are not looked upon - though quite wrongly - as miracle bringers. They are considered too ordinary, too local if not as outright weeds (Imperata or couch). The image of overgrazed range land has not helped much either.

- We would make a stonger platform if we did not exclusively concentrate on one species. We could include Paspalum, Eragrostis and others, even creeping ones.

From: "June Walker"
junewalker@malawi.net
Our local forestry assistant is very pleased that his first few cuttings from me have now produced a 3 ton truck full for the last rains. I see PROSCARP is on them network, maybe they know something. They visited me nearly a year ago but there has been no feedback from them yet.

From: "Miczaika, Christian
Christian.Miczaika@fao.org
I am just back from a mission to India for the ICR of the Bank-supported Tamil Nadu (India) ADP. Vetiver has been planted successfully under that project, and I can provide you with more information on this, should you be interested. One observation was made that livestock in Tamil Nadu do eat it, so it needs to be protected.

I also read your booklet and am wondering whether Vetiver grass might grow on my land in Tuscany. If so, I would like to get some and try it out. What do you think? Elevation 400 metres above sea level, rainfall around 800 mm p.a., 2-3 dry months in summer with practically no rainfall (but I could provide some irrigation, if required), temperatures below freezing with 2-3 days of snow, say, during four weeks in winter. Soil erosion is a continuing problem in Italy, see the muddy rivers and slides after heavy rains, and I would be keen to experiment on a limited scale. I know that my neighbors are always interested in my experiments, too! *(Can anyone respond to Christian on this last paragraph .. Ed)*

From: "A.M. LOUIS"
AMLOUIS@compuserve.com
We planted roughly 800 meters (distance between plants: 15 cm.) of Vetiver on different sites here in Gabon. Part of the material came from South Africa, the rest was from Vetiver found in country. The overall results are not very good: At first we observed young shoots developing, but they stayed small, and did not look very vigorous. Growth is generally very slow: after two years still no 'hedge' formation, and quite some die-back over the time. Any counsel is appreciated. *(We need to know more about the sites .. sounds a bit like Madagascar – see Criss Juliard's comments above … Ed).*

From: Otto M. Bundy, CEO and President, EcoGroup International Corporation, Parrish, Florida, USA. Email: <ecotech1@gte.net>
Our success story involves the establishment of a protocol for our cultivar of Vetiveria ziznioides "Florida Sunshine" (Ft. Polk) and maintaining it in the laboratory and cold storage. We are upgrading the micropropagation laboratory to produce over 800,000 plants units in the year 1999 and vetiver will be included in that number.

Marketing of vetiver deals with a global environmental economic-political set of criteria that will have to be addressed as the plant is further identified and proven to contribute to environmental preservation and restoration. Plant quality, quantity and function will take on a different meaning as vetiver works its way into the design for "environmentally sustainable agriculture". The Vetiver Network should look at the benefits of marketing and shipping so that the industry continues to advance and develop standards among themselves.

Research for of the improving vetiver cultivars starts with the cultivars that have DNA fingerprints and from those develop a new set of criteria that allows bio-engineering and genetic engineering as necessary part of preparing the vetiver of the future for broader use in the world environmental community. Specificity of cultivars and functions will be important, for we see plant function as a prerequisite for long term maintenance. Review and establish new indices for the best vetiver cultivars. there is excellent data excisting answering to these

objective but research must continue.

Cold storage and investigation of other storage methods of vetiver cultivars could be designed to extend plant life in marketing and shipping.

The Vetiver Network is a excellent clearing-house for these issues. Visit our web site: <http://www.ecomgmt.com>http://www.ecomgmt.com

From: Gueric Boucard "TEXAROME, INC." <texarome@hctc.net> Subject: Re: vetiver root mulch

I refer to the recent e-mail on the use of distilled vetiver roots. Perhaps we can offer some input to the network. We just put in a plant in Jacmel, Haiti to process vetiver and other agricultural raw materials. (See our website: www.ktc.net/jacosa). We process 2 tons of vetiver per day now, to be increased to 5 tons/day before the end of the year. The spent vetiver is simply spread out to dry in the sun and then used as boiler fuel in our specially designed boimass furnace. (the furnace also burns bagasse, spent amyris wood, and other biomass waste collected in the area).

We estimate the btu value of dried vetiver roots at 7000 btu/lb. In Haiti 1 ton (250gal) of No.6 fuel cost US$189.00. One pound of No.6 fuel delivers 20,000 btu's. Hence, it would take roughly 3 lbs of dried vetiver roots to compare with 1 lb of No. 6 fuel, which means that the comparative fuel value of vetiver or any other biomass is189/3 =US$63.00/ton. Haitian natives happily sell us waste biomass such as coconut hulls and leaves, drift wood etc. for US$10.00 per ton. This means that we are firing our boilers for 1/6 of the cost of No.6 fuel.

Having demonstrated the fuel savings, we are now trying to endoctrinate the Haitian native to a new way of thinking, to wit:

Why fatten the already fat white man by buying high price fossil fuels from him while the the Haitian farmer is starving to death. (in Haiti, calling foreigners "white man" is a term of endearment). We will show you how to plant vetiver fields and harvest 30 to 40 tons of dry leaves per acre to fire boilers to produce electricity. Electricity produced with fossil fuels or even with hydro power does not create any jobs to speak of.

Biomass electricity can produce massive employment in agriculture, which is what is needed in an "agrarian society". In Haiti where labor is cheap, biomass electricity would come at the same price or cheaper than fossil fuel electricity.

A biomass fuel crop in Haiti, be it bamboo or vetiver, will produce roughly the same tonnage per acre as sugar cane which has a poor yield for lack of fertilizers. Sugar cane is purchased standing in the field for roughly US$15/ton. Biomass fuel in the form of vetiver leaves could be purchased for up to US$20.00/ton and still be a third as cheap as No.6 fuel. Sugar cane is hardly grown in Haiti anymore because all sugar mills shut down. Their owners make more money importing sugar by the ship load and retailing it. What's left of the sugar cane goes to make cheap Rum (moonshine style - very inefficient). But all the "moonshine distilleries" are shutting down because it is cheaper to import cheap ethyl alcohol to mix with water and some flavorings to sell as artificial Rum.

The other crops are just subsistence crops because no large scale agriculture can be practiced. The reason: there are no roads and no transportation to take the crops to market. And there is no power to process crops into secondary export products. Citrus fruits and other goods often rot on the ground. Most rural areas have no power at all. Cities and small town that have small diesel power plants, usually provide power 4 to 8 hours per day. But total black outs can last several days.

What better use for (underutilized) Haitian arable land than biomass fuel to produce electricity? And what better biomass crop for Haiti than vetiver? The large vetiver fields could also produce roots for oil extraction. And seedlings for erosion hedges all over the island.

We have proposed a 2 Megawatt biomass power plant for the Jacmel area, based on vetiver fuel. It is now being reviewed by various NGO's and the Haitian government. Unfortunately, they don't seem to get it. Can anybody help?

From: "Ted Winston" <twinston@znet.net.au> Australia

Thank you for the note. In my local consulting work in North Queensland and Northern Territory I am working mainly with fruit tree crops (Mango, lychee, longan, avocado and coffee). Most are grown either on reasonably level land and/or farmers have taken good erosion control methods. I find little need for Vetiver under these conditions.

However when I was in Laos from 1993-1995 working on a Rural Intergrated Development project. We organised importation of 3 small truck loads of plants from Thailand. These were taken to a "research" station about 80 km of Vientiane. I along with local counterparts planted the Vetiver in several fields on the farm. Soil sandy loam, denuded rainforest country with a series of small hills. Soils are very subject to erosion in tropical downpours. The vetiver was planted near the end of my time in Laos, but I know that it had survived when I departed. Non irrigated conditions with a very pronounced

dry season. I don't know how well the vetiver has progressed since then as there was a complete change of staff at the station. I know that the station head was not very interested in vetiver as he stated that neither the cattle orhumans could eat vetiver. He wanted something that they could eat to help them survive. In some other areas of the station lemon grass was planted and this was looked upon much more favourabily as it could be used in cooking. THere are a number of areas where vetiver could be of benefit.

I was in Brunei earlier this year for a brief period and saw many areas where land development has led to erosion problems. Some of the land perhaps should not have been cleared. The smarter people at instigation of local horticulturist were planting lemon grass. I could see vetiver also having potential. I hope to be returning there within the next year and will suggest vetiver. There must be a limit to how much lemon grass the market can take!

Recently I was in Papua New Guinea and Tom Kukhang of the Coffee Research Institute was planting some vetiver on the edges of some coffee plots. I believe he is hoping to incorporate vetiver within some of his work. Thanks again for the note. I appreciate the Newletter.

From: Noah Manarang <noahvet@planet.net.ph> Philippines

Haven't written to you in a while. I would just like to tell you that more and more, Vetiver is being accepted as an effective technology here in the Philippines. I would also like to inform you that I'm now full time into Vetiver propagation. Vetiver Farms Incorporated now has 6 nurseries nationwide. Just recently, JG Summit Corporation who contracted us to plant vetiver hedgerows in their coral surfaced slopes where their factories stood, were very happy with the performance of the hedges after 3 months and they want us to plant their whole facility with the grass (approximately 200,000 seedlings). Forest Hills Golf Course where we did a test area was also very happy with the results and their consultans (Americans) conceded that Vetiver is better than hydromulch and tiger grass. I wish I could find time to sit down and do the documentation of these projects (these are just some).

Anyway, what do you think of using Vetiver on the Banawe Rice Terraces? They now have a bad case of erosion problem due to the giant worms. The Banawe Rice Terraces is one of the worlds heritage sites in the Philippines. My friends from Ateneo de Manila University (Science Education Center) would like to do a test of Vetiver there and would like to see also if the roots' aromatic properties could possibly repel the worms for good. Weena de Vera (another retired World Bank staff member) is linking us up with the Department of Tourism who is in charge of the terraces but I dont know what to propose to them. What do you think? How do we approach this? I believe that this is a very good opportunity for Vetiver not only here but internationally. Im sure funding agencies will be interested to fund any activity that could save this international treasure. I think its really high profile and Vetiver would have a lot of mileage out of this aside from that, I think Vetiver is really the answer to this problem. Please let me know your thoughts on this.

AUSTRALIA

Report from Australia

Paul Truong, Resource Sciences Centre, Queensland Department of Natural Resources, Brisbane, Australia <Truong@uq.net.au>, truong@mailbox.uq.edu.au

The application of VGT has gained great momentum in Queensland, Australia in 1998, both in the applications and research fields.

APPLICATIONS

Infrastructure protection. The major breakthrough in VGT application here is the acceptance of VGT by the Queensland Department of Main Roads for both routine maintenance work and new roads. Following my presentation at the North Queensland Main Roads symposium in Cairns I was invited by the Department to work with the design team to incorporate VGT in the design of the upgrade of the Cooktown Development Road north of Cairns. This was the first time in Australia that VGT was incorporated into the design of a new road and specified for batter and abutment stabilization, drainage channels and other concrete and rock structures protection. The first section of this road is now being built and 23 500 linear meters i.e. 188 000 vetiver slips are needed for a short section of about 10 km of this road. Other road stabilization works are in Mackay, Central Queensland and Toowoomba, Southern Queensland.

Environmental Protection. Mining rehabilitation has gained great momentum here, with the use of VGT to control wind erosion (dust storm) from a 300ha gold tailings dam. Mine tailings often contain heavy metals that can readily pollute the surrounding environment through both wind and water erosion. With Vetiver's very high levels of tolerance to soil pH and heavy metals, VGT is ideally suited for the rehabilitation of these contaminated sites.

In addition, the Regional Environmental Officer (south) of the Mine and Energy Department has also adopted VGT as the main method of stabilization, erosion and sediment control of small mines in the region. These include gold, arsenic,

and bentonite mines; clay pits and quarries. Interest was also received from Western Australia on the application of VGT in mining rehabilitation

RESEARCH

Three areas of research are being conducted in Queensland.

Mycorrhizal fungi. The fact that vetiver can grow in a wide range of soil conditions indicate that this species may be benefiting from symbiotic association with mycorrhizal fungi. To date, plant and soil samples have been collected at several locations and different habitats in Queensland and mycorrhizal fungi have been identified. One of the major findings to date is that both the number of species and populations of mycorrhizal in intensively cropped land are much lower in comparison to those from the poor degraded lands. This may be due to the effect of agrochemical on mycorrhizal population. The implication is that for heavily contaminated land (e.g. mine tailings and landfill) mycorrhizal inoculation may be needed to ensure good and sustainable growth. Work is continuous to identify and isolate the most efficient mycorrhizal strain for inoculation purposes.

Trapping Agro-chemicals and nutrients Trials are being conducted to determine the efficiency of vetiver hedges in trapping agro chemicals and nutrients in run off; sediment eroded from sugar cane fields and irrigated cotton farms.

The following chemicals and nutrients are being monitored:

- Insecticides: Lorsban, Endosulfan.
- Herbicides: Atrazine, Prometryn and Trifluralin.
- Fertilisers: N, P, K, S, Zn.

Phyto-degradation in wetlands. Some plants have the capacity of breaking down agro chemicals under wetland conditions. A trial is being conducted firstly to determine whether vetiver has this capacity and secondly if it does, how efficient it is in comparison to other species.

INTERNATIONAL CONFERENCE

TVN is one of the major sponsors of the First Asia Pacific Conference on Ground and Water Bio-Engineering for Erosion Control and Slope Stabilization in Manila, Philippines in April 1999. Paul Truong is presenting TVN on the Organizing Committee and he is also a member of the Technical Review Committee. VGT will be well presented at the conference, with several quality papers from Australia, China, India, Philippines and Thailand. In addition Paul will also coordinate a training course and will chair a Panel Discussion on vetiver and VGT at the conference.

Resistance Of Vetiver Grass To Infection By Root-Knot Nematodes (*Meloidogyne* Spp)

Lynette West[1], Graham Stirling[1], Paul Truong[2]

[1] Plant Protection Unit, Queensland Department of Primary Industries, 80 Meiers Road, Indooroopilly, Queensland 4068 [2] Resource Management Institute, Queensland Department of Primary Industries, 80 Meiers Road, Indooroopilly, Queensland 4068

Introduction

Vetiver grass (*Vetiveria zizanoides*) is well known for its tolerance to adverse soil conditions and is used as a contour hedge to prevent soil erosion on steep slopes in some countries. Anecdotal evidence also indicates that when grown adjacent to orchard trees for soil and water conservation purposes, Vetiver appears to improve tree growth.

In Queensland, Vetiver grass is being used to stabilize soil on slopes in sugarcane and pineapple plantations. Since root-knot nematodes (*Meloidogyne* spp.) can be a problem on both crops (Spaull & Cadet 1990, Caswell et al 1990), the status of Vetiver as a host of root-knot nematode was of interest. This work aimed to answer that question.

Materials and Methods

Two Vetiver varieties were screened for resistance against five root-knot

Table 1 Mean number of eggs produced per plant when five populations of *Meloidogyne* were inoculated onto *Vetiveria zizanoides Meloidogyne* populations

Vetiver cultivar	Ma	%*	Mi (B1)	%*	Mi (B2)	%*	Mj	%*	Mh	%*
Monto	489	0.16	238	0.09	70	0.28	1343	0.45	464	0.44
WA	147	0.05	15	0.01	17	0.07	410	0.14	23	0.02
Tomato	310110		274245		25228		296100		105930	

*Indicates the resistance status, determined by the number of eggs produced as a percentage of the number of eggs on tomato.

Table 2 Status of various grasses as hosts of root-knot nematodes, as indicated by the number of eggs produced on the grass as a percentage of the number of eggs on tomato.

	Meloidogyne populations		
	M. arenaria	***M. incognita (B1)***	***M. javanica***
Susceptible			
Maize:-			
cv. FSS	-	34.1	26.5
cv.Hycorn 82	-	24.7	58.6
cv.SSC 38	-	24.0	11.4
Moderately Resistant			
Maize:-			
cv. H5	-	4.9	9.1
cv. XL80	-	1.9	0.1
Setaria:-			
cv. Narok	8.3	2.7	0.8
cv. Solander	2.1	0.5	1.7
Panorama millet	6.4	3.0	2.9
Resistant			
Forage sorghum:-			
cv. Jumbo	0.00	0.08	0.00
Rhodes grass:-			
cv. Callide	0.32	0.09	0.07
cv. Nemkat	0.01	0.01	0.00
Pangola grass	0.34	1.22	0.04
Panic:-			
cv. Gatton Panic	0.00	0.03	0.01
cv. Riversdale Guinea	0.01	0.00	0.36
Vetiver grass:-			
cv. Monto	0.16	0.09	0.45
cv. WA	0.05	0.01	0.14

nematode populations. The populations are representative of the main genetic groups of *Meloidogyne* in Australia and consist of four species (viz. *M. arenaria, M. incognita* [populations B1 and B2], *M. javanica* and *M. hapla).* They were identified using DNA technology (Hugall et al 1994). The two Vetiver varieties used were Monto, a sterile selection, and a non-sterile type from Western Australia. The test plants were grown in the glasshouse in 200 mm pots in a sterile sand mix. Once they were established, five replicate plants were inoculated with 10,000 root-knot nematode eggs. A susceptible tomato cultivar (cv. Tiny Tim) was used as a standard for comparative purposes. Plants were harvested 6 weeks after inoculation, when egg masses on tomatoes were mature. Roots washed free of soil were immersed in a 1% NaOCl solution for three minutes and eggs were collected on a 38mm sieve and counted.

Results and Discussion

Both Vetiver varieties were highly resistant to all five root-knot nematode populations. Reproduction was approximately 1000-fold less than on the susceptible tomato (Table 1). Vetiver also compared favorably with other grasses that

have been found to be resistant to root-knot nematode in similar tests (Table 2).Our results confirmed those of de Moura et al (1990) who found that Vetiver was "immune" to both *M. incognita* race 1 and *M. javanica.*

Conclusion
Since the grass was resistant to all major species of *Meloidogyne*, Vetiver is unlikely to exacerbate problems caused by root-knot nematodes when used as a cover, companion or hedgerow crop.

Soil Moisture Competition Between Vetiver Hedges and Sorghum UnderIrrigated and Dryland Conditions.

Paul A. Dalton[a] and Paul N.V. Truong[b]
[a]Faculty of Engineering and Surveying, University of Southern Queensland, Toowoomba, Queensland, 4350, Australia.
[b]Resource Management Institute, Queensland Department of Primary Industries, Indooroopilly, Queensland, 4068, Australia.

Abstract
Soil moisture competition between Vetiver hedges and crop could potentially affect crop yield. To date conflicting results have been stated and very few quantitative studies on this topic have been reported.

This paper presents the effects of Vetiver hedges on soil moisture and sorghum yield under various growing conditions. Treatments include soil types (Vertisol and Alfisol) and moisture regimes (dryland and irrigated).

Gravimetric soil moisture and sorghum yield was recorded for each single row.
Under irrigated conditions on both soil types, mature hedges depleted more soil moisture than the sorghum crop, but sorghum yield was not significantly affected by the presence of mature Vetiver hedges.

Under dryland conditions on Vertisol soil, the presence of a mature hedge significantly depressed sorghum yield of the first two rows adjacent to the hedges. Yield of row 3 and further beyond the hedges was not affected.

The above results indicate that moisture competition does occur between mature hedges and the first few rows. However crop yield is only affected when soil moisture availability is very low. Under irrigation or adequate soil moisture conditions, Vetiver hedges did not adversely affect yield of adjacent rows.

Introduction
Grimshaw (1994) found most evidence indicates that Vetiver does not significantly reduce the yield of adjacent row crops. The works of Laing and Ruppenthal (1991), Yoon (1993) and Sagare and Meshram (1993) support this view. However these experiments look only at the global yield of the crop rather than the effect of Vetiver hedges on crop production in the area close to the Vetiver hedge.

At the International Crops Research Institute for Semi-Arid Tropics (ICRISAT) in India, Rao *et al.* (1992) investigated the effects of Vetiver hedges on maize production. It was found that maize grain yields were lower with Vetiver hedges (and other vegetative hedges) because of the competition of the hedges. The crop rows on either side of the hedge were reported to have produced no grain at all. Comparing this to a stone bund system of soil conservation it was found that Vetiver reduced runoff considerably more than the stone bunds due to increasing water infiltration. However the grain yield measurements indicated that the competition of the Vetiver for soil moisture outweighed the water conserved in the soil through increased infiltration in the vicinity of the hedge and also on the overall crop production. It should be noted that in this case the trial was performed in a semi-arid climate.

On a global field size scale runoff is reduced by Vetiver hedges and therefore soil moisture and sediment is conserved where Vetiver grass hedges are planted for soil and moisture conservation (Rao *et al.*, 1992 and Rao *et al.*, 1993). This in effect can give greater crop production on the global scale due to increased infiltration. However in the vicinity of the hedge the competition for soil moisture by the hedge may reduce the crop yield near the hedge.

The evidence suggests that the impact of Vetiver hedges on crop production cannot be generally stated as insignificant. It appears from the literature that increases or decreases in crop production depend on many factors including climate (arid or humid), agronomic practices (eg row spacing) and crop type. In this paper the effects of Vetiver grass hedges on soil moisture status and sorghum production for different soil types (Vertisol and Alfisol) and soil moisture regimes (irrigated and dryland farming) were trialed in South-East Queensland, Australia.

Methods

Field Sites
Three experimental field sites were used for the assessment of the sorghum yield and soil moisture encroachment of Vetiver. The selection of the Toowoomba and Gatton field sites was such that two different soil types and therefore moisture holding characteristics could be studied. Irrigation water was available at these two sites so that the sorghum crop and Vetiver could be raised unstressed and a wet profile established for the soil moisture analysis. The third site (Jondaryan) was used to monitor the effect of Vetiver on crop yields in a dryland farming situation. Soil moisture was

not monitored at this site. Fertiliser was applied at a rate commonly used for sorghum production

The Gatton Site

A mature Vetiver grass hedge, approximately 18 months old and almost 2 m tall was already established at the irrigated, Vertisol site near Gatton. Next to this hedge two replicates of sorghum crop were planted in 10 m lengths. The sorghum was planted using an accurate eight row cone planter at row spacings of 0.75 m and at the same spacing from the Vetiver hedges. Sowing rates were based on plant spacings of 50 mm. The young crops were maintained free of weeds using an inter-row cultivator and regular irrigations were scheduled to the crop over the dry summer period.

The Toowoomba Site

The Alfisol irrigated site for the soil moisture and yield experiment was established at the University of Southern Queensland agricultural field station. A mature Vetiver grass hedge, approximately 1 year old and 1.5 m tall existed at this site. The sorghum was planted next to this hedge at row spacings and sowing rates similar to the Gatton site. The site was managed by hand weeding, provision of sufficient fertiliser and regular irrigations to ensure good growth.

The Jondaryan Site

The Jondaryan field site was used to monitor the effect of Vetiver hedges on sorghum in a dryland farming situation. The soil is a typical black cotton soil (Vertisol). The site was planted to Vetiver hedges as a large scale soil conservation monitoring site in December 1993. In January 1995 sorghum was planted at 1 m row spacings adjacent to the Vetiver grass hedges. This site has experienced a prolonged dry period. During the growing period of the trial, only 235 mm of rain fell which is well below the long term mean of 314 mm over this period. The previous two years rainfall were only 358 mm and 382 mm respectively (annual mean is 624 mm).

Monitoring

The soil moisture was monitored in the Vetiver and crop rows to find the zone of influence of the Vetiver on the crop. At the two irrigated sites there were young Vetiver hedges planted at the time of the trial as well as the existing older hedges (as described in the field site description). Yield was measured by harvesting single sorghum crop rows.

Soil Moisture

Monitoring soil moisture in the Vetiver grass / sorghum crop environment was performed using the CPN Hydroprobe (503DR neutron moisture meter) at the irrigated Gatton and Toowoomba field sites. At the Gatton and Toowoomba sites field crops were kept unstressed with irrigation up to the critical stage of flowering. The plot was irrigated to the saturation point of the soil profile and the decline in soil moisture in the crop and Vetiver rows was monitored for several weeks using the Hydroprobe to give an indication of the competition of Vetiver on crop soil moisture over the yield critical crop stage. Soil moisture was measured from the soil surface to a depth of 110 cm in the root zone to give a soil moisture profile within each of the Vetiver and crop rows. Combining each profile across the plot a grid of soil moisture used by the Vetiver and the crop was obtained.

Yield

Over the life of the crops visual observations were made as to the effectiveness of crop growth within the Vetiver hedgerows. After monitoring the soil moisture drying cycle over the final stage of the crop life at Gatton and Toowoomba each of the four crop rows next to the Vetiver hedges were harvested to get the sorghum yield. The mature grain heads were hand cut and threshed for each row. At the Jondaryan site each of the four sorghum rows planted next to the Vetiver hedges were harvested individually using a grain header.

Results

Soil Moisture

Irrigated Vertisol at Gatton

Figure 4 shows the moisture status of the rows of sorghum and neighbouring 18 month old hedge on the Vertisol at Gatton near the end of the crop growing cycle. The Vetiver and neighbouring four rows of sorghum were monitored with “sorghum 1” being the row nearest to the Vetiver hedge.

Figure 3: Soil moisture status of the irrigated Vertisol at Gatton on day 1 after saturation irrigation.
Figure 4: Soil moisture status in the irrigated Vertisol at Gatton on day 22 after saturation irrigation.
Figure 5: Water depleted from the Vetiver and sorghum rows over a 22 day period of drying on the Vertisol at Gatton.

Figure 4 shows the moisture profile of the Vetiver row is much drier in the top 50 cm than the crop rows suggesting that the water usage of Vetiver is greater than that of the crop in the upper region of the soil profile. Within the crop rows there is no trend of greater drying occurring in the crop rows nearer the hedge.

Figure 5 describes the water depletion in the sorghum and neighbouring Vetiver row over the 22 day period of soil moisture monitoring. At day 1 the soil profile is regarded as full and from there the drying out of each row is described in terms of a depth of water depleted from the 110 cm measured soil profile. The soil in the Vetiver row was depleted of water at a greater rate than the sorghum rows and therefore the profile was much drier after the period of measurement. The

maximum difference in the soil moisture depletion of the sorghum rows is approximately 10% over the 110 cm profile. This difference is significant however there is no trend in the soil moisture depletion with distance from the Vetiver.

Irrigated Alfisol at Toowoomba

Figures 6 and 7 show the soil moisture status of sorghum and neighbouring Vetiver hedge at saturation point and after 44 days of drying on the Alfisol in Toowoomba. As in the trial on the Vertisol Figure 7 shows the soil in the Vetiver hedge row is significantly drier after the period of monitoring. The next driest row is the first sorghum row. This row is not significantly different to the rest of the sorghum rows to conclude competition for soil moisture by the Vetiver in that row.

Figure 6: Soil moisture status in the irrigated Alfisol at Toowoomba on day 1 after saturation irrigation.

Figure 7: Soil moisture status in the irrigated Alfisol at Toowoomba on day 44 after saturation irrigation.

Figure 8: Water depleted from the Vetiver and sorghum rows at Toowoomba over a 44 day period of drying on the Vertisol.

Figure 8 shows the moisture depleted in the Vetiver row to be significantly different to the sorghum rows. The soil in the Vetiver row was depleted of water at a greater rate than the sorghum rows and therefore the profile was much drier after the period of measurement. The sorghum rows are significantly spread in their soil moisture depletion. However no trend appears in the data at rows at incremental distances away from the hedge to conclude competition by the Vetiver hedge for soil moisture in the crop rows.

Yield

The effect of Vetiver hedges on crop production was measured under irrigation on a Vertisol at Gatton and an Alfisol at Toowoomba and under dryland conditions on a Vertisol at Jondaryan.

Irrigated Crop

The sorghum yields for the irrigated Gatton and Toowoomba trials are presented in Table 1.

There is a small yield reduction in the first sorghum row but statistical analysis indicates that the difference between this row and the other rows is not statistically significant at either trial site.

Dryland Crop

Table 2 shows the results of the sorghum yield analysis at the Jondaryan dryland field trial. Statistical analysis of the yields in each row neighbouring the Vetiver show that row 1 and row 2 are significantly different in yield to the next rows. Thus it can be concluded that under drought conditions Vetiver hedges affect crop production into the second neighbouring sorghum row. Beyond the second row differences in crop production are insignificant.

Discussion

It appears from the review of the literature that the effects of Vetiver hedges on soil and moisture conservation in a runoff event are very advantageous. The trails performed

Table 1: Sorghum yields of rows adjacent to Vetiver hedges at irrigated sites.

Sorghum	**Vertisol (Gatton)** Yield (t/ha)	Alfisol (Toowoomba) **Yield (t/ha)**
Row 1	1.985	1.789
Row 2	4.123	2.294
Row 3	2.358	2.318
Row 4	2.990	2.182
L.S.D.*	not significant	not significant

Table 2: Sorghum yields of rows adjacent to Vetiver hedges at dryland Jondaryan site.

Sorghum	**AverageYield (t/ha)**	**Significant Difference Level***
Row 1	0.144	c
Row 2	1.729	b
Row 3	2.356	a
Row 4	2.283	a
L.S.D.(5%)		0.491

(*The letters a, b and c denote statistically significant difference at the 5% level)

at Gatton and Toowoomba have shown that there is very little effect of a Vetiver hedge up to 18 months old on the soil moisture of the neighbouring sorghum crop rows. The soil moisture use of the Vetiver itself at this age is however significantly different to that of the sorghum crop. The grain production of the sorghum rows neighbouring the Vetiver is not significantly reduced at this stage of the Vetiver maturity. It should be noted however that in these two trials, the sorghum crops were kept unstressed by regular irrigations until the time of monitoring the drying of the soil. The only time of competition of the Vetiver with the crop was only over the final stages of the crop life. Hence from these two trials only reasonable conclusions on the effect of Vetiver on crop soil moisture can only be made. Any conclusion of the effect of Vetiver on crop yield from these trials would not be realistic.

In contrast to these two sites the Jondaryan trial showed that Vetiver hedges can effect sorghum yield under the typical arid dryland farming conditions and climate experienced in that region. Slashing of Vetiver hedges at planting may offer a partial solution to the water competition problem.

In a humid climate the availability of soil moisture may be less limited and therefore the effect due to the moisture conservation or competition of Vetiver grass hedges is negligible. However in an arid climate where the soil moisture levels can be marginal for crop performance the conservation of soil moisture due to reduced runoff and increased infiltration may be beneficial to crop yield on the broad farm scale. However in the localised region of the crop and Vetiver grass hedges the limited availability of soil moisture may cause the Vetiver hedges to compete with the crop. The overall positives and negatives within the spectrum of humid and arid environments needs to be considered before the Vetiver system could be classed as having a positive or negative effect on crop yield.

Conclusion

Vetiver hedges do use more soil moisture than sorghum row crops. However in irrigated conditions soil moisture and yield are not significantly reduced in the adjacent crop rows. However in dry conditions Vetiver does reduce the yield of sorghum in the adjacent two rows. Under favourable soil moisture conditions in good seasons of rain or under irrigation Vetiver will not reduce adjacent sorghum yield.

Acknowledgement

This project is funded by the National Landcare Program of Australia.

References

Grimshaw, R.G., 1994. *The Role of Vetiver Grass in Sustaining Agricultural Productivity*. International World Soils Congress, Acapulco, Mexico.

Laing, D.R. and Ruppenthal, M., 1991. *Vetiver Grass Newsletter #8*, June 1992, Asia Technical Department, The World Bank, Washington DC.

Yoon, P.K., 1993. *A Look See at Vetiver in Malaysia: A Second Progress Report*. Vetiver Newsletter #10, October 1993. Asia Technical Department, The World Bank, Washington DC.

Sagare, B.N. and Meshram, S.S., 1993. *Evaluation of Vetiver Hedgerows Relative to Graded Bunds and Other Vegetative Hedgerows*. PKV University, Akola, Maharashtra, India. Vetiver Newsletter #10. October 1993. Asia Technical Department, The World Bank, Washington DC.

Rao, K.P.C., Cogle, A.L. and Srivastava, K.L., 1992. *Conservation Effects of Porous and Vegetative Barriers*. ICRISAT, Annual Report 1992, Resource Management Program, 1992. International Crops Research Institute for Semi-Arid Tropics, Patancheru, Andhra Pradesh 502 234, India.

Vetiver in Wetland Research in Australia

Paul Truong, DNR, Queensland.

Due to its ability to thrive under water logged and flooded conditions, vetiver is currently being used in 2 wetland research projects in Queensland:

1- Pesticide Run-off Control Using Artificial Wetlands

Background and importance

A study into the use of wetland plants as bio-filters for pesticide contaminated run-off water is to be conducted as part of the BRIA (Burdekin River Irrigation Area) Wetlands Project. Pesticides applied to farmlands are essential to control weeds in crops, unfortunately the externalities that are involved in such practices dictates that the effects are wider reaching. For example, atrazine is recommended to be applied at a rate of 4-6L/ha as a pre-emergence weedicide to control broadleaf weeds. Consequently, the expected atrazine concentration rate in run-off water is 200 ug/L (Rice et al., 1997). This is considerable high as atrazine inhibits algal growth and photosynthesis at concentrations less than 1.0 ug/L (Spawn and Siefried, 1997).

Pesticide residues from weed control will primarily accumulate in sediments but other examples of adversely affected accumulators are algae, zooplankton and fish. The need for wetlands to control the amount of pesticides in run-off is essential for all aquatic life. Wetlands have demonstrated to be effective in reducing BOD, suspended solids, coliforms, nitrogen and sometimes phosphorus in controlled flow events (Raisin and Mitchell, 1996). Therefore it is not unreasonable to expect that a wetlands system will reduce pesticide concentra tions in run-off from farmlands as

well. The concentration of pesticides found in water bodies that enter wetlands depends on the amount of removal by volatilisation, photo-decomposition, microbial degradation and uptake by aquatic organisms. The ability to reduce the amount of pesticide in waterways by plant removal is of particular importance in this study.

The two pesticides under investigation are atrazine and diuron (both active ingredients) due to their use in sugar cane crops in not only the BRIA but also throughout Queensland and NSW. In particular, atrazine has been detected in the water and sediments of the BRIA Wetlands Project site at Clare Agricultural College, where artificial wetlands have been established since 1995.

Diuron and atrazine are formulated to control grasses and broadleaf weeds in pre-emergent plant and ratoon cane crops. Diuron is noted as being more persistent than atrazine in field situations (Hamilton, 1996) creating concerns for more than one run-off event containing detectable levels of diuron. Atrazine has a higher leaching potential than diuron therefore mobility within the soil profile is at a slower rate. This leads to surface layers containing unevenly larger amounts of diuron susceptible to run-off movement.

Objectives and Methods

The purpose for this study is to investigate the effects of pesticide addition to the growth of 4 emerged macrophytes: *Phragmites australis* (common reed), *Typha domingensis* (cumbungi), *Vetiveria zizanioides* L. (Nash) and *Schoenopliectus validus* (river clubrush). This study centres on plant growth parameters, for example leaf area index and water usage, as indicators to the viability of certain plant species in tropical wetlands. Further study into the quantification of pesticide uptake into the shoots and roots of Vetiver will also be undertaken.

The factorial pot trial will simulate wetland conditions, as plants will be growing in pots surrounded by a constant free water level (1.5cm). Each pot will be subjected to a single dose of atrazine or diuron at a zero, low (20 ug/L), medium (200 ug/L) or a high (2000 ug/L) rate. The pesticide will be applied to each of the four species, once adequate establishment of plants has occurred (approximately 6 weeks). Comparison within each species to pesticide rate responses is made possible using 3 repetitions.

Desired Outcome

During the course of the experiment it is hoped that plant growth will respond sufficiently under various rates of pesticide This will allow for future research into strategically placing these plant species into wetlands to reduce the effects of pesticide contaminated run-off. Vetiver may not only be suitable for bank stabilisation but also acting as a pesticide filter in the deeper margins of the wetlands.

Result to date

In a preliminary trial conducted to select suitable species for this trial, it was found that vetiver grew at least 4 times faster than other species in terms of leaf area and dry mater. The same growth rate is being recorded for the current trial where all species are planted in pots where the water level is kept constantly at 20mm above ground level. This is a very impressive growth and if found resistant to weedicide in run-off water as well vetiver would be an ideal plant for wetland application.

2- Atrazine Degradation in Wetland Systems.

In conjunction with the above study an additional experiment is being conducted into atrazine degradation in wetland systems. This will centre on the use of 3 wetland plants: Iris, Shoenoplectus and Vetiver, to determine the rate of atrazine degradation by these species as apposed to a non-plant system. Many studies have shown the ability of the wetlands to remove herbicides such as atrazine (Kadlec, 1994), but very little research has been done to investigate the specific role of wetland species in the degradation process. Redox potential will also be a factor in this experiment as under anaerobic conditions, found in wetland soil environment, the rate of atrazine degradation will be slowed compared to an aerobic system.

References

Hamilton, D. and Haydon G. (1996). *Pesticides and Fertilisers in the Queensland Sugar Industry – Estimates of Usage and Likely Environmental Fate.* Department of Primary Industries, Brisbane.

Kadlec, R.H. and Hey, D.L. (1994). Constructed Wetlands for River Water Quality Improvement. *Water Science and Technology,* **29**(4): 159-168.

Kruger, E.L., Anhalt, J.C., Anderson, T.A. and Coats, J.R. (1997). Phytoremediation of Herbicide-Contaminated Surface Water with Aquatic Plants. In: *Phytoremediation of Soil and Water Contaminants Symposium.* American Chemical Society, Washington, DC.

Raisin, G.W. and Mitchell, D.S. (1996). Diffuse Pollution and the Use of Wetlands for Ameliorating Water Quality in the Australian Context. In: *Downstream Effects of Land Use.* (Eds. Hunter, H.M., Eyles, A.F., Rayment, G. E.). Department of Natural Resources, Brisbane.

Spawn, R.L. and Siefried, B.D. (1997). Effects of Alachlor on an algal community from a midwestern agricultural stream. *Environmental Toxicology and Chemistry*, **16**: 785-793.

Sluggett, R. (1997). *Chemical Weed Control in Sugarcane.* Bureau of Sugar Experiment Stations, Brisbane.

VGT Applications in Queensland

From Paul Truong

Infrastructure Protection
The access road built to service a mountainous section of the railway between Brisbane and Toowoomba collapsed when torrential rain broke the drought in Southern Queensland in 1995.

Most unstabilised sections of this road cracked and landslip occurred resulting in heavy sedimentation of local creeks and streams and also blocking rural roads.

VGT was introduced as a low cost solution to the problem, in the stabilisation of road shoulder and steep batter, diversion of runoff water to stable outlets and trapping sediments. Results of these works were put to the test this summer (February 1999) when the region received the highest ever rainfall recorded over a one month period, with falls well over 100 mm (4 inches) overnight at times. VGT passed with flying colours, the access remained opened with only minor slips occurring in unprotected areas. The streams remained clear and both the local population and railway workers were very happy and impressed with the results.

By protecting the road from erosion, VGT also improved the safety of the railway workers and enhanced their work efficiency as water was drained off quickly, reducing drying off time.

In another project in tropical Queensland (Cape York Peninsula) Queensland Main Roads Department for the first time designed a new road section incorporating VGT as the main batter stabilisation method. The first planting was carried out on a highly erodible soil, which is highly dispersable and becomes powdery in dry conditions (bull dust), resulting in severe road shoulder and batter erosion.

Again the results have been outstanding, 3 months after planting both road shoulders and batters were stabilised by VGT despite occasional heavy rain including a small cyclone.

Mine Rehabilitation
On another front, VGT is gradually gaining ground in mine rehabilitation. Vetiver has been used successfully in Gold mine rehabilitation work to control both water and wind erosion, coal mine waste dumps (quarries, clay and sand pits) and most recently a Bentonite mine.

For more information on Australian vetiver research contact:
Dr Paul Truong, Resource Sciences Centre, 80 Meiers Road, Indooroopilly, Queensland 4068,Australia
Tel: (617 07) 3896 9304
Fax : (617 07) 3896 9591
EM: truongp@dnr.qld.gov.au

CHINA

Recent Trials with Vetiver in Hong Kong

R.D. Hill, Department of Ecology & Biodiversity, The University of Hong Kong. Email: RDHILL@hkucc.hku.hk

Vetiver has been used in Hong Kong for erosion control for almost 10 years, as has been reported in earlier issues of the *Vetiver Newsletter.* However, it has not been widely adopted for several reasons. First is the high cost of labor, about US$45 per day for unskilled workers. This has meant that Vetiver has no cost advantage over the well-established methods of hydro-seeding grass on bare slopes or planting trees, usually species of *Acacia.* Second is that there is a small but active contracting "industry" using hydroseeding, the proprietors of which, having invested in mixers, pumps and hoses, do not wish to use an alternative approach, especially one that is necessarily labor-intensive. Hydroseeding, usually onto cut slopes stabilized with geotextile, is regarded as effective, even though it suffers from some serious defects. The species used have flaccid leaves, especially when young, and while they offer reasonable protection from raindrop impact, they are not effective where concentrated overland flow develops and, of course, require about six weeks to become effective at all. A further disadvantage is that hydroseeding involves the pumping of a slurry of macerated paper, fertilizer and grass seed. It is thus limited to areas accessible to truck-mounted equipment though these probably account for four-fifths of the slopes to be treated.

The third reason why Vetiver has not been widely adopted is the desire by government agencies, which do most of the tree-planting, for a "one-shot solution", in a word, plant the trees and forget them. It seems easier to do this, using contractors, than to plant Vetiver hedges, which, to obtain optimal performance, require periodical cutting (burning is regarded as too dangerous) and fertilizer application. Contractors also view contour planting as "troublesome".

Fourth, there is the perception that the formation of terracettes behind Vetiver hedges may lead to a localized increase in the static load upon the slope and thus to slope failure. This is despite the fact that in nearly 10 years of trials, both by the author and by Dr Richard Webb under government auspices, there has never been any case of slope failure precipitated by slope overload.

tain virtually no nitrogen, are indurated when dry though friable when wet. They have low permeability. Whether moist or dry overland flow has been observed to begin within 10-20 minutes of the commencement of the area's characteristically sharp showers. Most of the slopes have lost between half and one and a half meters of material, more in gullies, as evidenced by vegetated "islands" perched above the general "soil" surface.

The main thrust of recent work has been to improve strike rates following planting, for these have been quite variable from site to site probably in response to weather conditions. Although Hong Kong receives an average of 2,224 mm per year, variability is substantial. However, whatever the total fall may be, the number of rain-days lies in the 90-120 day range annually. Dry spells can occur at any time of the year, the months of September through December sometimes having no rain at all. (However, earlier work has shown that there is probably sufficient residual moisture until October for Vetiver planting to succeed).

Until now bare-root planting, despite the major disadvantage of slow root development, has been the norm for several reasons. First would be the substantial labor cost of preparing slips and "pre-rooting" them in a nursery. Second is the cost and difficulty of obtaining soil for this process. Third would be the additional cost of transporting, say, polybags of slips and soil or mulch, to the actual planting site.

Experiment These considerations led to the decision to experiment with the use of a newspaper mulch for pre-rooting and planting out. Clumps of Vetiver were uprooted from the nursery and pulled apart into their constituent tillers, old or very young ones being discarded with stalky and dead material, the tops being cut to 20-25 cm and the roots to 5 cm. Newspaper mulch was prepared with tap-water in a commercial blender using torn-up paper. Three tillers were then bundled with about 100g of wet mulch, wrapped in newspaper and secured with a rubber band. Four treatments, each applied to 40 bundles of slips (i.e. 120 slips), were employed as follows:

A. no treatment (control)
B. 1g granular NPK fertilizer per bundle, applied when wrapped
C. 5m1 stock solution of 1GA rooting hormone (diluted at lml/l from solution as supplied), per bundle, applied when wrapped
D. 1g NPK and 5m1 1GA stock solution per bundle, applied when wrapped

The bundles were placed in separate trays and left out-of-doors in full sun of 21 days, following which the bundles were pulled gently apart and the number of new roots on each tiller counted. The bundles were then reconstituted using new wrappers and planted out on site three days later.

The results are set out in the following Table.

Number of new roots per tiller: Frequency by treatment

#	A	B	C	D
0	10	24	2	19
1	19	21	13	21
2	31	22	25	21
3	26	23	29	27
4	16	7	23	19
5	11	10	16	8
6	3	7	7	3
7	3	3	1	2
8	1	3	2	-
9	-	-	1	-
10	-	-	1	-
Total	120	120	120	120
Mean*	2.7	2.4	3.3	2.4
Mean SD*	1.0	1.2	1.0	1.5

*Calclated hill-by-hill

The treatment with rooting hormone (C) is clearly superior with no treatment at all (A) being quite satisfactory. The use of granular NPK, whether alone or with rooting hormone was not satisfactory. The granules were only partly dissolved and it was observed that in a number of cases the roots were chemically burnt. In addition the bundles in treatments B and D smelt strongly of sulphur compounds, presumably formed or released in a reaction with the newsprint as a result of the treatments. (Sulphuric acid is used in the manufacture of cheap papers and a residue remains after the paper is made). The implication of this is that fertilizer should be applied after planting out, not with the bundles.

Analyzed bundle-by-bundle similar results are obtained: A, average 8.1 new roots per bundle, B, *7.5,* C, 10.2, D, 7.2. Had the more time-consuming method of measuring the length of the roots been used, it is likely that the differences would have been even more striking for with treatment C many bundles had roots several centimeters long growing through the wrappers. This is important not only supplying nutrient from the soil but in quickly establishing resistance to flowing water which might dislodge the newly-planted slips.

It was intended that the bundles be planted out on site in a regular pattern that would enable their identification as to treatment, A-D, as they subsequently grew. Unfortunately, an error by an assistant at planting out has made such identification difficult. A further trial will therefore be made to monitor performance after planting out.

Vetiver For Water Eutrophication Control in Taihu Lake of China

Background of Taihu Lake Taihu Lake, one of the largest lakes in China is located at around N31.20' and E120.16' with a total area of 2,420 sq. km, total content for 4,870 million cubic meters, and inputted

Finally, there is a general reluctance amongst slope stabilization engineers to experiment with a method that relies upon natural processes to revegetate the bare slopes between hedges, one that if it fails may leave them financially liable. This fear to some degree applies even to hydroseeding and many engineers prefer to use "Chunam", a cement/clay mixture applied by pump to slopes as an almost dry plaster which immediately and effectively seals them. Aesthetic considerations do not enter into the equation.

However, there are significant areas distant from road access, where Vetiver can be used though erosion control has a much lower priority than in and near populated areas. In such areas the "traditional" approach has been to plant trees, in the past usually the local *Pinus massoniana,* now usually Acacias such as *A. confusa, A. mangium, A. auriculiformis.*

On some sites this has been reasonably successful though it usually takes 3-5 years for a closed canopy to form and even then it is clear that significant erosion continues. The architecture of Acacias is such that they initiate substantial stem-flow, certainly tens and possibly even hundreds of liters a day during rain. This results in local scouring. However, as the Acacia canopy closes, light levels at ground level clearly fall and this appears to reduce the ground cover often leaving only a thin litter of abscissed leaves. On steep slopes this readily washes downslope leaving the soil exposed to drip from the leaves and branches of the canopy. Work by Zhao in south China suggests that at high rainfall intensities drip is even more erosive than direct exposure to rain.

These considerations have led the author to persist with work on Vetiver hedges, especially on highly-eroded nutrient-poor substrates derived from weathered granite. These con-

flow of 195.0 cubic meters/sec., involving Jiangsu Province, Zhejiang Province, and Shanghai City. The Taihu Lake includes numerous smaller lakes, rivers, and channels. The Taihu region is a relatively developed area in the country with high population (986 persons/sq. km). Under subtropical climate, it has a mean temperature of 10∞ C and mean rainfall of 1,100-1,400 mm. With intensive land cultivation farmers harvest their crops 2 to 3 times a year under high chemical fertilizer input (N 345 kg/ha and P 18 kg/ha in average annually).

Water Eutrophication in Taihu Lake Based on the research in 1982-1990, the agricultural non-point nitrogen pollution in Taihu Lake was as high as 35,000 t N/yr, accounting for 25.20% of annual total N application, resulting in water eutrophication, while phosphor content and chemical oxygen consumption (COD) was relatively low. The water eutrophication is usually concentrated in the closed or semi-closed lakes and slow-flowing rivers (flow speed less than 1 m/min.), which account for about one third of the whole Taihu Lake. The eutrophication led to high content of N, P, and C elements in the water and nearby soils and resulted in rapid growth of blue algae, green algae, etc. Consequently, the algae blooms occurred while the water transparency and soluble oxygen content was declined, leading to the dead of many water living beings. In many places, a terrible smell was released from the water, influencing people's life.

Studies showed that in the period of 1981-1988, the content of NO3-N in the water of Taihu Lake was doubled. The content of NO3-N in the water of wells and rivers during dry seasons was increased, Ge Lake and Jiu Lake, the mean annual inorganic nitrogen content in the water was more than 0.25 mg/L, which was 2.5 times of national parameter of surface water. As a result, to control water eutrophication of Taihu Lake becomes a critical environmental issue in the region. ***Liyu Xu, Coordinator China Vetiver Network Email: lyxu@ns.issas.ac.cn***

Vetiver Grass For Water Eutrophication Control

Research indicated that vetiver cansurvive and grow well in wet land. It can grow much faster in the soil rich in nitrogen. Besides, vetiver has dramatic biomass up to 176,798 kg/ha to 353,596 kg/ha in 6 months (P.E. Lgbokwe, 1991) which can consume nitrogen considerably in the soil along the lake and in the area where water surface fluctuate seasonally. Because the high nitrogen content is more concentrated in the water near the banks of rivers and lakes, planting vetiver grass in wet land along rivers and around lakes can relief eutrophication problem as vetiver contains 0.44-0.68% crude protein and 0.068-0.076% P (R.D.Hill, 1992). The vetiver grass planted on banks and slopes along rivers and around lakes can reduce soil erosion caused by backwash generated by boat traffic. Besides, the grass will be harvested for pulp at a price of 80 Yuan RMB /ton dry matter (about USD10), which can increase farmers' income.

The research will include plot tests and in situ study and last 2 years supported by the Institute of Soil Science, Academia Sinica. ***Liyu Xu, Coordinator China Vetiver Network. lyxu@ns.issas.ac.cn***

Vetiver at China Super-way Conference

The China's national super-way conference titled Super-way Construction and Development Conference was held on 26-29 November 1998. The conference was organized by China Highway Engineering Society. The vetiver grass formed an important component of

the conference. During the conference the China Vetiver Network introduced the characteristics of the grass and the technology of applying the grass for highway embankment protection and erosion controlling along the highway slopes. Multiple vetiver publications were distributed. Typical examples of using vetiver for highway stabilization in Guangdong, Yunnan, Fujian Provinces were introduced. Grass samples and a set of photos were exhibited. The representative of CVN suggested that the environment should be one of the main parameters before the new road was checked and accepted, and mentioned that a proposed workshop on highway embankment protection and slope stabilization in 1999. More than 90 participants attended the conference coming from highway engineering institutions, universities, and construction companies through out China. Some detailed descriptions on the grass behavior and application in Yunnan Province was presented. During the conference, some participants went to AnNing to visit the demonstration site.

In the past, the highway institutions were used to protect the highway embankment with rocks or sometimes with short grass which usually could not stand long time. The grass generated great interests in the participants. The Highway Science Institute of Communications Ministry planned to establish a large demonstration for several dozens of kilometers. Many participants from northern China were also expressed to test vetiver.

The conference decided that the activities of China Highway Engineering Society will include three subjects: road surface, road embankment, and environment, in which the latter two subjects involving vetiver technology. Some participants said that the most impression issue from the conference was that they knew the miracle grass vetiver.

Email: lyxu@ns.issas.ac.cn

Vetiver Research and Development -- Published

Vetiver Research and Development, a proceedings of the International Vetiver Workshop held in Fuzhou of China in October 1997 was published by Agricultural Science Tech Press of China in Beijing. It included 4 parts: General description, Growth behavior and utilization, Vetiver for soil conservation, Reproduction and perspective. There are altogether 37 articles, most of which were written by Chinese scientists and extensionists. It contain 200 pages with 86 tables, 39 figures, and 28 photos. The Proceedings was published in Chinese, and its English version is to be published when funds available. ***Liyu Xu, Coordinator China Vetiver Network Email: lyxu@ns.issas.ac.cn***

Vetiver in Agriworld

The miracle grass vetiver was distributed into Agriworld as one of the most important component of modern agriculture and forestry technology this spring in Suzhou of Jiansu Province of China. Over 10,000 tillers of vetiver planting materials were transported to and planted in the Agriworld in March 1998. After 5 months' the grass grew pretty well without any management. It could stand both dry and water logging. Now, the Agriworld is going to propagate the grass and as a modern technology to disseminate vetiver technology to the whole country.

The Agriworld is an abbreviation for Suzhou Future Agriculture and Forestry World supported by Singapore WBL Co., Ltd., which was situated on the east bank of Taihu Lake. With 3,000 Mu (200 hectares), the Agriworld is to demonstrate the most modern agricultural technology in the world to Chinese farmers and to analyze and introduce development tendency of agriculture into China. The Agriworld will help upgrade China's agriculture by collecting and providing scientific information and personnel, explore and design the direction of China's agricultural development, promote the exchange of international scientific and economic issues. ***Liyu Xu, Coordinator China Vetiver Network Email: lyxu@ns.issas.ac.cn***

Insects on Vetiver Hedges

Chen Shangwen (Guangxi University, Nanning, China 530001)

Summary. *Vetiveria zizanioides* (L.) Nash is a perennial plant. In order to conserve and also effect better usage of the natural resources of insects, the author carried out an investigation of insects on vetiver hedges, from March to November 1998 in Guangxi Province of China. The results showed as follows:

In 211 days of investigation, 1225 common species of insects were found in Nanning suburb of Guangxi Province, of these there were 79 species on vetiver hedges. These insects were came from 53 families of 13 orders. There were 14 species from Hymenoptera, 11 species from orthoptera, 10 from Diptera, 9 from Homoptera, 9 species from Lepidoptera, 9 from Coleoptera, 5 from Odonata, 4 from Hemiptera, 3 from Mantodea, 2 from Blattaria, 1 from Isoptera, 1 from Dermaptera, and 1 from Collembola.

Under the environmental conditions of Nanning of Guangxi Province of China vegetables and flowers are widely cultivated. Of 79 species of insects on Vetiver hedges, insects eating vetiver leaf in test tube are locust, snoutmoth, tussockmoth and leaf beetle. Owing to a tiny population density and limited amount eaten these insects did not cause negative effect on vetiver growth. On the contrary, beneficial predators

(total 30 species) were attracted to the vetiver hedges, such as mantids, dragonfly, ladybug etc. — all are important predator insects of garden, agriculture, and forestry pests. Therefore, the author suggests that when vetiver is introduced to a new environment it would be appropriate to practice integrated pest management (IPM). Due to the short time of survey, the above conclusion needs verification by further research. (Full paper on web site at **www.vetiver.org**)

The First Highway Vetiver Contract Implemented In China

The first contract on the highway embankment protection with vetiver was signed and implemented in Nanping of Fujian Province of China. During the International Vetiver Workshop held in Fuzhou of China in October 1997 Mr. Diti Hengchaovanich introduced the successful experience of using vetiver for engineering purpose. After that the China Vetiver Network (CVN) disseminated his experience to numerous institutions involving in highway, railway, mining, quarry, etc. through out the country. In August 1998, the directors of the highway bureaus in 10 counties or cities in Nanping Prefecture of Fujian Province held a meeting to discuss the possibility of using vetiver for highway protection. In the meeting the director of Jianyang City Highway Bureau introduced the results and experience of using vetiver for highway embankment stabilization and rice field protection in Jianyang, which was conducted in 1997/1998 by Mingbei Agricultural HighTech Institute. A mid-meeting tour was organized to visit the protection site. Then a decision was made to establish a large demonstration on the National highway of No.316 in the most critical section where the soil was extremely poor and re-vegetation failed. The directors and engineers considered that if this demonstration could be successful, there were no problem in other places and more highways will be protected by vetiver grass.

A contract was signed after the meeting on 26 August 1998 between Nanping Highway Bureau (Party A) and Mingbei Agricultural HighTech Institute (Party B). The followings are some main contents:

1) Party A and Party B realized that it was an excellent thing to use biological methods to protect highway and nearby farm fields, while vetiver would be the first consideration of the plant to be used.

2) The demonstration section would be on the national highway of No.316: k109 + 800, and K120 - k121, with total area for 10,000 sq. meter (the sloping area). Party A would provide Party B 5 Yuan RMB x 10,000 sq. meter = 50,000 Yuan RMB. Party B would be responsible for the planting of vetiver grass, which would be completed within the period from mid-September to early October 1998. Vetiver would be planted honey combed, spacing 2 x 0.2 m. Each hole (clump) would include 3 tillers or more. Other spices of short grasses would be planted in between. The survival rate of the planted grass would be 80% in the first year of 1998, and 95% in 1999 after replanting. The roots of vetiver would be at least 25 cm deep at the end of half year since planted and 50 cm one year since planted.

3) Payment: the 50 % of the total payment would paid when the grass was planted; 30% would be paid half year later; and 20% would be paid one year later since first planting.

4) Party B would not be responsible for the possible collapse or landslides. If it happened Party B would replant grass on the additional charges from Party A. Party A was responsible to keep animals and human away from possible damaging. ***Liyu Xu, Coordinator China Vetiver Network Email: lyxu@ns.issas.ac.cn***

Vetiver: An Authorized Grass For Highway Stabilization

An official document was prepared and released by Highway Bureau of Fujian Province of China on 8 July, 1998. The document fully approved the function of vetiver for highway embankment stabilization and asked all highway institutions, offices, and departments at county and prefecture level throughout the province to study vetiver technology and to use vetiver for highway stabilization and erosion control. The document requested all institutions to strengthen the exchange of ideas and experience in order to extend the grass throughout the province more rapidly.

There are 3 prefectures, 16 cities, and 54 counties in Fujian Province with a total area for over 120,000 sq. km. The Province is northeast of Taiwan with many mountains and hills accounting for more than 90% of total land area. There has been a rapid development of highway construction. For example, in Fujian Province 4,000 km of highways were built during the period of 1992 - 1996. The highways were usually constructed on the deeply weathered granite, from few meters to several dozens of meters deep, and were subject to soil erosion and collapse, leading to damaged highways and new soil erosion area along the highways. To protect highway engineers had to use rock and concrete for the critical sections of the road embankment. There are 2.6 million sq. meters of road embankment slopes that need to be protected in Fujian Province. However due to financial constraints, there was only a very small percentage of the slopes protected. Following the International Vetiver Workshop held in Fuzhou, the capital of Fujian Province, in October 1997, the vetiver technology was intro-

duced to the highway authority of the province. They realized that the Vetiver Grass Technology was a cheap and effective way for highway embankment stabilization. As an attachment, the document also included the article titled Vetiver Technology Application in Engineering Aspects which was translated from the paper written by Diti Hengchaovanich of Thailand**. *Liyu Xu, Coordinator China Vetiver Network***

Email: lyxu@ns.issas.ac.cn" ***lyxu@ns.issas.ac.cn***

Study On Ecological Characteristics Of *Vetiveria Zizanioides*

Xia Hanping, Institute of Applied Ecology, Academia Sinica, South China Institute of Botany, Academia Sinica, May 1999 : x i a h a n p @ 1 6 3 . n e t " xiahanp@163.net

Abstract

Vetiver (*Vetiveria zizanioides*), a miracle grass, has been widely disseminated and applied around the globe due to the facts: 1) it has very high tolerance to adverse conditions; 2) it has an wide adaptation to climate and soil; 3) it has significant effects on: erosion control, polluted-environment mitigation, soil amelioration and so on. Over the past 14 years, scientists and researchers have carried out many studies on this unique plant and gained substantial achievements. On the basis of the past research, the author conducted further research on the species, and obtained the following results:

The experiment on leaf electrical conductivity showed that the resistance of three species of plants to adverse conditions, including drought, and high and low temperatures, was *V. zizanioides* > *Paspalum notatum* > *Alternanthera philoxeroides*. Especially when the period of stress was longer or the stress factors are stronger, the high resistance of *V. zizanioides* showed more prominently. As compared to *P. notatum* and *A. philoxeroides*, *V. zizanioides* had the characteristics of high-intensity and sustainability in respects of tolerance to extreme environments.

The three species had few or no distinct differences in their tolerance to salt when experimenting with in vitro leaf, whereas they presented an evident sequence of *V. zizanioides* > *A. philoxeroides* > *P. notatum* in this aspect when experimenting with seawater irrigation. Soil ECse values for 90% biomass yield of *V. zizanioides P. notatum* and *A. philoxeroides* were 6.40, 4.32, and 5.12 dS m^{-1} respectively, and those for half yield were 20.94, 11.45 and 16.17 dS m^{-1} respectively. *V. zizanioides* and *A. philoxeroides* were the tolerant group, and *P. notatum* was moderately tolerant, to salt. In sum, the three species were all relatively strong-resistant plants.

Effects of salinity on the growth of *V. zizanioides*, *A. philoxeroides* and *P. notatum* were quite conspicuous, and both Na^+ and Cl^- were probably the direct factors influencing their growth and development. Contents of Na^+ and Cl^- in plants, especially in shoots, increased with increasing level of salinity, and had negative correlation with leaf area, plant height, biomass. However, Na^+ and Cl^- did not substantially influence leaf photosynthetic pigments. Photosynthetic pigments increased as contents of plant Na^+ and Cl^- rose when the latter was relatively low, and reduced as contents of plant Na^+ and Cl^- rose when the latter in plants were relatively high, but their decreased scopes were much less than those of biomass. It is suggested that a reduction in photosynthesis could be due to feedback inhibition by high sugar concentrations in mesophyll cells resulted from high salt concentrations, but could not be limited directly by Na^+ or Cl.

Different plants have different salt-resistant mechanisms. *V. zizanioides* was characteristic of avoidance to salt, and kept a great part of salt, particularly Na^+, absorbed in the roots. The mechanism of salinity resistance in *A. philoxeroides* was increasing water content and diluting salt in tissues, and moreover it leaves seemed to become thicker, so it was characteristic of tolerance to salt. *P. notatum* had a huge capacity to salt, and probably it could exclude extra salt, through salt glands and through accelerating the death of old leaves, to resist salt harm and there was characteristic of secretion to salt in *P. notatum*.

The pollution caused from urban garbage and its leachate on the environment is becoming an increasingly prominent problem in the process of development of Guangzhou City. Wastewater leached from Likeng Life Garbage Landfill of Guangzhou contained high concentrations of pollutants, and did not reach the effluent standard, and therefore could be harmful to plants and surroundings. Of four plant species investigated in this study, *Eichhornia crassipes* was poisoned to death in two types of wastewater tested; *Paspalum notatum* could not survive in the high-concentrated leachate (HCL) and was severely damaged in the low-concentrated leachate (LCL); *Alternanthera philoxeroides* was impaired in HCL, too, but it formed a considerably large biomass in LCL, which was possibly due to the result that LCL may have efficiency of eutrophication; *Vetiveria zizanioides* was also damaged by the leachates, but was the least of the four species. The tolerance of the four species to garbage leachate was ranked as *V. zizanioides* > *A. philoxeroides* > *P. notatum* > *E. crassipes.*

Of the two species growing relatively better in wastewater, *A.*

philoxeroides on the whole was superior over *V. zizanioides* in purifying LCL, especially in purifying total N and nitrate N; but the effect of *V. zizanioides* in purifying seven kinds of "pollutants" of HCL were all better than that of *A. philoxeroides*, and furthermore the purification of P and COD in LCL by *V. zizanioides* was, too, better than by *A. philoxeroides*. Of all seven items measured in the study, ammoniac N was the best cleansed, and its purification rate was between 77%_89%. *V. zizanioides* showed a quite high purification rate for P, more than 74%. From the research, we suggest that *V. zizanioides* and *A. philoxeroides* could be used as purifying plants to assist in purifying the high and low concentrated garbage leachates respectively.

However, the amounts of purification by plants were absolutely unequal to the amounts of uptake by them; as a matter of fact, the latter accounted for only one limited part of the former, some 26%_73% for N, 88%_94% for P, and 33%_96% for Cl^-. Moreover, the ratio of the amount of uptake to the amount of original leachate was lower. This indicates that the main approach to remove wastes, with exception of uptake of roots, contains adsorption of roots, and subsidence, conglomeration, volatilization of elements, and influence of micro-animals and microorganisms in water, etc. In a word, the plant purification of waste water is in fact a comprehensive influence of the rhizospheric microecosystem on pollutants.

Three plant growth retardants, B9, PP333, and CCC, all had influences on the growth, development, tiller formation and inflorescence of vetiver grass; but different kinds or concentrations of retardants produced distinctly different effects on the respects. The three medicaments all promoted tiller formation, up to 11% _52% or so in a growing season. 8 g L^{-1} B9 also retarded the growth of vetiver by 6%, delayed flowering for nearly 10 days, and reduced the number of inflorescence significantly by 80% at the same time, as compared to the control; but 4 g L^{-1} B9 hardly retarded the growth and flowering except that it, too, reduced the number of inflorescence, up to 50%. However, PP333 with concentrations of 0.6 and 1.2 g L^{-1}, and CCC with 1.0 and 2.5 ml L^{-1} all promoted the growth of vetiver, up to 5%_22% or so; and furthermore, the treatment of 1.2 g L^{-1} PP333 also enhanced inflorescence by 31%, and 0.6 g L^{-1} PP333 promoted flowering 4 days earlier than CK did. The results abovementioned indicate that B9, as the retardant of vetiver, had better effects than PP333 and CCC. The reason why B9 had relatively better effects resulted probably from its relatively higher applying concentrations, which not only increased the cost, but produced environment pollution as well.

This field trial showed that impacts of the plant growth retardants on vetiver were obviously different from on most crops, which is most likely that vetiver has strong resistance and accordingly the retardants do not produce clear influence on it. In sum the plant growth retardants can efficiently promote the tiller production of *V. zizanioides*, but cannot dwarf it effectively. Therefore it is necessary, also meaningful, to seek new vetiver dwarfing mechanisms or methods, such as gene mutation.

Highway slippage not only blocks the traffic, but also endangers the safety of lives. The general way for inhibiting slippage is to take stone-based projects, which not only is expensive, but also has quite limited eco-benefits. The Vetiver Eco-engineering was applied in South China for the first time to control landslides and protect highways. Vetiver planted in slopes of highways, under some cultivation and management measures, grew rapidly and luxuriantly and formed dense hedgerows. These appropriate cultivation and management measures include planting along the contour, reasonable spacing, applying fertilizer, especially basal manure, etc.; irrigation is not necessary if the Eco-engineering is conducted in rainy season. The Vetiver Eco-engineering is quite effective for stabilization of slopes and embankments, and furthermore it costs no more 18% than the stone-based technique does. Other species in the Vetiver Eco-engineering, including trees, shrubs, herbs and vines also aided vetiver to mitigate runoff, inhibit erosion, stabilize slope as well as afforest and beautify highways. In a word, the application of the Vetiver Eco-engineering in roadcut and embankment protection produced quite good ecological, social and economic benefits, which indicates that the Eco-engineering will have a broad application perspective.

Plantings of vetiver plus local species of trees, shrubs, herbs and lianas with strong resistance and adaptability, and supported by simple engineering structures where necessary, form "The Vetiver Eco-engineering". All experiments and applications conducted in highways, including the Conghua section of China National Highway No. 105, Tianluhu section of Guangzhou First-Ring Highway and Huadu section of CNH No. 106 have indicated that the Vetiver Eco-engineering provides better ecological effectiveness in respects of slope stabilization, environment mitigation, beautification and the like than just vetiver planted alone. Therefore, it is suggested that the term Vetiver Hedgerow Technique should be substituted with the Vetiver Eco-engineering.

It is generally believed that vetiver grass is native to India and the cultigen domesticated in China was introduced from India and Indonesia in the middle 1950's. However, there have been natural distributions of wild vetiver all long in Guangdong

and Hainan of China. Particularly in the 1950's, a total area of up to 6670 hm^2 natural vetiver community was found in Wuchuan County, Guangdong. This tropical grassland, however, has been severely destroyed due to the effects of human activities and the excessive utilization, which has been rapidly dwindled over the last 40 years. Therefore, it is very meaningful, and also urgent, to protect the vetiver wetland through demarcating a reserve *in situ*. This would not only efficiently protect bio-resources and biodiversity, but would also offer an ideal basis for conducting research on vetiver and tropical wetland in South China.

Vetiver from the Wuchuan Wetland had been regarded as *V. nigritana* during the past 40 years. The specimen study in the paper, however, indicates that it is *V. zizanioides*, not *V.* nig*ritana* or other species. But then it has already prominent differences with the cultigen in aspects of growing habit and genetic feature, so it has become another completely different ecotype or genotype.

There have been poorly documented about the origin and genealogy of vetiver, and the taxonomic system the genus *Vetiveria*, currently, is far from consummate, so the basic research in this area should continue. In addition, there is also lots of work to do in aspects of vetiver's biodiversity and the preservation and utilization of its germplasm.

On the whole, *V. zizanioides* is an indeed excellent species with reference to its resistance to adverse circumstances, and its ability to alleviate polluted-environments and inhibit soil erosion and runoff.

China Vetiver Network (CVN) Annual Report (1998)

Email: lyxu@ns.issas.ac.cn

The year 1998 is an unusual year for vetiver technology development and dissemination through out China. In 1998, the CVN's work focused on the following points: the continuation of vetiver technology dissemination to most of the provinces in southern China. Many new applications were tested, such as the uses of vetiver for vegetation recover on sandy dune in Poyang Lake area, recovery of copper mines, and vetiver for river bank stabilization. More and more institutions were involved in vetiver tests and application. However, one of the most inspiring issues is that the grass has given deep impression to engineers who are working in highway and railway institutions, as they realized that the grass could be economically and effectively used for highway and railway embankment stabilization.

Information dissemination. Although many thousands of copies of vetiver publications were released countrywide in the past few years, is still a strong demand for vetiver information dissemination. As a large agricultural country, there are thousands of research institutions at from national to provincial to prefectural level. Besides, there are many thousands of extension stations at county and township level involving agriculture, forestry, soil and fertilizer, soil and water conservation, etc. Besides, there are also thousands of institutions involving in engineering subjects and also ecology and environment. Therefore, information dissemination should be a top item in a long term.

In 1998, we continued to publish and distribute the following publications:

- Vetiver Newsletter in Chinese, 4 issues, totaling 4500 copies were disseminated.
- Vetiver Fact Sheets, 4 issues totaling 8000 copies that introduced substantial technology to extension stations were mainly distributed to county extension stations.
- Agroforestry Today. A quarterly journal in Chinese published for 6 years, in which vetiver grass technology is a major component. The average circulation remained around 1000 copies.

Besides, Vetiver Research and Development, a Proceedings of International Vetiver Workshop (Fuzhou, 1997) with over 200 pages, was published in Chinese by Agricultural Science Tech Press of China.

In 1998, CVN also introduced vetiver through other multiple national or regional communication mediums, such as:

- Chinese Journal of Ecology,
- Soil and Water Conservation,
- Soil Science,
- Soil and Water Conservation in Fujian,
- Science of Jiangxi Province,
- Resources and Environment in the Yangtze Valley,
- Reference Information,
- Huangshan Daily.

To disseminate vetiver technology, multiple meetings and training courses were organized, co-organized, or participated by CVN and its members, such as:

- South China Soil and Water Conservation Meeting (Xiamen),
- Soil Erosion and Conservation Workshop (Jiangxi),
- Vetiver Network Meeting of Fujian Province,
- Yangtze River Flooding and Soil Conservation (Wuhan),
- Sustainable Agriculture in Yangtze River Basin (Nanjing),
- Vetiver for Edible Fungi Cultivation (Fuzhou),
- One-day Training Courses in Fujian and Anhui Provinces, etc.

Vetiver introduced to highway institutions. During the International Vetiver Workshop, organized in Fuzhou, October 1997, Mr. Diti Hengchaovanich of Thailand introduced vetiver application in engineering aspects, which generated high interests in participants. Most of them realized that there is a great potential for vetiver in highway and railway construction and maintenance. Because there has been a rapid development of highway and railway construction in China vetiver could play an important role in the embankment stabilization and controlling the erosion caused by road construction. As a result, since the beginning of this year, we decided to introduce vetiver technology to highway institutions, representing the engineering field, andwas divided the process into three steps:

- disseminatation of vetiver information to highway and railway institutions;

- designing and establishing large demonstrations showing how the grass can stabilize highway embankments and protect farm land from erosion and sediments adjacent to the roads, and the demonstration of methods of proper application of the technology.
- organizing a conference, in cooperation with national highway research institute and highway bureau to show engineers the examples.

To achieve this target, multiple measures were taken by CVN and its friendly members throughout the country:

CVN translated the article on vetiver grass in engineering application written by Diti Hengchaovanich into Chinese and distributed to 1200 highway institutions via our Vetiver Newsletter.

- In cooperation with experts and engineers from Highway Bureau of Jiangsu Province, and Survey and Design Academy of Communications of Jiangsu Province, we prepared articles to introduce vetiver and its application in highway aspects. These articles were published in several highway journals as:

- The Journal of Jiangsu Provincial Highway Society
- The Journal of Guangdong Provincial Highway Society
- The Journal of East China Highways
- Science and Technology of Communications of Zhejiang Province (to be published)
- CVN introduced vetiver at several regional and national highway conferences, such as East China Highway Conference in Xiamen in June 1998, National Superway Conference in Kunming in November 1998.

Following the above information dissemination many engineers started to accept and test the grass. Again, just like the wide application of vetiver for erosion control, riverbank stabilization, sandy dune fixing in Fujian Province, the Fujian Highway Bureau acted as a pioneer to accept the grass for highway embankment stabilization. On 8 July 1998, the Highway Bureau formally issued a document to ask all highway institutions through out the province to use the grass to protect the embankments. So, Fujian Province became the first to authorize vetiver as a grass for highway stabilization in China, and possibly in the world.

Following Fujian Province, the highway bureaus of Jiangxi Province, Zhejiang Province, and Hubei Province are also testing vetiver on different level highways and in different area.

Demonstration of vetiver for highway embankment stabilization and paddy field protection was established in Jianyang County of Fujian Province in 1997 and enlarged in 1998. A large demonstration is to be established in Fujian by Ms. Zhangjing of CVN and Fujian Highway Bureau. During the East China Highway Conference held in Xiamen in June 1998, a special national highway conference titled Vetiver for Highway Embankment Protection and Slope Stabilization was proposed to be held later 1999 in Fuzhou in cooperation with national highway research institute and Fujian Highway Bureau. Looking is better than hearing. The conference participants will watch demonstration, exchange information, and then distribute vetiver technology more widely in highway field though out the country. Although agriculture and engineering were two independent kingdoms here in China, we are very pleased to see that vetiver enabled scientists and engineers to join together for solving a same problem soil erosion control and slope land stabilization, although it is only an initiation.

New applications and new users. The International Vetiver Workshop held last year familiarized more people with the grass. In order to support more person to test and use vetiver we released mini-grants. There were total mini-grants for US$ 10,375 distributed to 17 recipients in 7 provinces in 1998. In addition, CVN organized one million planting materials during the spring of 1998 and transported to 14 institutions in 9 provinces free of charge. All of these encouraged more scientists and technicians to test and use the grass. So far most of the recipients sent us feedback and used the mini-grants and/or planting materials very effectively and successfully. As most of the recipients were those who did not know or did not see the grass before, the first thing they did when they had received planting materials was to establish nursery for reproduction. Also, there were some recipients who arranged and conducted various tests or experiments with limited and valuable planting materials and re-distributed

planting materials to their neighboring institutions. The followings are the short description of new applications:

Fujian Province. Ten hectares of demonstrations were established on saline sandy soils of Pingtan Island aimed at using vetiver to improve soil property and reduce salt contents. Meanwhile, the grass was planted as living fence along home gardens and roads to relieve harmful effect of wind /sandy storm to the village. The prunings were used as fodder.

In addition to a small demonstration for 4 km for highway stabilization and 100 ha for slope tea and fruit tree protection in Jianyang County, in cooperation with Fujian Highway Bureau, three sections of highways with different construction standard were selected as large demonstration sites based on a joint field survey. A 10 ha nursery was established to provide high quality planting materials. The latter is very important for highway embankment stabilization because the condition along most highways is usually bad, particularly where the soil nutrients are poor and moisture retention is limited, and usually contains harmful chemicals. As a result, the planting materials should be of high quality and planted carefully.

Following the International Vetiver Workshop, the Fujian Provincial Vetiver Network was established in November 1997 aiming at information exchanging, allocating planting materials, coordinating different institutions involving in agriculture, forestry, highway construction and maintenance, mining, etc.

Guangdong Province. Several new nurseries were established which can provide millions of planting materials for the year 1999. The grass was planted in coastal islands to fix sandy dune. The tests indicated that grass was much better than the traditional tree belt wood (Casuarina equisetifolia L.). A demonstration of using vetiver for highway stabilization was implemented at the national highway No.106 near Guangzhou where the cut was 26 m high with 50 m of slope. More research was conducted on the effect of salt on vetiver; vetiver nanization with growth regulator; vetiver propagation with tissue cultivation.

Additionally, supported by National Natural Science Foundation, a new project is to be launched, studying the effect of heavy metal elements on vetiver in order to use vetiver to ameliorate metal mine wastes.

Hubei Province. In Hubei Province which is situated in central China and suffered from serious flooding in 1998, the grass was tested in three places: Luotian County, Huanggang City, and Machen City. All of these places belong to Poverty Area of the Dabie Mountain where soil erosion was proved to be serious. In Luotian County, the Huanggang Prefectural Soil and Water Conservation Institute established a nursery on the terrace. The grass grew extremely well. It was over 3 m high after 6 month's growth. Besides, the grass was also planted on the edges of the terraces. Unfortunately most of them were only around 40 cm high caused by repeated grazing of cattle and goat. It seems that these animals were fond of eating vetiver especially when it was young. Even the 6-month old grass cut from the nursery still attracted the goat. Hence, in sub-tropical area where there were less species of grass for animals, vetiver could be a prospective source of fodder.

In Huanggang City, the grass was successfully used to protect the new terrace that was 1 m deep and 4.5 m wide in average. Although it was only 6 months since it had been planted after long distance transportation by train for over 20 days, it is quite evident that the grass experienced a very good example for soil erosion control, especially where soil was deeply disturbed such as newly established terraces.

In Machen City, the Soil and Water Conservation Station of Machen City established a demonstration. The grass was contour-planted on river banks consisting of pure white sands where there was very little water and nutrients. They all grew well and exerted as a pioneer plant for vegetation recovery. Even though cattle repeatedly grazed vetiver it grew much better than local wild weeds. There is a long distance of river bank in the city, i.e., 280 km, most of which consisted of white sands subject to breaching during the flooding season.

All of these tests showed that the grass had high survival rate even after long distances and long time transportation. The only problem is that they had fewer tillers (about 1:10-1:50) than that in Fujian Province (1: 80) as all of the planters did not prune the grass because they worried that pruning might be harmful to vetiver. All of the planters will enlarge their planting area and distribute the grass to their neighboring area in next spring. There were more than a dozen of counties in Hubei Province of Dabie Mountains visited the vetiver plots and asked for planting materials for testing.

Jiangxi Province. In Jiangxi Province, the grass was planted on sandy dunes formed by the river in order to establish an example for desertification control in sub-tropical China. The grass was planted in lines with a space of 5 m between rows. The groundwater table was high but the soil was short of nutrients. Therefore, agricultural production there became impossible. Further more, there was an obvious tendency that the desertification is accelerating. Although the height of most of the grass was around one meter after one growing season, evidently the grass played an impor-

tant role in dune stabilization and the vegetation recovering. Since vetiver planted more grasses were found on the plots than the control. That is vetiver helped other grasses to grow on the barren land.

Another inspiring issue was that there was an excellent demonstration of using the grass for embankment stabilization at the highway of Nanchang-Jiujiang, where the slope was about 10 m high in which the lower 2 m was protected by stone and the remainder protected with honey combed grass.

Chongqing Municipality.
Chongqing Municipality is situated at the upper reaches of the Yangtze River, belonging to the Three Gorges area. Accordingly, soil conservation became a critical issue to reduce the harmful effect of sediments to the dam and to diminish the losses caused by heavy flooding in the lower reaches. Supported by local government vetiver was introduced to the area, to have been used as pioneer plant for afforestation, controlling new soil erosion caused by resettlement of immigration, and retaining sediments on lower land.

Since the establishment of the Municipality highways have been constructed on a large scale in the Three Gorge area. However, most of the highways were along migrating rivers and a lot of soil and rock fall into the river and caused further risk of slope collapse and point erosion. Vetiver was selected as a priority species for vegetation recovery and slope stabilization. The Fuling Forestry Institute has actively involved in the coordination of vetiver technology development in this area.

Shanghai Municipality. In Shanghai, vetiver was introduced and experimented by Shanghai Agricultural Academy starting from the spring 1998. They received planting materials from Jiangxi Province and also from Mr. Diti in Malaysia.

Eleven tillers from Malaysia was planted and grown in green house from 17 February to 9 April. The tillering was 1:1.8 and the height was 15 cm in average at the end of this period. Then the grass was removed outside the greenhouse. Observation on 22 May indicated that survival rate was only 60% with 12 cm high. But later it grew as well as the vetiver from Jiangxi, except that it was shorter. It remains to be known that if they can withstand winters in Shanghai.

The planting materials from Jiangxi were tested at several sites with different living conditions: nursery, river bank, pots, and orchards on slope land of Zhejiang Province. General speaking vetiver grew well at all of these sites, it could compete successfully with local weeds, and could withstand drought and waterlogging. They produced fewer tillers (from 1:8 to 1:20) compared with that in Fujian Province. In the coming year of 1999, the grass will be planted in a larger scale for Shuzhou River management and garbage yard covering, depending on the quantity of planting materials.

Jiangsu Province. The miracle grass vetiver was distributed into Agriworld as one of the most important component of modern agriculture and forestry technology this spring in Suzhou. Over 10,000 tillers of vetiver planting materials were transported to and planted in the Agriworld in March 1998. After 5 months the grass grew pretty well without any management. It could stand both drought and waterlogging. Now, Agriworld is going to propagate the grass and as a modern technology to disseminate vetiver technology to the whole China through its information service system.

The Agriworld is an abbreviation for Suzhou Future Agriculture and Forestry World supported by Singapore WBL Co., Ltd., and is situated on the east bank of Taihu Lake. Comprising 3,000 Mu (200 hectares), Agriworld will demonstrate the most modern agricultural technology in the world to Chinese farmers and will analyze and introduce development tendency of agriculture into China. The Agriworld will help upgrade China's agriculture by collecting and providing scientific information and personnel, explore and design the direction of China's agricultural development, promote the exchange of international scientific and economic issues.

Besides, multiple tests and experiments have been implemented in Jiangsu Province:

- Vetiver was tested for wet land utilization in Wuxi City by the Limnology Institute of Academia Sinica.
- Supported by Director's Foundation of Soil Science Institute of Academia Sinica, vetiver was to be used for eutrophication control in Taihu Lake.
- Pot test was conducted in Nanjing for vegetation recovery of copper mine wastes.

Guangxi Province. In Guangxi Province, vetiver was mainly introduced and tested by Guangxi University and the Science Bureau of Du'an County. The grass was planted in nursery and water reservoir area. The experience from Du'an confirmed that the grass could withstand serious drought and long term waterlogging. The grass was planted on 1 April 1998. There was heavy water logging on three occasions: from 11 to 16 May with water depth for 50 cm above ground surface; from 23 to 30 June for 80 cm; and from 25 July to 5 August for 150 cm deep. Later, since1 September there was a long period of drought for 2 months. Investigations at the end of October showed that vetiver still grew well with 2 m high, while the elephant grass which was planted at the same time died

during the first waterlogging. As a result, the county leader planted to develop a larger nursery in 1999 to produce more planting materials in order that the grass can be planted on a large scale in the year of 2000.

It is worth emphasizing that Du'an is national poverty county and they planted the grass with their own tight budget. Some other poverty counties, such as Bama County, are also searched for planting materials for the application with their own money, because more government leaders realize that soil erosion could threaten their economy and aggravate their poverty, especially after the heavy flooding in the Yangtze River Basin in 1998.

The scientists in Guangxi University studied the effect of various factors on the growth of the grass, that includes: soils with different pH, fertility, organic matter, etc., different treatments before planting, sunshine and shading, temperature and moisture. Their study showed that pruning at a height of 5 cm above ground surface promoted the growth of the grass, while the shoots of unpruned grass began to turn yellow when observed on 9 November.

Moreover, vetiver exhibition was organized by Forestry Department to introduce the grass to students and colleagues during the 70th anniversary celebration of the university.

Anhui Province. In addition to Yuexi County in Dabie Mountain where the grass was introduced and extended in 1996, vetiver was introduced to Xi County, as a reproduction base. The county is situated in Huangshan Mountain area, a famous tourist site, and the grass is to be used for slope stabilization, reservoir protection, and highway stabilization in the region. It was implemented by an NGO called Ever Green Charity Society.

As we did in Fujian Province, one-day training courses were organized in several townships. Participants included master farmers and technicians, government officials and leaders from townships and counties as well. Meanwhile, small group discussions (from village to village and even from family to family), were held by CVN members, local technicians, and also government leaders, with the objective of disseminating vetiver technology and to listen to farmers' comments and suggestions.

Yunnan Province. Directed by Insect Resources Institute of Chinese Academy of Forestry, vetiver was introduced and planted in several cities or counties, such as Chuxiong City, Yuanmo County, Yuanjiang County, and Jingdong County. They established nurseries and implemented some experiments with very valuable planting materials for slope stabilization of waste mountain in the hot and dry valley, riverbank protection, and highway embankment protection. They also cultivated seedlings in paper bags for vegetation recovery in the extremely hot and dry slopes. Again, all of this work was done at their own expense except for the granted planting materials.

Other Provinces. In addition to the provinces described above, institutions in other provinces also showed great enthusiasm in testing and introducing vetiver, such as Hebei Province, Tianjing Municipality in Shangdong Province, the grass became a top subject of research and extension by agricultural institutions.

To sum up, the year 1998 was a great year for vetiver technology dissemination and development throughout China. More institutions, disciplines, and regions were involved in the technology. Many scientists and institutions promoted the development with their own funds.

Jiji sao: a grass for soil conservation in cold and dry areas. In 1998 three field investigations were carried out in Loess Plateau area involving 12 counties in 4 provinces in order to study the possibility of using jiji sao *(Achnatherum splendens*) as a 'cold vetiver' for the extremely dry and cold area. Mr. Grimshaw led the first investigation in May. Through field investigations and discussion with villagers we realized that jiji sao was similar to vetiver but tolerant to extreme drought and cold:

- Its natural habitat is the saline soils in northwest China such as Inner Mongolia, Ningxia, Xinjiang Provinces. When planted on upland soils (such as the Loess soils) it grows extremely well.
- Like vetiver it also belongs to Gramineae, some farmers in northern Shanxi use it to stabilize the vertical cuts made in the hill slopes above their houses to prevent slippage and damage to the house.
- The grass has strong, deep (at least 3 meters), and profuse roots.
- It is completely drought proof, and withstands extreme cold.
- It has good longevity and is usually propagated vegetatively by plant division and is not invasive.
- The grass was used also to feed animals with young leaves, to make basket, broom, mattress, rope, curtain, shed roof cover, and medicine. And also, it was used for pulp purpose and for highway stabilization as we saw in Inner Mongolia.

The jiji sao appears to have many similarities to vetiver grass, although there are some very distinct differences, including a less dense and weaker leaf system. However there are enough similarities, as well as farmer experience and knowledge, to suggest that jiji sao could be key to long term embankment stabilization (terrace, dams, and roads) in north China and other similar areas in the world if planted as a closely spaced in line hedgerows across the slope of embankments, just as has

been widely proven for vetiver. It also may well be possible to use it as an effective contour hedgerow on unterraced sloping land. The China Vetiver Network's newsletters included information on jiji sao. Some experiments were arranged in Ningxia Province on Loess Plateau. Demonstration was established in cooperation with county or township extension stations in Shanxi Province.

Improvement and promotion in 1999. All of the tests implemented in 1998 showed that the grass had high survival rate even after long distance transportation. It can tolerant various conditions. We have not got any report on insects or disease induced from vetiver so far. The grass in most of the planting provinces could flower but could not produce ripe seeds. Generally, the grass had fewer tillers in northern provinces than that in Fujian Province possibly caused by less rainfall and lower temperature. Almost all of the new planters did not prune the grass during the growing season because they worried that pruning might be harmful to the newly planted vetiver. Due to the lack of planting materials, in some places the grass was planted with too much space between clumps, which resulted in an ineffective hedge and subsequent erosion.

The experience showed that more institutions were involved in vetiver technology extension. Especially, we were very pleased to see engineers are being interested in the grass. Many new users applied the grass on their own expenses, including the institutions from poverty counties. As a result, in the year 1999, we are planning to distribute more planting materials free of charge to new users and then to establish awards for successful users, in stead of distribution of minigrants.

In China, the construction of highway forms the major component of economic development and was deemed as a key channel for poverty alleviation. The total length of highway increased from 1,118,000 km in 1994 to1,186,000 km in 1996. The annual increase reached 34,000 km. However, caused by financial limitation many highway embankments were not properly protected and subject to destruction, resulting in frequent re-construction and burdensome maintenance.

Furthermore, unprotected highways not only caused big problems in transportation but also influenced agricultural production and environment. The construction of highway often leads to accelerated run-off, new soil erosion, increasing sediments and land collapse in a considerable area outside road, dozens of meters wide as usual on both sides of highway. Friable road embankments formed serious point sources of erosion, that created major problems further down in the catchment area. Sediments from eroding highway embankments bury each year farmlands and crops.

A workshop on vetiver for highway embankment protection and slope stabilization is proposed to be held in October 1999 in order to show engineers the demonstrations, and to disseminate the technology more widely to highway, railway, and other engineering institutions.
In 1999, a comprehensive research will be started on the Loess Plateau to investigate the "COLD VETIVER" — jiji sao:

- effect of jiji sao hedges on run off and sediments (amount and nutrients)
- effect of jiji sao hedges on the intercropped crops
- ecological change of surface soil layer and micro climate
- growth behavior of jiji sao under different water, pH, soil, fertility, and landform

Demonstrations, training, and small workshops will be organized. However, as we did in the past years, the top task will still be information dissemination at a national level to let more people be familiar with and to encourage the use of the grass.

EUROPE AND THE MEDITERRANEAN

Status Report - European And Mediterranean Region, The Vetiver Network (EMVN) - April-November 1998

mikepease@mail.telepac.pt

Overview Since the last EMVN Status Report the majority of activity in the region has occurred in Portugal. It is very much hoped that on the next occasion there will be more to report from other countries within the region where interest and positive responses have been expressed, but not yet brought to fruition through research or field application activities.

Visit of Dr. Paul Truong Paul and Julie Truong visited Portugal and Spain between September 9-18, which gave a considerable boost to our activities. Paul spoke at two well attended seminars/field days in the Algarve and also visited a number of locations where vetiver was established in March 1998. These included those of a non-government organization concerned with the protection of a sensitive mountain region (Serra de Monchique) which has suffered considerable erosion in recent years. He also visited Antonio Vasco de Mello's property in Central Portugal (39ºN) where vetiver is thriving, having been established in April 1996. Paul was also able to appreciate some of Portugal's soil erosion problems particularly in regard to the need to stabilize cliff-tops and protect disturbed soils along engineered structures, notably highways and dams. His visit, which was reported in the

press, stimulated interest in the potential of Vetiver Grass Technology to address critical aspects of soil erosion and soil stabilization in this part of Europe. As a result we are now initiating action towards making a further importation of 1 cu. meter planting material in March 1999 to meet the increased demand. In Spain, Paul met with Dr. Tíscar Espigares of the Universidade de Alcalá de Henares, near Madrid who accompanied us to view vetiver planting activities in the harsh climatic and pedologic conditions near Lorca, Murcia region where vetiver was established some 4 years ago. Engº Diego Frutos, the responsible agricultural technician, was an enthusiastic and excellent host who sees considerable potential for VGT as a stabilizer of engineered structures in this part of Spain. Drip irrigation ceased for the hedges at Lorca in about March 1997 but they are nevertheless performing well in a 250mm environment, protecting the steep banks of an access road leading to a reservoir. Control blocks on either side of these plantings show severe erosion and gullying.

Conclusions arising from Dr. Truong's Visit My personal conclusions or lessons learnt out of Paul's visit were as follows:

- In Southern Europe it is likely that we should give primary focus to agro-engineering uses of VGT ahead of agro and forestry uses. Findings in China and Australia, for example, indicate that VGT when applied to such structures as highway embankments and cuttings are some ten times cheaper than classical engineered approaches. Thus, in drier parts of Europe drip irrigation of vetiver hedges established along highway embankments would still be considerably cheaper, more permanent and more environmentally friendly than an engineered alternative. Under such circumstances, irrigation would be critical and justified in the drier areas (say 300-700mm p.a.) to ensure rapid and effective establishment and long-term continuity.
- Paul places considerable emphasis on periodic application of inorganic fertilizer—diammonium phosphate) to ensure vigorous and continued field hedge growth and we would follow this practice.
- Hitherto, for the Region, I have recommended maintenance trimming of field plants (to say 40cm) at least once per year to stimulate tillering and root growth. Paul advises that whilst desirable, this is not strictly necessary. This can be important for doubters of the technology who would otherwise be concerned regarding annual maintenance costs.
- In Southern Europe our climatic conditions provide us with tighter margins of planting times than in the tropics. I feel, therefore, that stimulating early establishment could be of particular importance in EMVN where the emphasis will be primarily on agro-engineering uses of VGT. During Paul's visit we put together a paper summarizing four techniques for aiding early establishment with contributions from Paul, Dick Grimshaw and Criss Juliard. These are described elsewhere and include: manure-tea; sand pots; strip production and individual pots.

March '98 Plantings Reports and observations of the plants that were imported from Zimbabwe in March, and which were established in 14 locations ranging from the Açores to Southern Spain, indicate that the majority of plants are now well established and subdivisions have been successfully carried out. By Spring of 1999 there should be a good plant resource base in Southern Portugal and a steadily increasing knowledge as to vetiver's performance or limitations in Southern Europe.

DNA Analysis Program Under the overall coordination of Dr. Paul Adams of Baylor University, Texas, the following accessions were obtained from Spain (ex Dr. Juan Tasias and Engº Diego Frutos) and are being multiplied in the Coordinators nursery: Malaysian, Sabak Bantar, Parit Buntar, Sabah and Karnataka. The program will be expanded considerably with the receipt of some 13 further accessions from Bob Adams that will be established under professional management in a commercial nursery located in the Eastern Algarve.

Northerly Limits of Vetiver Establishment Contact has only recently been established with growers of vetiver in the Piedmont Region of Northern Italy. Vetiver was apparently established in 1997 and some 3,000 plants are doing well at 45º 20' N at Vercelli which is about equidistant between Torino and Milano. This may be the most northerly latitude at which vetiver has been established and we will monitor its future performance with considerable interest. It is early days yet and 1997/98 was a warmer than usual winter in Northern Italy. Encouragingly, reports from Albania indicate that the vetiver that was established at about 40º N some two years ago is doing fine.

***Achnatherum splendens* (jiji sao)** The above comments on latitudinal/climatic limitations to the establishment of vetiver are particularly pertinent to our European conditions. We are therefore taking considerable interest in the possible application of jiji sao within EMVN at latitudes and climates where basic temperatures are too cold for vetiver's survival. We are liaising closely on this matter with Professor Liyu Xu and wish to identify research bodies in Europe that might be interested in examining the potential of this relatively unknown plant as a vegetative means of soil conservation and soil stabilization under European conditions. There is also the possibility of a joint Sino-European

exercise to examine the potential or limitations of this grass in much greater detail.

Use of VGT in Cyprus and Gibraltar EMVN has provided advice to an engineering consultancy firm, Allot & Lomax of Sale, Manchester on the use of VGT relative to a large, steep and complex hillside that surrounds a proposed power station project in Cyprus. This may be typical of the agro-engineering projects which could employ VGT effectively in the EMVN region. In similar vein, EMVN has drawn the attention of the Ministry of Defence UK to the possibility of using VGT in stabilizing the Eastern face of the Rock of Gibraltar which is currently being decommissioned as a water catchment area and which the Government of Gibraltar in association with the MOD proposes to be vegetatively rehabilitated.

Registration of EMVN The Deed registering EMVN as an official body in Portugal was signed in November by six founding members coming from Albania (2), Germany (1), Portugal (1), Spain (1) and United Kingdom (1). TVN funded this formality which formalizes EMVN as an European-based body. Whilst the informational and reporting links to TVN remain as before there is now financial and organizational responsibility within Europe. It is hoped that this action will strengthen the position of EMVN in its upcoming application to the EC for finance covering the period 1999-2001 or to other European-based funding bodies.

Lectures During the review period lectures supported with slides were given to Universities in Spain and England.

The Vetiver Network needs your funding support in order to continue producing newsletters like this one. Please send your donations to The Vetiver Network, 15 Wirt Street NW, Leesburg Virginia.

This newsletter and the upcoming number 21 has been funded by a donation from The Wallace Genetic Foundation

INDONESIA

Cultural Practices for Soil ErosionControl on Cassava based Cropping Systems in Indonesia

SUYAMTO, Soil Scientist, Research Institute for Legume and Tuber Crops (RILET), P.O. Box 66 Malang 65101, Indonesia
R.H. HOWELER, Agronomist, CIAT Regional Office, Bangkhen, Bangkok 10900, Thailand
Email: "Reinhardt Howeler"CIAT-BANGKOK@CGNET.COM

ABSTRACT
About 1.3 million hectares of cassava harvested area in Indonesia are located in sloping marginal - upland, where soil erosion is a serious problem. Alfisol is the dominant soil for cassava cultivation. Cassava cultivated in sloping land could resulted a severe erosion if it is not properly managed. Study on the effect of different cultural practices on erosion and yield of cassava was conducted on Alfisol with about 15% slope in East Java during the rainy season 1996/1997. Twelve cultural practices were tested, using 12 m long and 3 m wide plot for each treatment. A channel was made below each plot and covered by plastic sheet to collect eroded soil. The eroded soil was weighed every month and the crop yield was recorded at harvest time. Trial on the effect of potassium fertilizer on cassava yield was also carried out closed to the above trial. Five fertilizer treatments were studied to determine the role of potassium in increasing yield of cassava. Results showed that farmers' practice with "up and down ridging" gave the highest cassava yield (18.6 t/ha), but produced high level of erosion (11.8 t/ha) compared to other treatments. Staggered mounds for cassava cultivation that is mostly practiced by other farmers also produced high level of erosion (8.3 t/ha). When contour ridging was prepared before planting, the soil losses due to erosion were similar to the above system (9.0 t/ha). Combination of contour ridging with elephant grass (Pennisetum purpureum) hedgerows or vetiver (Vetiveria zizanioides (Linn) (Nash) hedgerows in every 4 meters produced the lowest level of soil erosion> (7.3 t/ha) and good cassava yield (13.4 t/ha). Lemon grass (Cymbapogon sp.) could be used as an alternative of hedgerows, however, vetiver was the most tolerant to drought compared to the other grasses. On the other side, gliricidia (Gliricidea maculata), Flemingia (Flemingia sp.), Leucaena (Leucaena leucocephala), or Caliandra (Calyandra callothyrsus) hedgerows produced higher level of soil erosion (9 -10 t/ha) compared to elephant and vetiver hedgerows. It can be concluded that contour ridging combined with elephant or vetiver grass hedgerows could be recommended for planting cassava since this practice reduced soil erosion as well as gave a good cassava yield. Potassium application for up to 200 kg KCl/ha linearly increased cassava yield, and indi-

rectly would reduced soil loss due toerosion. Alternative materials which are cheaper than KCl and available locally should be identified, since this fertilizer now is too expensive for farmer.

MEXICO

Program for Erosion Control and Restoration of the Soils of Oaxaca (PCERS) on behalf of SASO.

Nick Dolphin

Background SASO is a small Oaxacan NGO which provides direct services to communities and small farmers to conserve and restore their soils and natural resources, as well as to improve their food self-sufficiency. The core program of SASO is the dissemination of vetiver grass technology and in this regard SASO started, and continues to take a lead role in, a statewide program for erosion control (PCERS) spearheaded by vetiver grass technology, in collaboration with communities, local authorities, government agencies, NGOs, and research centers.

Mexico is the 10th largest country in the world in area and Oaxaca State in southern Mexico is the 4th largest state in Mexico. The State of Oaxaca is the size of Portugal and almost twice the size of Costa Rica. It contains 80% of the vegetation types in Mexico, from desert to tropical rain forest, and has the highest concentration of ethnic and biological diversity in the country. Oaxaca has been identified by the World Resources Institute as being one of the places on the Earth of grave concern for its soil erosion and rate of desertification. It is therefore an excellent place to demonstrate the exceptional properties of vetiver grass which is one of there few plants which can unite the whole State around the common theme of erosion control and soil conservation because it grows in all the climatic and vegetation zones.

There are two equally important challenges to getting vetiver grass used on a significant scale throughout Oaxaca and to creating the awareness of the seriousness of the problem of soil loss: firstly, production and demonstration of the grass (when well demonstrated the grass speaks for itself), and, secondly, the development of organizational and diffusion mechanisms which will enable this to happen in a relatively short time. The problem is so serious and the social, inter-organizational and political divisions so deep that new approaches are needed. SASO and The Program for Erosion Control and Restoration of the Soils of Oaxaca (PCERS) are attempts to find new forms of organization to disseminate the vetiver grass (and other) technologies.

SASO provides a legal and support structure for individuals wishing to develop their projects on soil, water and seed conservation. SASO focuses on communities and small farmers - 75% of the territory of Oaxaca is the collective property of communities, mostly indigenous.

The PCERS provides a legal and support structure for organizations to work together pursuing their soil conservation projects in their own ways integrating vetiver. The Program, which started in 1995, has 50 participants from communities, NGOs, research and education organizations, state and federal government agencies, and the private commercial sector - small farmers and householders also participate.

This report focuses more on organizational mechanisms for diffusion than on the technical aspects and outputs of the vetiver grass because this year has been a year with few funds and has been used to prepare strategies and to make appropriate changes in the organizational mechanisms for the second phase beginning next year.

SASO para los Suelos Agua y Semillas de Oaxaca. SASO is focussing on 3 regions - the Sierra Norte, the Sierra Sur and the Costa - with its own propagation nursery in the center of the State in the Valles Centrales, and work in the City of Oaxaca.

In the Sierra Norte, we continued with the two communities which established nurseries in 1996 and 1997 - Tlahuitoltepec and Amatepec. The new Tlahuitoltepec authorities (which change every two years), being unaware of the value of the grass, were persuaded to exchanged it for tree seedlings by an entrepreneur from out of the State. Whilst slowing dissemination of the grass in Tlahui (it retains a basic nursery), this shows that the grass is taking off in other states and that the market is developing. (Tlahui is way up in the mountains, very poor roads and hundreds of miles from where the entrepreneur set up his nursery). About 15 campesinos in Amatepec have distributed the grass amongst themselves for individual nurseries. A new campesino member of SASO, Carlos Sanchez, established a nursery and two demonstration barriers with the farmers group in his community of Chichicaxtepec. The site will provide a source of grass for over 20 communities in this ecozone. These areas range from 1000 to 2500 meters above sea level.

In the Sierra Sur, we continued follow-up in the three communities in Sola de Vega District identifying hedgerow demonstration sites with farmers in each area. In the event, not more than 300 meters of new barriers were planted. We discovered that in this area farmers are used to being paid by government projects to improve their land (fertilizer subsidies) and to introduce new crops (vote catching). In this case - and the problem is not unique to this area - a slow process of demonstra-

tion will be required. One of the members of SASO, Paul Hebb, is setting up a nursery in Sola de Vega and will be on hand next year to work directly with the local farmers to demonstrate the use of the barriers. A new nursery was set up with a group of 120 mezcal producers - mescal, the local alcohol, is produced from the maguey cactus and is the major export of the area. The leader of this group is the technician who originally requested the grass for Sola de Vega. There are now four nurseries in Sola de Vega area.

In the Coast, a new campesino member of SASO who worked with Kevin O´Sullivan in the early 1990s set up a nursery. Heriberto Ricardez is working directly with 6 communities in the area which will receive the grass next year and has good contacts with the Pochutla Municipal Authority. We participated in the first University ecology event in Puerto Escondido and will be planting a nursery in this important tourist resort over the Christmas period.

In addition to field activities, Ana Maria Le Moing included a significant vetiver component in her proposals for rural development in the Huaxteca region of Veracruz; Government/World Bank funding is expected next year for protecting 10 hectares of steeply sloping farmland. I wrote an article on the PCERS for publication in the Autonomous University of Mexico anthropology journal. The SASO team participated in a degree program on natural resource management for Portland State University/Technology Institute of Oaxaca taking the group of 25 US and Mexican students to our sites in Sola de Vega and talking on erosion and vetiver in Oaxaca. In March, a team from the BBC filmed the SASO mother nursery which has resulted in a BBC/ITDG Hands-on Program on vetiver (also with inputs from TVN); we will also be editing the raw footage into a vetiver promotional video for Oaxaca. The trial vetiver clothes sachets have been selling consistently (150 to date). Vetiver is being tested in a household black water recycling system and another friend intends to bale it up and build houses.

The new Mayor elect of Oaxaca planted vetiver at the Nexacubi site in Oaxaca City and we will give his team a talk on vetiver when he takes over early next year. We also have contacts with the new State Governor who takes office this month for a six year term; his support is essential to getting vetiver into official projects and programs. Finally, I have been helping the 3 local entrepreneurs develop the market for vetiver.

Program for Erosion Control and Restoration of the Soils of Oaxaca (PCERS). The first phase of the Program culminated in 1997 (results were reported in previous reports). The objectives of the first phase were to prove that vetiver grass grows in all the climates and vegetation zones of Oaxaca and does not become a weed, and to establish sources of grass throughout the State by including all relevant sectors of government and civil society. By the end of 1997 there were 35 nurseries directly participating in the Program, plus at least 15 others, in 6 of the 7 regions of Oaxaca, and all sectors are participating - community and other local authorities, farmers and women's groups, NGOs, research and education centers, state and federal government agencies, and the commercial sector. See the annexed map.

The main objectives of the second phase, which starts next year, are to: 1. widely demonstrate the vetiver grass in use (farm land conservation, restoration of eroded lands, gulley stabilization, and road maintenance): 2. influence public policy in favor of soil conservation; and, 3. start disseminating local plants and techniques for erosion control alongside vetiver.

Between July 1997 and December 1998, the Program continued with only a small grant of US$7,000 from the Fondo Mexicano para la Conservación de la Naturaleza, A.C. for the 18 month period - $390 per month (we have still not received the final payment). The fact that it has continued indicates the commitment of key members working voluntarily and the fact that the dissemination of the vetiver grass no longer depends on the Program.

Nursery and hedgerow outputs for the year will be surveyed when funds become available early next year. Casual contacts indicate that the grass is spreading well through all participants. For example, in one area in the arid zone of the Mixteca, 70 small demonstration hedgerows have been set up, and a member in the Valles Centrales has started work with 4 new communities.

The vetiver is now taking off in 7 other states and, as reported previously, an important demonstration, including several kilometers of hedgerow, is flourishing in the State of Mexico and the Federal District with plant material and technical assistance from members of the PCERS. The site is very heavily eroded, has very poor soils with little organic material, and receives 3-400 mm of rainfall per year - a good challenge. The vetiver is being used in conjunction with reforestation. In addition, there are at least 5 commercial vetiver nurseries, 3 of which are in Oaxaca and the others in Morelos and Hidalgo States.

The report on the first vetiver training workshop held in 1997, in which Jim Smyle and Joan Miller of the Latin America Vetiver Network participated, was completed. This report contains an excellent summary of the experience with vetiver in Oaxaca to date. A manual on vetiver nursery establishment and management was also produced.

Protracted negociations with the

Fondo Mexicano para la Conservación de la Naturaleza, A.C. resulted in obtaining a grant of 500,000 pesos for the next 3 years. The main sponsors of the FMCN are the US and Mexican Governments. We also managed to persuade the FMCN to be flexible in their requirements for working with organizations. The Program is not a legal entity - to date one of the members has provided a channel for funds. This arrangement has enabled a wide variety of organizations to participate who would otherwise have found it very difficult to do so. For example, government agencies have been able to participated and get familiar with the grass without requiring official, political endorsement. The FMCN will accept a simple notarized contract between the members of the Technical Committee giving us time to bring new members into the organizational bodies of the Program and to decide what kind of formal identity we want and when. We are also designing a management structure that does not have a single coordinator - competition for power and control is a major cause of conflict and failed initiatives. We are also exploring various ways of ensuring transparency, such as publishing the accounts in a web page - expropriation of funds is a major cause of suspicion and lack of cooperation.

Experience. In places where local technical assistance organizations, usually NGOs, have established good, long term working relationships with local communities and farmers groups, the vetiver takes root fast. In other areas, it has proved relatively easy to establish nurseries with communities, however dissemination in hedgerows is much more complex. The reasons, which vary from place to place, include dependence on government programs for payment to adopt innovations; the communal land tenure system; lack of awareness of soil loss; small farmers suffering depression under the onslaught of the global cultural and market changes taking place which are undermining local traditions and cohesion; realistic and natural caution over new fixes; soil conservation is a long term investment with no immediate returns (which also puts off many funders). Local farmers groups participating have said that it will take 4 to 5 years to convince their neighbors to adopt vetiver. In addition, we have not designed an effective demonstration package to go with nursery establishment. We are working on this now.

The first phase of the Program concentrated on small farmers and a major effort has not been made to influence government, formal institutions and the commercial sector. The research and government sectors tend to be reluctant to adopt vetiver because initially there is no money to be made and because of the "not-invented-here" syndrome. However, individual researchers in all the major agricultural research organizations in Oaxaca have been some of the most ardent supporters. Ecologists and environmentalists tend not to like the grass because it is introduced (not native) - like wheat, cows and cars.

The PCERS has been set up in such a way that anyone can participate. There is no central control or party line - each organization can use and develop their own ways of disseminating the grass. The members of the Program provide technical advice and collaborate to provide training and production of technical information. The coordination provides exactly this function - coordination of technical advice and assistance between the participants as they want it. It also has the role of promotion.

The dissemination system which has evolved can best be described as a flat pyramid: flat because each member and participant is autonomous, and pyramidal because each year the base broadens as each participant spreads the grass to their neighbors and collaborators. The basic design principles have proved to provide the basis of an effective organizational structure: autonomy of participants (so each can work in the way they know best and no central control or ownership), independence of the Program (it is not the property of one organization), minimum of bureaucracy (it can survive with a minimum of money), and dissemination by *enlaces* (liaisons), the only obligation being to pass the grass on to others and tell us what you are doing.

Contrary to the good advice of many, initially the vetiver grass was given free to every organization and individual who wanted it. In three years there are over 50 nurseries in all but one of the 7 regions of Oaxaca and I am beginning to meet people on the street who ask me if I know about vetiver grass. The vetiver grass is now disseminating on its own, however, the Program has an important role to play in speeding up the process and demonstrating the many alternative uses of the grass.

SOUTH AFRICA

Vetiver as an Effective Mulch

Tony Abbot

A Mauritian farmer who came to our district introduced vetiver as a tool in the conservation of natural agricultural resources to me. He told me that in Mauritius it could be seen all around the small farms protecting the soil and was also used by the cane farmers for soil movement control.

The need for better control of soil movement becomes clear when the research carried out by the Agricultural Research Council at Cedara is considered. From this work in soil

loss, it has become clear that, as farmers, we are not maintaining a sustainable soil profile. In real terms, we are losing our soil faster than it is being created. This research targeted commercial farming operations where techniques for soil control and resources for their implementation can be expected to be available.

The first step in controlling soil movement lies in controlling water run-off. Water carries 32 times the amount of silt and particles 64 times larger when its speed of flow doubles.

Clearly, this is where we must concentrate our attention to conserve our capital stocks of soil. Biological contour banks of Vetiver grass make good sense, preferably planted on a slope sufficient to carry away the excess water but at a speed not fast enough to cause erosion.

Vetiver as a mulch works extremely well and can last for up three years, depending of course on how thick the application is. It easily outlasts veld grass due to its stem thickness and texture. Mulch must be one of the most useful farming techniques available to farmers. As a mulch it:

- retains moisture;
- assists rainfall penetration;
- controls surface water movement;
- suppresses weed growth; and
- improves soil texture.

The only disadvantage that I can think of being its tendency to reduce ground temperature.

Turning specifically to how we carry out the mulching on my farm. We cut Vetiver by hand and bind it into bundles for transport; the grass itself makes suitable ties. It makes very compact bundles as it is more stem than leaf and is more economical to move than veld grass. The bundles are moved by tractor and trailer and are convenient for carrying into plantation crops where vehicles can not go. As it does not shoot or sprout, it makes a most convenient mulch as compared to Napier Grass which repeatedly regrows in the field.
Vetiver grass may well provide the only techniques available to us which can be used without machinery and expensive planting methods to control water run-off, to maximize its availability in the soil and to conserve our rapidly disappearing soil stocks.

Editor's note. I have seen numerous photographs of mulch applications in South-East Asia. One of the techniques that is employed in orchards is that vetiver is planted between the rows of trees as a conventional soil conservation mechanism (care needs to be taken that the trees do not shade out the vetiver). The hedge is then cut annually and the cuttings are placed directly around the base of adjacent trees. This saves on transporting cuttings into the orchard and provides a two-pronged approached to moisture conservation.

I understand also that in South Africa vetiver has been used very successfully as a mulch in coffee plantations. In addition to its moisture conservation activities it has resulted in reduced applications of both herbicides and insecticides

Mpumalanga Vetiver Program - an update

David Jobson (The most useful point ***of contact for David is through his cell-phone: 082 708 6820)***

A Visit to Palabora and Foskor Mines. The main aims of the Mpumalanga Vetiver Program (MVP) are to raise awareness of the value of vetiver for bank stabilization and soil erosion control in particular, and to help to create economic opportunities in the process. As many of you will know, several mining companies have been using vetiver as a pioneer grass for some years in order to stabilize slime dams, reduce wind and soil erosion, and to provide an environment in which indigenous vegetation can thrive.

As my knowledge of South African mines is extremely limited, I was keen to team up with an Ecolink colleague who was exploring some work with the Palabora Foundation, a local NGO set up and substantially funded by the Palabora Mining Company (PMC). Knowing that Tony Tantum of Specialized Soil Stabilization had been planting at Foskor for over a year, it seemed opportune to have a look at the progress that was being made. I was particularly interested to see how vetiver coped with the poor substrate conditions and extreme heat associated with the mine dumps.

At PMC I made a short presentation to the Environmental Unit. Some of the staff from this unit then took me across to Foskor where Patrick Tantum (*son of Tony - also bigger than Tony if you can imagine that, but not quite as good looking. Ed.)* showed us some of the vetiver sites. We were enormously impressed with the impact vetiver had made in a relatively short space of time. Correct planting methods together with the heat and ample summer rainfall had clearly done wonders. Vetiver had established in weeks rather than months which is the usual situation in normal growing conditions in non-toxic soils. It was fascinating to see vast swathes of vetiver lines marshaled across an alien landscape. Contours had been created and a light covering of topsoil had been deposited in which indigenous grasses were already growing vigorously.

This visit appears to have stimulated the PMC environmentalists to trial some vetiver stabilization themselves and to seriously consider it for other purposes such as channeling water.

Another purpose of my visit was to check out the potential for creating economic opportunities for people from disadvantaged communities. I found that the Tantums together with the mining companies and an organization called Business Linkage were already well down the road of developing a business plan for setting up community operated nurseries at the mines. This has great possibilities. Correctly implemented, such initiatives can contribute to addressing the multiple issues of unemployment, retrenchment, skills training, and rehabilitation and conservation.

While in Phalaborwa I made inquiries about loans and start-up grants for SMMEs. As per usual there was not much information available. (Who actually gets all this help that is supposed to be available and accessible?) Khula Enterprises and the Industrial Development Corporation (IDC) were suggested. Also the Great North Credit Company, Pietersburg, for those living in the Northern Province. I understand that the Palabora Foundation has a scheme to assist micro-enterprises which is basically a very low interest loan scheme for capital items. I appeal to readers of this article who know more about obtaining low interest loans for small enterprises requiring less than R 50 000 to contact me. I am mainly trying to assist people in Mpumalanga and surrounding provinces.

Help me be More Effective

As a foreigner (this English accent does me no favors), promoting the value of vetiver to an often skeptical audience can be a lonely and discouraging task. Civil engineers and farmers, for example, are not renowned for seizing on new ideas - or more particularly those that work elsewhere and were not invented here! Not that I am blaming them. Farmers, for example, have often been led up the garden path to bankruptcy by bold new methods and supposed miracle crops. However, as we know, vetiver is for the cautious as well as the brave.
Rather than waste time up dead-end garden paths myself, I appeal to readers in Mpumalanga, Gauteng, Northern Province and Swaziland in particular to give me contacts where doors don't have to be levered open. My focus for workshops this year is on
forestry, roads, dams and mines. I will follow up on the most promising leads and then link up to try and find local supplies of vetiver. For example, it would make a lot of sense for forestry companies to supply vetiver from their own nurseries for the public and their own use as Mondi does in White River. The same could apply to the Department of Environment and Tourism, and the Mpumalanga Parks Board.

I also find that forestry and agricultural shows are the type of arena in which vetiver gets very useful exposure. Do you know of any appropriate shows and venues coming up this year?

Finally, I am preparing a simple manual comprising mainly photographs of vetiver doing its job in a variety of Southern African situations. If you have or can take such pictures I would be delighted to consider them for inclusion. Any photographs would be credited.

Comment by Duncan Hay:

David Jobson is a British Volunteer from Voluntary Service Overseas (VSO). VSO is the largest volunteer-sending agency in Europe and the third largest worldwide. It provides skilled and experienced men and women to work alongside local colleagues in response to requests from governments and NGOs. David has been in South Africa for three years during which time he achieved the dubious distinction of being mugged on three occasions. Despite that we don't seem to be able to get rid of him! He is currently attached to the Institute of Natural Resources and his costs are covered through a variety of donations and grants.

Vetiver in Aromatherapy

By Angela Stubbings

The term aromatherapy was coined in 1920 to describe the usage of essential oils for therapeutic purposes. The aromas and oils come from the plant kingdom: flowers, herbs, trees, bushes and roots. The relevant part of the plant is distilled and the volatile aromatic substances are captured. These substances are called "essential" oils. They are highly concentrated and should be diluted before use.
The oils are rich in teipines, phenols, alcohols and aldehydes. These natural essences have antiseptic properties and their anti-bacterial action has been used in practice for thousands of years.

The roots (rhizomes) of vetiver grass are extremely rich in volatile oil. It has a heavy earthy aroma and is strongly repellant to flies, cockroaches and fish moths for example. It is used as an ingredient in oriental "woody" perfumes, soaps and cosmetics, and also as a powerful fragrance fixative.

Vetiver oil has the ability to combine with other scents, thereby enhancing blends of oils.

TANZANIA

Terminal Report On Vetiver Technology And Development In Tanzania - Rukwa Region

Vetiver Grass is now a talk shop in Kaengesa Ward and Sumbawanga township. The impact of Vetiver grass is now felt by the grassroot people, almost every farmer wants the grass as a soil erosion control plant.

The climax of Vetiver Technology promotion was at the time of the Presidential visit to Rukwa Region in which the President participated in planting the grass and trees. A handshake by his Excellence Benjamin W.Mkapa to the Chairman of KAESO Mr. Ozem Chapita commending him for his NGO and himself in particular added flavor in the crusade to promote the grass. The President in his remarks to the Chairman of KAESO said, *"I have visited several parts of Tanzania and a lot more people are talking about the environment, but much of it is theory only, but you - KAESO, are talking, about environment by doing practical things I thank you very much. Please I request you to continue doing what you are doing".*
The Vetiver Technology has been given to the villager by way of Video shows, Seminars, and mobilizing drama groups. However, Vetiver knowledge dissemination by video shows has proven to be very effective followed by the drama group.

To our advantage, heeding to the presidential call on environmental conservation and soil erosion control, the regional district authorities could get vetiver splits from KAESO only. This has resulted in a big demand for vetiver grass splits to be distributed in all the three Districts of Mpanda, Nkansi, Sumbawanga rural and urban. KAESO's next move is to identify interested farmers in each district who could run vetiver nurseries in each district for future distribution in their district as opposed to the present situation where all vetiver splits are collected from KAESO's central nursery at Lula Village in Kaengesa Ward.

On the other hand, GTZ, a German development agency which has been involved in Nutrition Programs in Rukwa Region, became the major distribution agent of the grass to all farmers under their project, given their transport facilities to reach as far as possible all villages all over the Region.

Despite all the success achieved, the project faced a lot of problems, namely,

- Lack of transport to distribute the grass and the movement of personnel to supervise planting in the field.

- Cost of having a pickup vehicle for video shows and drama group is a limiting factor.

- Lack of a photo-copier for producing leaflets, newsletter for distribution to villagers.

- The El Nino rains have destroyed most of the access roads making it very difficult to reach as many villages as possible.However, for all the success achieved, all has been possible through the financial support from VETIVER NETWORK and more sincerely all thanks are directed Mr. Richard Grimshaw for his tireless efforts to encourage us to promote this unique grass.

Vetiver Grass in a Soil and Water Conservation Trial - Tanzania

By Holger Nehmdahl (Holger is a Ph.D. candidate at the Royal Veterinary and Agricultural University, Denmark. Ed.)

Introduction
This article contains a presentation of a soil erosion and water management trial site located in the Iringa Region of Tanzania. Special emphasis is given to the performance of Vetiver grass. The aim of the experiments is to evaluate the effectiveness of different low input soil erosion control measures and impact of these measures on the plant nutrient - and water balance. The experiments are fully financed by the Danish International Development Agency (DANIDA) and carried out by the Chemistry Department and Department of Agricultural Science at the Royal Veterinary and Agricultural University, Denmark. Locally, there is close co-operation between the research project, the HIMA/ DANIDA-Iringa project (presented in Vetiver Newsletter No. 16) and the Soil Science Dept. at the Sokoine University of Agriculture in Tanzania.

The three soil erosion control measures tested in this study are either recommended by the HIMA-Iringa project and/or practiced by some local farmers. Although Vetiver grass in numerous experiments has proven to have almost ideal properties when used to combat water caused soil erosion, no controlled experiments on the effectiveness of Vetiver grass and magnitude of soil erosion in the Iringa Region have been carried out. Data from 3 growing seasons has been collected so far starting with the 1995/96 season. Since this is an ongoing research project and selected data will be published in technical/scientific journals, only few figures are presented here.

The experiments

Location, climate and soil
The trial site is located in Kilolo Division, Iringa District, Iringa Region on a 29% slope with a SSW aspect. The climate is moderately cool tropical and subhumid. The unimodal rainfall pattern is often broken by a short dry spell in January/February. The start of the rain season is marked by thunderstorms yielding high intensity downpours with a high degree of spatial variability. The highest temperatures occur in November/December and the lowest in June/July, when temperatures can drop below 0º C.

Average annual rainfall in the area is1100 mm and the annual average potential evapotranspiration about 970 mm.

In the area, characterized by steeply dissected convex slopes, maize sometimes intercropped with beans

is the dominant crop on well-drained soils. The parent material, climate and the extent of weathering determine the nature of soils in the area. Located in the subhumid and cool tropical climate of the Iringa Highlands and developed on a mosaic of acidic pre-Cambrian metamorphic and plutonic rocks, most soils are deeply weathered and leached. Kaolinitic clay minerals and aluminum - iron-oxyhydroxides dominate the red and yellow soils. Another important feature of the soil is a high infiltration capacity approaching values for sandy soils despite its high clay content. The soil is classified as a "Humic Acrisol" according to the FAO Soil Classification System.

The Site

Three soil erosion control measures are tested in 12 classic runoff plots separated into 3 blocks. Each plot with dimensions of 4 times 20 m is fenced on 3 sides by metal plates buried to a depth of 0.5 m. At the downslope end of each plot a collection gutter guides water/soil lost due to surface runoff into a system of 2 concrete tanks. One fourth of an eventual overflow from the first tank is collected in the second tank. The total tank capacity is close to 3000 l. The volume of water and soil lost from the runoff plots is recorded after each single runoff event. Samples are taken for laboratory analyses.

At the site rainfall is recorded by means of an automatic rain gauge monitoring amount and intensity of the incoming rain. A nearby meteorological station supplies the other climatic data. Soil water content at different soil depths is monitored the Time Domain Reflectometry (TDR) - method. Soil water samples are collected from 1 m depth in all plots and analyzed.

Soil conservation measures applied

In each of the 3 blocks 3 soil conservation measures are tested against a control plot. The 3 measures are:

- Vetiver grass lines on the contour
- Calliandra hedgerows on the contour
- Tied contour ridges

The vegetative control measures used are *Vetiveria zizanioides* and *Calliandra calothyrsus* provided by the HIMA-Iringa project. Grass lines and hedgerows are repeated every 2 m of vertical interval. Vetiver grass was planted with a spacing of 10 cm between slips, Calliandra with 20 cm between seedlings. Both Vetiver and Calliandra was planted in 1992 and fully effective with regard to soil erosion control in the first trial season 1995/96.

Tied ridges have a spacing of 80 cm. The control treatment is flat cultivation as practiced by nearly all farmers in the area.

In all plots (including the control plots) maize intercropped with beans was used as test crop for all 3 seasons. All plots received N - and P - fertilizer and pesticides were used when needed.

Rainfall and runoff statistics

The first 2 seasons were characterized by a late start of the rain season, rainfall below average, prolonged dry spells and few high intensity rain events. Widely blamed on the "El Nino" phenomenon, rainfall above average with often destructive downpours were recorded in the third season.

In each of the first 2 seasons only one major runoff event was recorded. In total 14 runoff events were recorded in the 1995/96 and 1996/97 seasons and 22 events in the 1997/98 season.

Only 1 - 2% of the incoming rain was lost as surface runoff from control plots in the first 2 season but about 10 % was lost in the last. In single events up to 20 % of incoming rain was lost by surface runoff from control plots during the first 2 seasons and up to 70 % during the last season.

The highest recorded rain intensity was 192 mm/h (5-min. max.) i.e. receiving 16 mm within a period of 5 minutes. No rain storm with an intensity lower than 24 mm/h (5-min. max.) triggered losses of measurable amounts of soil/water. During the first 2 seasons 5-min.-max. intensities had to exceed 40-60 mm/h to cause any runoff since the top soil usually dried up between major rain storms and regained it's porosity. As the top soil largely was saturated throughout the first months of the last growing season, large amounts of soil and water was lost in rain storms at much lower intensities.

Surface loss of soil and water

All applied soil erosion control measures greatly reduced soil and water loss by surface runoff. Vetiver grass lines virtually stopped the loss of soil and reduced the amount of water lost by surface runoff by 85% on average. In total - 110 tons soil/ha was lost on average from control plots during 3 growing seasons compared to less than 2 tons/ha from Vetiver plots (preliminary data).

Within the 3-year trial period a 50 cm terrace developed along Vetiver grass lines. This is partly due to sediment trapped behind the lines but also due to a downslope cultivation of the plots. The contribution of the latter to a terrace build-up becomes obvious in the "Calliandra plots". Here terraces reached almost the same height although the amount of soil trapped behind the hedges during runoff events is much less.

The efficient filtering effect by Vetiver grass lines is easily observed when comparing soil/water loss in plots with Vetiver lines and Calliandra hedges. Whereas the decreased slope angle/length between the Calliandra hedges sharply reduced surface runoff in the first 2 seasons, an additional filtering effect was needed in the extreme 1997/98 season. During this season average soil

loss from Calliandra plots was above 20 tons/ha.

Soil loss from plots with tied ridges was less than 10 tons/ha during 3 growing seasons. When evaluating the effectiveness of tied ridging it has to be mentioned, that ridges were re-established in connection with major agronomic activities in the plots (weeding).

On this soil even a moderate loss of plant nutrients will exceed quantities provided by continuing weathering. Obviously, losses of topsoil from the control treatment, i.e. the commonly practiced cultivation of farmland in the area, and its constituents do reach unacceptable values. Although not readily available for plant growth both total N and total P lost from these plots equals the amounts of N and P removed by 6 - 7 tons of harvested maize grain i.e. about 2 years produce for this site (tons/ha) and the applied fertilizer/pesticide strategy. Plant nutrients lost in this way from Vetiver plots are negligible.

Assuming that most of the water retained in Vetiver plots during runoff events compared to control plots will have to be added to water leaching through the system (rooting zone), then this "surplus percolation" in Vetiver plots will remove more plant nutrients like Ca, Mg, K than are lost by surface erosion. This assumption is based on analyses of soil water samples collected at the bottom of the rooting zone.

Possible implications on water balance

As mentioned above the soil water content at different depth in the rooting zone (0-100 cm) is monitored by means of the TDR-technique. Analyses of 3 years of data is still incomplete but with regard to the Vetiver treatment observations do indicate:

- a lower soil water content in all layers of the rooting zone inside and close to the Vetiver lines at the end of the dry season as compared to measurements made between the lines and inside the control plots. This may be due to the continuous transpiration byVetiver grass throughout the dry season.

- a higher soil water content along the Vetiver lines in the upper soil layer in very wet periods of the rainy season (e.g. in Figure 1) as compared to measurements in the control plots. The higher water content may be due to increased infiltration around Vetiver lines during runoff events. A comparable higher water content in the upper horizon is also observed in periods without any surface runoff. This could be explained by a higher water retention capacity of soil accumulated here.

- Accumulated within a certain period an increase in soil water content along Vetiver grass lines often exceeds the amount of rain received. This can be due to subsurface flow accumulating at a hydraulic barrier. As seen from Figure 1, this excess water is rapidly lost to drainage/ evapotranspiration in dry spells during the rain season (day 85 - 105).

- a lower soil water content in deeper parts of the rooting zone between Vetiver grass lines i.e. inside the maize/bean crop. A possible explanation to this finding could be a diversion of lateral soil water movement into deeper soil layers along Vetiver grass lines.

Crop yield

Amounts of harvested maize and beans are recorded for each plot. A direct comparison between treatments proved to be difficult since crop yield is affected by changing soil physical/chemical properties within the experimental site. Data on crop yield will have to be collected for some more years before significant differences in crop performance due to soil conservation measures should be considered.

Other findings with focus on Vetiver grass lines.

Cultivation at a 29 % slope will leave areas close to the downslope side of Vetiver grass line stripped for humus rich top soil. Crop performance of the first line of maize below Vetiver grass lines therefore was very poor. Along with the area occupied by Vetiver grass this fact was often pointed out by visiting farmers. For farmers with access to farmyard manure and/or compost this problem could be addressed by localized application of these inputs. On the other hand this drastic removal of topsoil accompanied with a poor crop performance can be seen at as a forecast on crop production in unprotected fields.

Rats and mice do find shelter and hiding places in Vetiver grass lines. Although no immediate problems arose from this, a large percentage of maize seed close to the lines was eaten and re-planting had to be done.

VIET NAM

The Vieät Nam Vetiver Initiation Visit of January-February 1999

Ken Crismier, Interim Coordina tor,The Vetiver Network Viet Nam, 4850 156th Ave NE #395, Redmond Washington 98052, USA. kencris@gte.net

This trip was the culmination of a process that began in the latter half of 1997, when I first "discovered" vetiver on the Web. Soon thereafter, my 2-month trip of December 1997-February 1998 did not have vetiver as a nominal purpose, but many initial contacts for vetiver were made at that time, including the single contact which appears to be

continuing to develop into the most important one.

The period of February-October 1998 was a time of intense effort in learning more about vetiver and looking into how most effectively to spread the word about vetiver in Vieät Nam. Following up on and developing a suggestion from a friend of many years in Vieät Nam, the effort came to focus principally on working with the Department of International Cooperation of the Ministry of Agriculture and Rural Development (MARD), as being appropriate for the way this kind of thing would normally happen in the Vieät Nam context.

The 1-month trip of October-November 1998 was an intense round of meeting prearranged appointments with mostly governmental agencies, including among others the Departments of International Cooperation in the Ministry of Transport and Communication and the Ministry of Science, Technology, and Environment, as well as (within MARD) the Department of Flood and Storm Prevention and Control and Dikes Management. At each stop I spent the time provided me in telling and retelling the story of vetiver.

At MARD, in particular, we spent much time at first organizing a first significant meeting – a "buoåi trao ñoåi", an "exchange of views", the designation reflecting the modest scale and goals of that meeting. On November 7 about 23 people from 17 different government and quasi-private agencies met for 3 hours for a presentation by me and questions and discussion with the other participants. Subsequently, and by consensus of the participants, meetings focused on preparing for the larger objectives of the next trip.

The trip now just past lasted from 9 January to 7 February 1999. Since I have always made it clear that I am not a professional in the field – as a self-defensive measure if nothing else! – this time, the culmination of the vetiver education process, two international experts accompanied me, Paul Truong from Australia and Diti Hengchaovanich from Thailand. (This was Paul's first visit "home" since 1975 – he found it very rewarding to be reunited with, and feted by, colleagues and students from the University of Can Thô! – and the first visit ever to Vieät Nam for Diti and his wife Arunee.)

The main organized events were

- 19 January: seminar in Haø Noäi, the capital, with about 100 participants
- 20 January: field trip to vetiver site in the uplands of Phuù Thoï province for about 10 of the seminar participants
- 25 January: seminar in Vinh, the main city of Ngheä An province, with about 20 participants
- 26 January: guided tour for Ken and Paul of various representative erosion sites in Ngheä An province
- 29 January: seminar in Hoà Chí Minh City (Saøigoøn), with about 80 participants.

The seminars featured presentations by Paul (Haø Noäi and Saøigoøn), Diti (Haø Noäi only – Diti and Arunee had to return to Bangkok early), and Ken (Saøigoøn), as well as shorter presentations by local people experienced with vetiver, including Mr. Thaùi Phieân (Haø Noäi) and Mr Ñaëng Thoï Loäc (Saøigoøn), both from the National Institute of Soils and Fertilizers. (The Phuù Thoï vetiver site is a project of NISF.)

The province Gardeners Association, also known as Vacvina sponsored activities in Ngheä An province. Vacvina is a very major grassroots organization in Vieät Nam, which is (so I am told) present in every district of every province. Vacvina Ngheä An – and in particular its chairman, Mr Nguyeãn Hoàng Sôn – was that "most important" contact referred to earlier. (This was just one of several contacts made back on 27 December 1997, the day after the most recent 5-year national congress of Vacvina ended, when representatives of a number of provinces had not yet left for home.) The seminar included basically all the agriculture leadership at the province level, and the morning of 27 January four of us (Paul, Son, Vieät the Vacvina general secretary, and myself) were also able to meet with Mr Hoà Xuaân Huøng, chairman of the People's Committee of Ngheä An and the highest-ranking official in the provincial government, and separately with more ag. leaders.

The Haø Noäi and Hoà Chí Minh seminars each concluded with very enjoyable, very late lunches – noteworthy in that almost all participants chose to remain at least to enjoy the lunch at the beginning, when typically lunch would have been nearly 2 hours earlier!

What did we accomplish? As I have said quite a number of times, "All that hard work paid off – now the really hard work begins!" To this point we have "merely" laid a foundation of vetiver awareness – I would guess the number of people in Vieät Nam who are now well aware of vetiver and its role against erosion might well be 10 times what it was in mid-1997. (I am referring here to people in the scientific/technical community, policy makers, and planners – the kinds of people who participated in the seminars.) Discussion has been voluble and animated, and of course we hope it reflects how vetiver will progress in the near term!

We distributed a good quantity of assorted vetiver literature, including 200 copies of the "blue book" (the BOSTID/NRC report of 1993), dozens of copies of recent reports by Paul (vetiver in environmental protection and mitigation) and Diti (engineering aspects of vetiver), information about the vetiver movement

in Thailand, and – especially – the World Bank "green book" of vetiver, recently published in Vietnamese by the Agriculture Publishing House (also of MARD) – of the 5,000 copies printed, about half have been placed in the hands of people to whom it is of interest! Along with that we created a poster based on the green book cover – and of the several hundred that have been distributed, some have started showing up on inside office walls here and there!

Where do we go from here? At the moment that is somewhat hard to say with any certainty... In any society, inertia tends to militate against significant mobilization of efforts in a "cause" such as vetiver. In Vieät Nam, that tendency is perhaps exaggerated both by the way elements of the society interact traditionally, and over the past 50 years by the form of organization and control imprinted on the society by the Democratic Republic of Vieät Nam, earlier, and later by the Socialist Republic of Vieät Nam, and by its "vanguard" element the Communist Party. The "renovation" (ñoåi môùi, change for the new) since 1986 has certainly greatly modified the social climate, but it remains true that individual initiative is the exception, not the norm – in Vieät Nam it would be difficult – it is difficult – for a "champion" of vetiver to rise up as has occurred in a number of other countries.

Secondly, Vieät Nam despite "renovation" is still a poor country – although perhaps a more significant observation is that what wealth exists may not be directed to the most important aspects of its future. (My motivational speech for the seminars – as opposed to my vetiver presentation! – opened with the opening lines from the Land Law and the Law of Water Resources of Vieät Nam, which go so far as to say that these are matters of "survival" for the country...) In any case, resources – funds – are not necessarily readily available for as mundane a purpose as vetiver against erosion, when the existing funds can be applied to major construction projects, major reforestation projects, major "investment" and "development" schemes of all sorts, which are far more visible, more dramatic, more bespeaking "progress". The nascent vetiver movement in Vieät Nam could benefit hugely from an amount of money that would be insignificant in some of these other areas – such money has not yet been found.

The best we can do until a can of gasoline comes along is to carefully tend and encourage the bright sparks that do exist – most noteworthy being that of Sôn and Vacvina Ngheä An, with whom I have personally cast my lot, vetiver-wise, and Paul I believe shares that approach in his involvement with vetiver in Vieät Nam. Working with Sôn, Paul, and Diti, and members of the vetiver community in Thailand, along with Thaùi Phieân and Loäc from Vieät Nam, we are urgently trying to prepare for the coming rainy season by getting planting material in hand at Vinh, at least for a decent nursery. Email exchanges even of the past 24 hours are cause for concern, but we plunge forward, exploring all avenues, rejecting none out of hand. It is of utmost importance to move vetiver along this very rainy season!

The immediate goal is to procure planting material in significant quantity to establish as much as 1 hectare of nursery in which to multiply vetiver as a first step. Beyond that – just beyond! – are 40 hectares of sloping cultivated land on which Sôn wants to apply vetiver, along with pilot projects urgently desired by folks in the Ministry of Transport (a badly eroded site along Highway 1, also in Ngheä An) and the Dikes Management department (test sections on the banks of the fabled Red River right on the edge of Haø Noäi proper).

I myself have repeatedly emphasized that which I think is paramount – even more than planting material in the ground – and that is communication among all interested parties. In theory this does not absolutely need to be embodied in a formal organization, but in practice it is probably the best way. To that end we are trying to get together a nucleus of committed people who can "take the ball and run with it", who will "take the bull by the horns", to start the work of realizing the Vetiver Network Viet Nam (Maïng Löôùi Vetiver Vieät Nam).

In the manner of the successful model of many other regional and national "vetiver networks" around the world, VNVN (MLVVN) would coordinate and promote ongoing efforts in the cause of vetiver against erosion in Vieät Nam.This is definitely a critical moment for vetiver in Vieät Nam: It would have done no good to delay the propaganda effort until the future after it was already assured, since there could be no assurance that happy state would ever be achieved – but having accomplished the missionary work to date, without that immediate future assured, there is a risk the work might be wasted, its energy squandered, if that energy is not soon harnessed to visible, satisfying action. Many are very supportive in this – and as for myself, I am committed to not allowing that to happen...

Vì nöôùc soâng Lam trong, vì ñaát nöôùc Vieät Nam! – for the sake of clear water in the Lam river, for the sake of the "land and water" [the country] of Vieät Nam!

Report on the Visit to Vietnam 17 to 30 January 1999

By Dr Paul Truong Email: <TruongP@dnr.qld.gov.au>, Queensland Department of Natural Resources, Brisbane Australia and Ir Diti Hengchaovanich Email: diti@samart.co.th APT Consult Co. Ltd., Bangkok, Thailand.

BRIEF BACKGROUND

Through the initiative of Ken Crismier of the VietNam Vetiver Network (VNVN), a visit was organized by Ken and the Vietnamese Ministry of Agriculture and Rural Development (MARD) to promote the application of Vetiver Grass Technology (VGT). The Vetiver Network, Ken Crismier and MARD supported this visit.

A series of four seminars were held during this visit, one at the MARD auditorium in Hanoi, one at MARD Training Center in Saigon, one at VACVINA (Gardeners Association) at Vinh, Nghe An province and one at the Institute of Agriculture Science, South Vietnam (IAS) in Saigon.

Due to unexpected health problem, Diti was only able to give the seminar and associated field trip in Hanoi.

NORTH VIETNAM

MARD Seminar in Hanoi

About 100 participants attended this seminars, in addition to representatives from various MARD departments, research institutes, provincial chiefs and agencies, there was a good number of representatives from other Ministries (Transport and Communication, Animal Production), Universities, Agro Forestry agencies and Agribusiness.

In addition to the traditional application of VGT in agriculture and forestry lands, the main attraction here is in infrastructure protection particularly in highways, dams, river banks and dykes. Some interests also in environmental protection such as landfill and mining rehabilitation.

Of particular interest was that Dr.Tung, Vice Director of the Department of Science and Technology, Ministry of Transport and Communication, approached Diti personally after his presentation for more details of VGT and expressed keen interest in using VGT to stabilize steep slopes on National Highways 7 and 8, connecting central Vietnam to Laos.

Field Trip to Upland Region of Phu Tho Province

This is the demonstration site of the Canadian-Vietnamese project on Sloping Land Management Practice. This site is 2 or 3 years old, it was established by the National Institute for Soils and Fertilizers to demonstrate to farmers the effectiveness of a number of vegetative hedges system in soil erosion control (details in Vetiver Project section). In addition to the main demonstration site, the farmer also uses vetiver for terrace stabilization and soil and water conservation purpose in his cropping land.

To date he is very happy with the effectiveness of vetiver in terrace stabilization and thinks vetiver is much better than pineapple, the species commonly used for this purpose locally, as vetiver is easier to manage and it does not spread into his cultivation. He prefers vetiver for this purpose despite the fact that he can get a small income from the pineapple crop. However he is not happy with the vetiver contour hedges planted amongst his crops as these hedges take a lot of land and he is in the process of digging them out even after we demonstrated to him on site that only after one year about 20cm of soil was trapped by the vetiver hedge.

Field Trip to the Red River Bank and Dyke in Hanoi

Following a brief discussion with the Director of the Department of Dyke Management and flood Control, MARD, the senior engineer in charge of bank maintenance took us to a site on the bank of the Red River where work was being carried out to repair a section that collapsed last year. Massive rock works were being taken at the site and this officer literally 'jumped with joy' on learning the effectiveness of VGT in bank stabilization. He admitted that rock baskets (mattress/gabions), which he called "Chinese technology", do not work as they were always washed away when the earthen bank collapsed under them. He added that the Red River is now full of rocks from previous attempts over the years but they have no choice as they do not know any other techniques. He also told us that the Red River delta has 5 000km of banks and 20% of which is damaged every year after the rainy season, this translates to 1 000km of banks which need repair every year. After we explained to him the roles of the deep root system and the tops of vetiver under flood flow conditions and also the design layout of the hedges, he was so convinced that VGT would provide effective protection that he is willing to keep a 100m long section, which was being prepared for gabion work, for an immediate trial this year if we could provide planting materials.

CENTRAL VIETNAM

VACVINA Seminar at Vinh

Vacvina is a very active NGO in Vietnam with branches throughout the country. It promotes good and modern agricultural practices not only to gardeners but also to farmers in the province. Nguyen Hong Son, the Chairman of Vacvina in Nghe An province is very active and a keen supporter of VGT. He has experience in working with farmers in central as well as south Vietnam, he is also politically well connected so he

would make a good candidate for the position on of VNVN coordinator or Chairman.

About 25 people attended the seminar from various local government agencies, MARD and NGO. Again the main interest is in infrastructure stabilization particularly highway batter, dam wall and river bank stabilization, in addition to agriculture and forestry applications in soil and water conservation.

Field Trip to Upland Region of Nghe An Province

Field trip to visit several problem sites in various districts including Thanh Chuong and along the Lam River valley of the province. One site of particular interest was a section of National Highway 1, just north of Vinh, the capital of Nghe An, where a massive and expensive rock retaining wall at least 300m long was built to stop the eroded sediment from its steep batter blocking the Highway. Although the batter now looks well stabilized with various Acacia species from the distance, on closer examination bad gullying still occurs between Acacia trees. As a result the retaining wall is now almost full after only 3 years and further protection is needed as other sections of the badly eroded batter threaten to block the Highway again. This is the location that Vacvina hopes to establish the demonstration site as it is highly visible and of significant importance to the local authority. On another section of the Highway where new road was being built, no attempt was made to stabilize its batter which form the bank of a 700 year old historical canal.

Two sites along the Lam river were visited, one to demonstrate the seriousness of the erosion problem on dykes and its annual costly maintenance program, and the other to show the devastation of severe bank erosion which is threatening the stability of a dyke system protecting a thin strip of fertile and precious farm land. According to the deputy chief of the district, if the erosion went unchecked this whole strip of alluvial land, which currently supports the livelihood of several thousand people, would be washed away.

I strongly believe that these dykes could be simply and effectively protected against flooded water with VGT, as for the river banks, major reshaping of the slope is needed before planting can be carried out.

SOUTH VIETNAM

MARD Seminar in Saigon

Approximately 80 people attended the seminar including representatives from MARD provincial offices, Vacvina, University, Research Institutes and Agro-forestry business. The main interests are in erosion and sediment control on agricultural land on the foothill region north of Saigon, river bank erosion control in the Mekong Delta, rehabilitation of eroded acid sulfate soil in the Plain of Reeds and also in coastal lowlands.

Strong interest was also expressed in the use of VGT in the rehabilitation of landfill and industrial and contaminated lands

Seminar at the Institute of Agricultural Science

This seminar was, basically a training session on the principles of Soil Conservation, erosion and sediment control on sloping lands, given to the Institute staff, with special emphasis on the advantages of VGT over traditional soil conservation practices such as contour terraces, farm waterways and diversion banks etc.

About 60 staff members from Saigon and surrounding provinces attended, the majority were P.Truong's old students from the Faculty of Agriculture, Cantho University. The main interests were on the application of VGT for erosion control of the foothill region north of Saigon where the major crops are maize, sorghum, fruit trees and industrial crop; such as mulberry are grown on sloping lands, severe canal bank erosion in the Mekong delta and acid sulfate soil rehabilitation.

NEEDS AND POTENTIAL APPLICATIONS OF VGT

From the above it is obvious that there is a tremendous need for VGT in Vietnam due to its low cost, simplicity and effectiveness. Although its importance in erosion and sediment control in agricultural, forestry and grazing lands can not be overemphasized, we feel that the most urgent need of VGT is for the stabilization of the banks and dykes of the major rivers throughout the country, particularly the Red River and its tributary in north Vietnam.

The next urgent need and of equal importance is the use of VGT for the stabilization of infrastructure such as highways, roads, railways and dams.

Although we did not have the opportunity to visit the upland region, the very steep slopes of Truong Son mountain range where extreme erosion occurs due to massive deforestation in recent years, the rehabilitation of these highly erodible slopes is also urgently needed. However, we think the application of VGT in the present form, that is hedgerow planting, is very difficult to achieve and slow due to the harsh environment and remoteness, a more innovative approach is needed. The use of native and seeded varieties of vetiver as proposed by Dr. Hong of Reading University may offer an opportunity to tackle this very difficult problem.

VETIVER PROJECTS IN PROGRESS

Presently there are two major research/demonstration projects in Vietnam involving vetiver grass — one in the north conducted by the

National Institute for Soils and Fertilizers in Hanoi, Prof. Thai Phien is the leader of this project. The second project is being conducted by the Institute of Agricultural Science in Saigon, this project is led by Dr. Cong Doan Sat. Highlights and results to date of these projects are presented below:

1- The use of vetiver grass as green vegetative hedges in the protection of sloping lands in Vietnam by Thai Phien and Tran thi Tam.

Vetiver contour hedges is one to the several green vegetative hedges used in this series of trial on four different soil types and land uses in North Vietnam. The effectiveness of vetiver hedge in terms of soil erosion control and casava and peanut yields was compared against other hedges such as pineapple, and two legumes *Tephrosia candida* and *Flemingia congesta*. In addition to pure stands of vetiver, the combination of vetiver and *Tephrosia candida*, vetiver and tea plant and vetiver and *leucaena* were also tried at some of the sites. These sites were also intended to be used as demonstration sites for local farmers to judge the effectiveness and economic return of the different systems.

Results obtained at some of the sites are shown in the two tables above

One of the reasons farmers favor vetiver hedges was that it provides a long term protection whereas *P.candida* has to be replanted ev-

Site 1: Phuong Linh Village, Thanb Ba District, Phu Tho Province (average of 4 years 1995 – 1998).

Treatment (hedges)	Soil loss (*t/ha*)	Profit (Mdong)	Farmers' choice (%)
No hedge	43.0	8.2	25
T. candida	32.2	8.6	82
Pineapple	23.1	9.1	96
Vetiver	28.7	10.0	100

Crop: Cassava intercropped with peanut.
Fertilizer: NPK
Landslope: 18°

Site 2: Pho Yeu district, Thai Nguyen Province (1996 results)

Treatment (hedges)	Soil loss (*t/ha*)	Profit (Mdong)	Farmers' choice (%)
No hedge	8.3	4.6	-
T. candida	4.9	6.8	59
Vetiver	6.3	6.8	40
Vetiver & *T. candida*	4.2	5.8	3

Crop: Cassava intercropped with peanut
Fertilizer: Manure 15 *t/ha*

Site 3: Luong Son District, Hoa Binh Province (1997 and 1998)

Treatment (hedges)	Soil loss (*t/ha*)	Profit (Mdong)	Farmers' choice (%)
No hedge	1.8	4.6	10
T. candida	0.3	3.6	55
Pineapple	0.1	8.5	47
Vetiver	0.0	4.3	58

Crop: Cassava intercropped with peanut
Fertiliser: NPK
Landslope: 15 – 18°

Summary of annual soil loss on sloping lands.

Hedges	Soil loss (*t/ha*/year)
Cassava only	32.2
Cassava & *T.candida* hedges	14.2
Cassava & *F.congesta* hedges	13.2
Cassava & vetiver hedges	9.7

ery 3 years.

Conclusion:
Vetiver hedges provide the best soil erosion control measures, reducing soil loss by 50 – 90% as compared to control. It also has good effect on the crops grown between the hedges and it is recommended for application in sloping land in Vietnam. The combination of vetiver and other legume is probably better than pure vetiver stand. However to promote the application of vetiver hedges further, the following limitations have to be overcome:

- Shortage of planting materials
- Technical specifications for different soil types, slope gradients etc. (spacing)
- Limited contribution to soil fertility level
- Financial assistance to establish demonstration sites, training and extension programs
- Financial assistance to farmers to establish hedges

2- Soil erosion control practices for sloping lands in the Lam Dong province by Nguyen quang Chon.

The aim of this trial is to determine the effect of soil erosion on maize and soya yields in terms of nutrient and soil losses. Vetiver hedge was introduced as a soil control measure to reduce nutrient losses.

Vetiver hedge is a very effective soil erosion control measure on sloping lands of this province. In comparison to other methods such as contour planting of tree crops, contour ridges & contour banks etc. (Average soil loss reduction of between 35 – 52%). Vetiver contour hedge is the most effective and the best soil erosion control measure tested.

RECOMMENDATIONS

- Establishment of nurseries is the first most important step for the introduction of VGT to Vietnam. A nursery in Nghe An province can supply planting materials to both northern and central regions, but a nursery in the south is needed for southern region. Vacvina should have enough experience to establish and propagate vetiver plants for both agricultural and industrial applications.

2- For greatest impact two demonstration trials should be established as soon as enough planting materials become available. One on the Red River bank in Hanoi and one on the National Highway No.1 north of Vinh.

PLAN OF ACTION
As proposed by Mr Chuong, representing MARD at the end of the seminar in Saigon.

MARD (Mr.Bam):
- Summary and proposal to establish VNVN through out VN in the next 2 years
- Present to the Prime Minister and all four Deputy Prime Ministers the effectiveness and benefit of VGT applications in VNVN.
- Establishment of demonstration sites in 3 regions

Summary of results: **Soil loss (*t/ha*) (1995 – 1997).**

Year (age)	Control	Vetiver hedges	% reduction
First year (1995)	31 .143	23 .156	26
Second year (1996)	52 .996	11 .057	79
Third year (1997)	79 .362	10 .243	87

Land slope: 12 – 15°
Nutrient loss in 79 .362 *t/ha* of soil in 1997 was 140 kg of N, 218 kg P_2O_5, 466 kg of N_2O and 1968 kg of organic carbon.

VNVN
- Appointment of Chairperson
- Continuation of the extension effort.

Paul Truong
- Contact and request supply of vetiver planting material from the Director General, Land Development Department, Bangkok.
- Provide technical input in nursery establishment and any demonstration sites in the future**.**

Do you want to support Ken Crismier's efforts in Vietnam. If you do please contact him directly at:
Vietnam Vetiver Network,
4850 156th Avenue NE #359,
Redmond, WA 98052, USA.
Email: kencris@gte.net

POWER FLOUR ACTION NETWORK

The Vetiver Network is helping to promote Flour Power through people and organizations associated with the Vetiver Networ. Flour Power has great potential in reducing malnutrition in young children, and like vetiver the technology is effective, simple and very cheap.

If you want further information and some samples contact:
Thomas H. Hartzell
Power Flour Action Network
1717 Pheasant Lane
Sheboygan
WI 53081-7724
(920) 458 0244
thartzell@tcbi.com

Every year, malnutrition claims somewhere between 10 and 14 million children. These innocents mainly reside in Africa, Asia and Latin America. At present they suffer and die with only the remotest hope of rescue. The Power Flour Action Network is being established in an effort to change all that. With its new and novel approach, the Network hopes to remove an underlying cause of this tragedy: the lack of appropriate babyfoods.

In this project, we are bringing to world attention a technique that is potentially effective for feeding those children at highest risk: the ones born to the poorest of the poor, the ones whose mothers are themselves badly malnourished, and the weanling orphans with no mothers at all. The new technique is notably promising for use in remote locations, in times of want, and in the aftermath of natural or manmade disasters. In can thus reach the populations where mortality from malnutrition is greatest. It complements breast feeding and makes the weaning process more successful for the most threatened individuals in locations where milk and baby formula are unavailable.

The prime "tool" in this new technique is food-grade malted barley. This white powder is nothing more than ground-up sprouted barley grains. It is a flavoring ingredient in malted milk, corn flakes, Grape Nuts, Wonder bread, English muffins, pizza crusts, Milky Way bars and many more foods. The United States, alone, produces thousands of tons of it annually, but none is now used to help starving babies survive.

Nonetheless, food-grade malted barley flour could save lives. It is rich in the enzymes that digest starch. Indeed, it digests starch so well that it turns any hot boiled staple into a fluid. We call it "Power Flour" because it causes such a spectacular transformation.

The approach we envision involves no change in diet, no complex routines to learn, and barely any change in lifestyle. Power Flour would be employed solely to turn a portion of the family staple into a form babies can fill up on. Children have difficulty swallowing corn mush, rice, potato, sorghum, and dozens of other "solids." Power Flour converts those boiled staples into liquids to be drunk. In other words, solids that infants struggle to ingest become suddenly easy to handle with a baby's natural born instincts.

Using Power Flour is simple. The mother merely adds the powder to the hot pablum, porridge, mash, mush or gruel that constitute the basic diet of the poorest of the poor families. The conversion occurs almost instantaneously. The quantity used is very small: a teaspoon of Power Flour easily liquefies a gallon of corn porridge, mashed potatoes, or other boiled staple. The cost is negligible; the price of a teaspoon of Power Flour, for instance, is not even 1/10 of a cent.

Taste is no limitation. Power Flour gives malted milkshakes their flavor. Moreover, its enzymes release sugars from the starch, so the liquefied product becomes doubly palatable. Despite some studies of weaning foods made with starch-digesting enzymes, nothing like this instant, barley-based, food-liquefying catalyst has been employed before.

In everyday practice in the Third World village, the mother merely scoops a sample from the family cooking pot, stirs in a little Power Flour, and passes the resulting fluid to her weanling child. No more fighting to get pablum down; no more diluting pasty foods with potentially contaminated water; no more digestive difficulties from a wad of starch balled up in a tiny tender stomach. The baby feeds itself by sucking a sweetish liquid from a cup.

Power Flour samples could be supplied by the local health service, rural clinics, relief agencies, or other organizations. The raw ingredient could be provided in bulk or in pre-packaged form by United States, Denmark, The Netherlands, South Africa, Japan, or other country that makes food-grade malted barley. The cost would be about 1 cent per child. One cent buys enough Power Flour to catalyze the liquefication of 100 cup-sized servings of the local staple. Ingesting that much food will ensure an infant a full stomach at least once a day. That in turn will remove the threat from inadequate food intake during the early weaning period.

The process is safe. The food has been boiled and thereby rendered free of infection. More than 99 percent of it is the local staple, eaten since time immemorial. The added Power Flour (less than 1 percent) is itself wholesome. The only real changes are the liquid consistency

and the disappearance of starch. In most cases this latter will cause no problem, but the released sugars may perhaps prolong any diarrhea outbreak.

The Power Flour Action Network is being established to get this process employed with dispatch and with appropriate cautions and guidance. Through the Network, information will be communicated to audiences ranging from national leaders to field workers. Trial Power-Flour samples will be provided to interested parties. Research results and field responses will be compiled and disseminated. The Network's written documentation will include a technical overview, a field-guide in different languages, and a newsletter published several times a year. Electronic dissemination will include a website and an e-mail service to answer questions and take orders for Power Flour. A videotape demonstrating the process will also be created. Although the ultimate outcome can only be speculated on, we are confident that the results will be profound. Already, a program directed by former president Jimmy Carter and Nobel Prizewinner Norman Borlaug has found that malnourished children in Ghana's villages ingest three times more food using the Power Flour process. Observers consider that the method makes the difference between life and death for those children. Similar results are reported from Haiti and other spots where fatal malnutrition is prevalent.

The Power Flour Action Network is being established as an IRS-approved nonprofit organization under code 501(3)(c). The activities proposed will help garner the worldwide attention this innovation deserves. In this way, the Power Flour Action Network might well accomplish in a few short years, and at modest cost, a result that multinational, multi-million-dollar organizations could take pride in accomplishing over decades. At present, Power Flour is hardly known to such organizations. By stimulating them and also others outside the mainstream we can swing open a new window of opportunity for reducing the death rate among the world's littlest and least deserving sufferers.

Noel Vietmeyer
President
The Power Flour Action Network
noelvi@aol.com

ROTARY DISTRICT 6270
NEWSLETTER, MARCH 1998
POWER FLOUR UPDATE

The Power Flour project, now in its fifth year, is directed by our District's World Community Service Committee. During the past year, Power Flour(P.F.) has nourished children m HAITI, MALAWI, GHANA, and PERU. A brief description of its role in these third world countries follows. Presently a new Rotary Club in Port-de-Paix is distributing P.F. to drought-stricken families in northwest Haiti. This club has requested an additional 200 pounds of four, as the need continues to help these isolated families.

Three separate feeding programs have been initiated in Malawi, a poor east- central African country, where communication is sadly lacking and infant mortality is alarmingly high. A St Louis Fulbright scholar and pediatrician is monitoring the benefits to Malawian children. Last week, additional P.F. was flown by the Global 2000 project of Jimmy Carter and Nobel laureate Norman Borlaug to supplement Dr. Borlaug's maize introduction in Ghana, which is made into cooked porridge for weanling babies.

The latest success for P.F. has been documented by a botanist who routinely visits Amazonia, Peru. Native Indians who inhabit the area along the Amazon River depend an a beverage they produce from locally grown cassava and plantain. This drink, known as "masato," is the major nutritious food for young children and the elderly. Unfortunately, in recent years, the outbreak of both hepatitis and tuberculosis has been traced through the traditional spittle method of digesting the starch for this fermented beverage. Last year, officials persuaded the Indians to substitute P.F. in preparing the masato, rather than chewing the starch to ferment the beverage. This innovation not only eliminated the disease transmittance, but resulted in a sweeter beverage that was easier to prepare! Additional P.F. will be needed this spring to continue this successful venture.

This month, ten-pound samples of P.F. have been airmailed to caregiving organizations in ETHIOPIA and KENYA. As the benefit of P.F.'s use spreads, more and more countries will need a dependable source.

Our District's Zone A Rotary Clubs have elected to pool their resources to help defray future shipping costs of P.F. If your Rotary Club would like to join in contributing, please contact Ken Schumann, W.C.S. Treasurer at 140 North Ave., Hartland, WI 53029 (Office Phone is 414-367-3322)

An exhibit of this project is planned for the Indianapolis R.I. convention in June. Please stop by to visit and offer suggestions for the future benefit of the P.F. Action Network As R.I. President G. Kinross wrote in the December ROTARIAN MAGAZINE, "This year Rotarians are working to combat poverty and hunger. Children are the major victims of these two evils. Some 18 million people, the majority of them children, die each year from poverty-related causes - most often chronic hunger. And, all of those children who are malnourished between birth

and age three, will live their entire lives with mental deficiencies. In 1998, let us 'SHOW ROTARY CARES' by protecting the children of the world.

Thomas H. Hartzell, 1717 Pheasant Lane, Sheboygan, WI 53081-7724, (920) 458 0244,

Briess Malting Company, PO Box 226, Chilton, WI 53014-0226, Phone 920 849 7711, FAX 920 849 4277

DIRECTIONS FOR USING POWER FLOUR (MALTED BARLEY FLOUR) TO FEED ONE BABY

Prepare a normal porridge-like consistency of the starchy food to be used. This starch source may be maize, rice, cassava, potato, wheat, oats, millet or any other carbohydrate starch source. Remove 1 cup portion (1cup=227 grams) of porridge that is to be

used to feed the baby. When it is "warm to the touch" add 1/4 teaspoon (= 1.3 ml) of Power Flour and stir for several minutes. This will liquify the porridge so that it can be given to the baby By spoon or bottle. The baby will benefit greatly by this method of feeding.

DIRECCIONES PARA USAR POWER FLOUR (HARINA DECEBADA) PARA ALIMENTA A UN BEBÉ

Se prepara normalmente el atol de maiz, arroz.,mandioca, tapioca, papa. harina. avena, mijo u otra comida de fecula.

1 taza = 8 onza = 250 ml
1\4 cucharita = 1.3 ml

Se quita una porcion (una taza) del atol que se va a usar para dar de comer al bébé. Cuando estécaliente, se anade 1\4 cucharita de Power Flour y sc remueve por varios minutos. De esta manera el atol se hace líquido y se puede darselo al bebe por cuchara o por botella. El bebé sacará mucho provecho de esta manera de alimentarlo.

DIRECTIONS: COMMENT SE SERVIR DE POWER FLOUR (FARINE PUISSANTE) (ferine d'orge malt) pour donner à manger à un bé**b**é

Préparez une bouillie (porridge) normale d'une source de fécule, puet-etre mais, riz, cassava, pmme de terre, blé, millet ou aucun autre aliment qui consiste de carbohydrate.

Enlavez une portions d'une tamme (227 grams) de cette bouillie (porridge) qui est preparée pour donner à manager au bébé. Commencez à la chauffer. Quand à d'est chaude au point de toucher, ajoutez 1/4 cuiller à thé (1.3 ml) de cette farine puissant Power Flour) et agitez pour quelques minutes. Ceci liquéfiera la bouilie pour qu'elle puisse etre donnée à manger au bébé per cuiller ou bouteille.

Le bébé benéficiera grandement de cette méthode d'alimentation.

TYPICAL SPECIFICATIONS OF A NATURAL MALTED BARLEY FLOUR

MALTOFERM* MDF F-17
DESCRIPTION:
A white to creamy, NATURAL MALTED BARLEY FLOUR with a pleasant accented malt aroma and flavour. Diastatic
ADVANTAGES:
1) Uniform and improved fermentation. Enzymatic digestion of starch increases production of fermentable sugars aiding in browning and oven kick.
2) Helps reduce dough mix time, improves machinability, extensibility, and gas retention (increased volume).
3) Natural dough conditioner. Improves crumb quality and grain, softer texture and helps extend product shelf life.
4) Provides a clean barley flavour and aroma.

APPLICATIONS:
Bagels, Beverages, Crackers, Flavour enhancer, Ice cream cones, Pita bread, Sauces/gravies, baked Goods, Breakfast cereals, Fermentations, Health Foods, Pancake/waffle mix

SPECIFICATIONS:
Moisture 7.0%
Color (extracted color) 2.0%
Diastase, Lintner minimum...200
Protein (Nx6.25) 12.0%
Fibre (total dietary 7.5%
Fat 2.6%
Ash 1.4%
Carbohydrates 77.0%
Calories 380
Sulfite .....less than 10ppm

LABEL INGREDIENT LISTING:
Barley Malt, Barley Malt Flour, Ground Barley Meal.

SHELF LIFE:
Suggested Storage: 6 months maximum
Storage Temperature: 40º - 75º F
Storage Conditions: Clean dry warehouse

PACKAGING:
50# net weight, multiwall paper bags with polyliner. Heat sealed. 20003 (40 bags) per pallet, stretch wrapped

*DGR LOVIBOND, SERIES 52, 1/2" CELL
The data listed under specifications are subject to the standard analytical deviations. They represent average values, not to be considered as guarantees expressed or implied nor as a condition of sale.

The product information contained herein is correct, to the best of our knowledge. As the statements are intended only as a source of information, no statement is to be

construed as violating any patent or copyright

RECENT VETIVER PUBLICATIONS

Proceedings of the First International Conference: Vetiver: A Miracle Grass, Chiang Rai, Thailand, 4-8 February *1996,* Edited by Narong Chomchalow and Hans V. Henle. Published by The Office of the Royal Development Projects Board, Bangkok, Thailand.

Capim Vetiver – a Barreira Vegetal contra Erosão, Perguntas & Respostas E Proximos Passos. Ciers – Es -Brasil Rede Mundial E Latino-Americano Do Capim Vetiver~Edwin A. Balbarino Rotaclo S. Gravoso

Vetiver Grass: The Hedge Against Erosion. Modfied, printed and distributed by the Kwekwe Environmental Education Programme (KEEP), Zimbabwe.

Bio-Engineering For Effective Road Maintenance In The Caribbean, by J. Clark And J. Hellin. Published by FRP, ODA, NRI

Proceedings of Conference 30, February 22—26, 1999, Nashville, Tennessee. USA International Erosion Control Association Steam Boat Springs, Colorado. USA

Boletín Vetiver Volume 1: Abril 1996 - Junio 1998. La Red Latinoamericana Del Vetiver Enero 1999. Published by La Red de Vetiver Latinoamericana, Apdo. 173-2020, Centro Postal Zapote, San Jose 92332, Costa Rica

Vetiver Grass — A Hedge Against Erosion. Vietnamese translation. Translated and published by Ken Crismier, Vietnam Vetiver Network, 4850 156th Avenue NE #359, Redmond, WA 98052, USA

Vetiver: For Soil Erosion Control. By Edwin A. Balbarino and Rotacio S. Gravoso. Published by Vetiver Network–Philippines (VETINETPHIL) and Farm Resources Management Institute (FARMI)

Pacific Rim Vetiver Network Technical Bulletin No. 1998/2 Vetiver Grass for Slope Stabilization and Erosion Control By Diti Hengchaovanich. Published by the Pacific Rim Vetiver Networ, the Office of the Royal Development Project Board, Bangkok, Thailand.

Pacific Rim Vetiver Network Technical Bulletin No. 1998/1 Vetiver Grass System for Environmental Protection by P Truong and D Baker. Published the Pacific Rim Vetiver Network, Office of the Royal Development Project Board, Bangkok, Thailand.

CD Roms by Paul Truong. Resource Sciences Centre, 80 Meiers Road, Indooroopilly, Queensland 4068 Australia , Tel (07) 3896 9304. Fax (07) 3896 9591 International Code +617 Email: truongp@dnr.qld.gov.au

Vetiver Grass Technology. Research and Development in Australia

Vetiver Grass Technology for Flood Erosion Control on the Flood Plain in Australia

Vetiver Grass Technology for Infrastructure Protection (Globa)

Vetiver Grass Technology for Environmental Protection (In preparation for the IVC2 January 1999)

THE VETIVER NETWORK DIRECTORS AND OFFICERS

Mr. T. James Goering
1603 Wrightson Drive
Mclean, Va 22101-4418, USA
sgoering@juno.com

Mr. John Greenfield.
Edmonds Road, RR3, Keri Keri
Bay of Islands
New Zealand
Tel/Fax: 64-9-4077268
Email:Greenfield@xtra.co.nz

Mr. R. G. Grimshaw (President)
15 Wirt St NW, Leesburg
Virginia 20176
Tel: 703 771 1942
Fax: 703 771 8260
E.mail: Grimshaw_R@vetiver.org

Mr. James Smyle
Apdo. 173-2020
Centro Postal Zapote
Costa Rica
E.mail: hamilton@sol.racsa.co.cr

Mr. Noel Vietmeyer
5921 River Drive, Lorton
Virginia 22079
Tel. 703 339 6161
nvietmey@nas.edu
noelvi@aol.com

Dr. P.K.Yoon
69 Jalan S33/39
Petaling Jaya 47300
Salangor
Malaysia.
tel: 60-3-7762880
Fax: 60-3-777 1966

Mr. Monty Yudelman
World Wildlife Fund
1250 Twenty-Fourth Street, NW
Washington DC 20037-1175
Tel: 202 778 9638
Fax: 202 293 9211

Mr. Paul Zuckerman
The Old Rectory
105 Grovenor Road

London SW1V 3LG
Great Britain
fax: 01718284246
Email: <p.zuckerman-harlowbutler@btinternet.com>

Corporate Secretary
Mr. Mark Dafforn
2817 28th Street NW
Washington DC 20008
Tel: 202 334 2692
Fax: 202 334 2660
E.mail: mdafforn@nas.edu
E.mail: VetiverNet@aol.com

COORDINATES OF REGIONAL AND NATIONAL VETIVER NETWORKS

The Vetiver Network (TVN) - Leesburg - Virginia - USA.

President and Network Coordinator: **Richard Grimshaw**
Address: The Vetiver Network
15 Wirt Street NW, Leesburg
Virginia, 20176, USA.
Tel: 703 771 1942
Fax: 703 771 8260
E.mail: vetiver@vetiver.org
Home page: http:// www.vetiver.org

Corporate Secretary: Mark Dafforn.
Address: 2817 28th Street NW, Washington DC 20008 Tel: 202 334 2692 Fax: 202 334 2660
E.mail: mdafforn@nas.edu
VetiverNet@aol.com

European Representative: Cornelis des Bouvries
Address: Emausland 27, 2012 PH Haarlem, 3123291, The Netherlands, Phone/fax: 31-23-5291682

Far East and Pacific Representative: Dr Paul Truong
Resource Sciences Centre
80 Meiers Road,Indooroopilly,
Queensland 4068, Australia
Tel (07) 3896 9304
Fax (07) 3896 9591
International Code +617
Email: truongp@dnr.qld.gov.au

China Vetiver Network (CVN)
Coordinator: **Liyu Xu.** Address: The China Vetiver Network. Institute of Soil Science, Academia Sinica, PO Box 821, Nanjing, 210008. China. Tel:86-25-3367364
Fax: 86-25-3353590
E-mail:lyxu@issas.ac.cn
HomePage: http://www.vetiver.org

European and Mediterannean Vetiver Network (EMVN)
Coordinator: **Michael Pease**
Address: Quinta das Espargosas, Odiaxere. 8600 Lagos.Portugal
Tel: 351-82-798466. Fax: 351-82-798466
Email:mikepease@mail.telep
Homepage: http://www.vetiver.org

Latin America Vetiver Network (LAVN)
Coordinator: **Joan Miller**
Director: **James Smyle**
Address: La Red de Vetiver Latinoamericana,Apdo. 173-2020, Centro Postal Zapote, San Jose 92332,Costa Rica
E.mail: hamilton@sol.racsa.c o.cr
Tel: 506 255 4011 Fax: 506 522 6556
Homepage:http://www.vetiver.org

Madagascar Vetiver Network (MVN)
Network coordinator Antananarvo**:Voahangy Randriambololona**
Network representative Fianarantosoa:**Jacque Ravelonahina**
Network representative Mahajanga:**Guy Robert Ribearivon**y
Network representative Ambatondrazaka: Belazard Andriambolasoa
Network representatives
Peace Corps: **Betsy Carlson, Joe Shaefer**
Address: Vetiver Network de Madagascar, Boite Postal 4301 Antananarivo, 101, Madagascar
Email:nr@chemonics.mg
Phone:261 22 348 08
Fax: 261 22 348 01

Pacific Rim Vetiver Network (PRVN)
Executive Secretary: Dr. Sumet Tantivejkul
Editor:**Narong Chomchalow**
Email:<journal@au.ac.th>
Admin. Contact:: **Suwanna Pasiri**, Email: pasiri@mail.rdpb.go.th
Address:Pacific Rim Vetiver Network (PRVN),Office of The Royal Development Projects Board, 78 Rajdamnern Nok Avenue, Dusit, Bangkok 10300, Thailand
Tel:(66-2)-2806193-200
Fax: (66-2) 2806206, 629-8915
Homepage: http://prvn.rdpb.go.th

Southern Africa Vetiver Network (SAVN)
Coordinator: **Duncan Hay**
Address: Southern Africa Vetiver Network, Institute of Natural Resources University of Natal, Private Bag X01, Scottsville 3209 Republic of South Africa.
Email: hay@inr.unp.ac.za
Tel: 0331 46 0796.
Fax: 0331 46 0895

Vetiver Network Philippines (VETINETPHIL)
Coordinator: **Mr. Edwin Balbarino**
Address: The Vetiver Network, Philippines, The Farm Resource Management Institute, FARMI-ViSCA, Baybay, Leyte, The Philippines. .Tel:053 335 2630
Fax: 053 335 2433 Cell Phone: 0918 601 0530
Email:vnp-ed@mozcom.com

Vetiver Network Thailand (VNT)
Contact: **Suwanna Pasiri**
Email: pasiri@mail.rdpb.go.th
Address: Office of The Royal Development Projects Board, 78 Rajdamnern Nok Avenue, Dusit Bangkok 10300, Thailand
Tel: (66-2)-2806193-200
Fax: (66-2) 2806206, 629-8915
Homepage: http://thvn.rdpb.go.th

West Africa Vetiver Network

(WAVN)
Coordinator: **Linus Folly**
Address: West Africa Vetiver Network, CEDIA, PO Box C-753 Accra, Ghana

Vietnam Vetiver Network
Coordinator: **Ken Crismier**, Vietnam Vetiver Network, 4850 156th Avenue NE #359, Redmond, WA 98052, USA.
Email: kencris@gte.net

Cameroon Vetiver Network
Coordinator: **Ngwainmbi Siimon**, C/O BERUDEP,PO BOX 10, Belo-Boyo, NW Province, Cameroon

Seychelles Vetiver Network
Contact Person. David Barker at <eco-engineer@bigfoot.com>

Haiti Vetiver Network
Contact**: Calvin Bey** at <cfbey@erols.com>

The Vetiver Network is a registered on profit organization under IRS code 509(a) (1). Donations to the Network are welcome and are tax deductable.

The Network produces a biannual newsletter edited and published by Dick Grimshaw. We encourage those interested in vetiver technology to participate by contributing articles to the network.

The Network also manages ahomepage on the Internet at http://www.vetiver.org. Most articles are published on the homepage and the associated ftp site at ftp://www,vetiver.org. The small green handbook, including diagrams, "Vetiver a Hedge against Erosion" can be downloaded from the ftp site

FIRST ANNOUNCEMENT

Vetiver and the Environment

The Second International Conference on Vetiver To Commemorate the Sixth Cycle Birthday Anniversary of His Majesty the King of Thailand

Phetchaburi, Thailand, 17-21 January 2000

It is undeniable that man is a main source of changes in the world geography and environment. Explicit examples of such act include the explosion of mountains to build roads, drilling of mountains to operate a mineral mine, construction of dykes along rivers which creates large bowl of water storage comparable to a lake, or the destruction of forest resources. Besides those, other causes include chemical changes in the atmosphere as a result of emission of gas or certain types of chemical substances, earthquakes, landslide and land subsidence, extinction of wild animal and plant species, as well as waves of extreme heat or drought which have occurred in several parts of the world. Undesirable and critical changes to the environment caused by man are now having impacts on human lives beyond control. Worst of all, one cannot anticipate the possible disastrous outcomes of this ongoing situation.

In response to this, different countries are earnestly trying to resolve or mitigate the problems by using several measures. Different methods including reliance of heavy machinery and cultivation of various crops have been attempted to resolve and prevent the problem. However, some of the methods incurred high costs and the technologies applied are too complicated for farmers to implement.

It has been proven worldwide that vetiver grass grown as contour barriers across sloping lands provides a low cost and sustainable system with numerous advantages for environmental conservation e.g. preventing and controlling soil erosion, maintaining soil moisture, trapping heavy metals and other toxic materials before they reach valuable natural resources etc. Moreover, the grass's ability to grow in areas containing high levels of toxic substances proves significant in removing heavy metals and other toxic materials by increasing the organic content and allowing the translocation of plant nutrients in the soil. All these help improve the conditions of the area, in terms of soil nurturing and atmospheric moisture.

Thailand is a country which faces the problem of soil erosion and has been utilizing vetiver grass in many areas throughout the country. In 1992, His Majesty King Bhumibol Adulyadej of Thailand graciously granted initiatives to relevant agencies to use vetiver grass for conserving soil and water as well as for other purposes on a continual basis. Consequently, study, experiment, research, together with actual cultivation of the grass in different areas, have been carried out. The fruitful results of the experiments have been extended to farmers who applied the cultivation on their own land and successfully improved the soil, allowing the benefits from farming to be realized.

On 4-8 February 1996, Thailand received the honor from The Vetiver Network to host the First International Conference on Vetiver in Chiang Rai province under the name *"Vetiver: A Miracle Grass".* The seminar ended with overwhelming success in widely disseminating vetiver uses and benefits. On the auspicious occasion to commemorate His Majesty King Bhumibol Adulyadej's Sixth Cycle Birthday Anniversary on 5 December 1999, Thailand is once again given the privilege by the Interim Committee for the Second International Conference on Vetiver to host this second seminar. The main objective of this seminar (ICV-2) is to show that vetiver grass is one of the simple and low cost solutions to deal with a broad and ever increasing range of environmental problems.

Conference Theme
Towards the new millennium : an era of practical and economical methods of vetiver utilization for environmental conservation and protection.

Objectives
1. To commemorate the Sixth Cycle Birthday Anniversary of His Majesty King Bhumibol Adulyadej of Thailand;
2. To provide an international forum for experts to exchange views, knowledge and new techniques on the utilization of vetiver, especially on its attributes in environmental conservation and protection;
3. To educate the public and disseminate the knowledge on vetiver, its usage and application.
4. To be a venue for different vetiver networks and dissemination units all over the world to share their work experiences and achievements.

Organizing Agency
The Chaipattana Foundation and the Office of the Royal Development Projects Board, Thailand.

Conference Technical Program
The conference technical program will be divided into 4 main sessions: plenary sessions, concurrent sessions, poster sessions, and technical tours. Research works and experiences on the following topics will be presented:

1. Soil and Water Conservation Attribute
   - erosion control in agricultural areas
   - land rehabilitation- watershed management
   - improvement of extreme soil
   - sedimentation control - irrigation
   - soil fertility improvement and associated impacts on farming practices
   - waterway stabilization

2. Pollution Control and Treatment / Restoration and Rehabilitation of Disturbed and Contaminated Areas
   - wastewater treatment
   - wasteland
   - mine spoils
   - highway and other constructions
   - non-point source pollution
   - bioengineering applications
   - pollution from construction

3. Disaster Prevention
   - flood control
   - fires
   - hurricanes
   - structural failure
   - droughts
   - mudslides

4. Training and Technology Dissemination
   - vetiver network experiences
   - best practices of vetiver promotion
   - available sources of vetiver for dissemination

- economic way for vetiver application and for improving planting practices

5. Basic Research and General Studies
   - environmental tolerances and responses
   - taxonomy
   - pest and plaque resistance
   - genetic research
   - heavy metal accumulation
   - association with other species
   - CO_2 absorption - etc.

6. Alternative Uses of Vetiver
   - construction materials
   - supplementary feed
   - handicraft
   - weed prevention
   - energy source
   - essential oils & traditional medicine

7. Other Topics
   - vetiver on national policies
   - hydrologic regime regulation
   - use of vetiver grass and its role in the certification of sustainable agriculture

Technical Tours
With particular reference to the environment, four sites for technical tours on vetiver researches, applications, and technology dissemination to farmers have been selected. Huai Sai Royal Development Study Center and Chaipattana-Mae Fah Luang Reforestation Project in Phetchaburi Province will provide activities concerning researches and applications of vetiver while visiting to a farmer's farm will enable the participants to see the practical use of vetiver and the successful application of vetiver.

Participants
A total of 300 participants are expected to attend ICV-2. These include about 120 international vetiver experts from countries of all regions, international organizations and development agencies.
Additionally, about 180 local experts from Thai government agencies as well as non-governmental organizations involved in the utilization of vetiver are also anticipated to join the conference.

Venue and Date
Cha-am Regent Beach Resort Hotel, Phetchaburi, Thailand, on 17-21 January 2000.

Official Language
The official language as well as all documents during the conference is English.

Registration Fee
As this Conference is organized to commemorate His Majesty the King's Sixth Cycle Birthday Anniversary, all participants will be treated as our special guests. Thus, there will be no fee for registration. This includes the attendance of all sessions, the provision of all documents, and transportation while attending the ICV-2 (includes pick-up service from and to Bangkok Airport and study tours) However, due to the prevailing economic crisis, all participants are required to pay their own accommodations and all meals during the conference period.

Sponsorships
There will be a limited number of sponsorships for qualified participants from the least developed countries. Those interested should send, along with the pre-registration form, their curriculum vitae indicating work experience related to the topics in the technical programs.

King of Thailand Vetiver Award
King of Thailand Vetiver Award has been announced since June 1997. According to the announcement, His

Majesty the King of Thailand has agreed to award two US $5,000 from the Chaipattana Foundation funds. One award will be granted to the best vetiver research work while the other for the best dissemination of vetiver technology. Nominees for these awards have already been selected by a committee of The Vetiver Network who sent them to the Thai Committee for the selection of the winners. The awards have not been judged, however, since it was considered that as Thailand is about to host ICV-2, these awards should be extended to provide opportunity to other qualified persons whose papers will be presented at the concurrent sessions and the poster session at the ICV-2. Winners of the award will be announced in December 1999 and will be invited to attend conference with full sponsorship.

Spouse Program

During the conference period, a spouse program will be provided for participants' spouses or followers to visit interesting places which are abundant in the area such as the near-by Cha-am and Hua Hin beaches, world famous's Dammoen Saduak Floating Market, Khao Wong Heritage Park, and Khao Luang Cave. The program will be arranged by Tourism Authority of Thailand (TAT), the detailed information of which will be found in the Second Announcement.

Post Conference Tour

The post conference tour will be organized in collaboration with TAT for the participants and their spouses to visit vetiver growing and applications in areas other than those specified in the technical tour program. The proposed areas will either be: (i) Chiang Mai and Chiang Rai in the North, or (ii) Pattaya in the East, or (iii) Phuket and Hat Yai in the South. Participants will have a chance to visit vetiver application fields as well as world famous tourist attractions of Thailand. More details will be provided in the Second Announcement.

Second Announcement

The Second Announcement which will include detailed programs, instructions for submitting abstracts and papers, registration form and accommodation will be available in August 1999. It will be sent only to those who pre-register with the attached form (may be photocopied if more copies are needed).

Pre–registration Procedure

Pre–registration for the conference can be made through 3 different channels :

1. Fill out the form below and fax or mail it to the Secretariat of the Conference at the address specified at the end of the announcement.
2. Fill out the form attached in the First Announcement sent by the Secretariat , then send the filled form for pre–registration. In case you have not received one please request for the announcement from the Secretariat at the address below.
3. On-line registration through PRVN web site at 'http://prvn.rdpb.go.th'.

PRE-REGISTRATION FORM

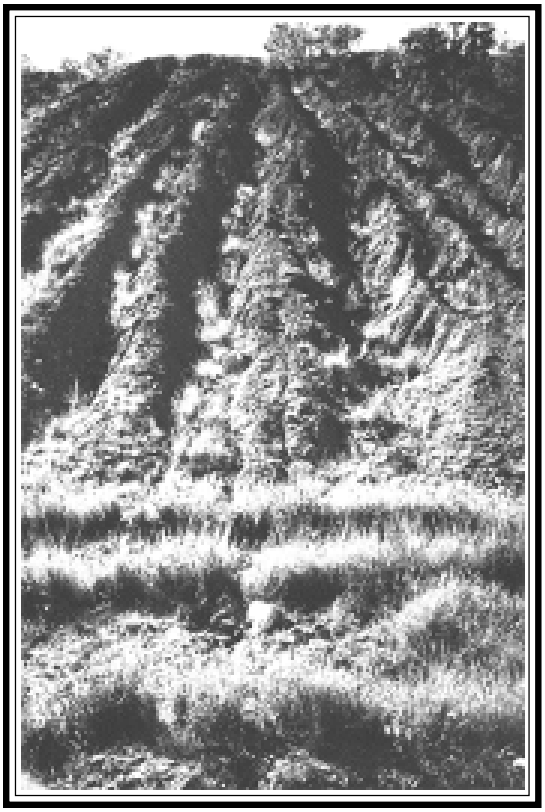
First Name …….....
Last Name :.....
Position .....
Organization :.....
Country :.....
PostalAddress :.....
.....
.....
.....
Tel : (.....) (.....) Fax : (.....) (.....)
E-mail .....

Please check (X) in the box below.

( ) I want to receive the Second Announcement.
( ) I plan to present a paper.
( ) I plan to attend the Conference.
( ) Please mail the First Announcement to:
Name .....
Address .....

.....
Country .....
Tel : (.....) (.....).....
Fax : (.....) (.....).....
E-mail :.....

Australia, Queensland: A Severely eroded gully rehabilitated with vetiver grass hedgerows. Photo Credit: **Paul Truong.**



Left: Australia, Queensland: Coal mine tailings stabilized with vetiver. Note vetiver has been planted up and down in the deep rills and in hedgerows across the bottom of the tip. Once vetiver is established natural grasses and shrubs can colonize the area. Photo Credit: **Paul Truong.**

Below: Australia, Queensland: Vetiver Grass Hedgerows planted along housing area to stabilize the embankment and prevent pollution and trash “invading” the road. Photo Credit: **Paul Truong.**

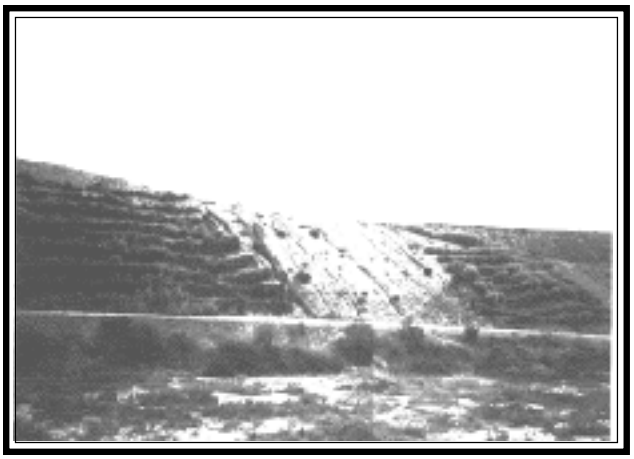
Australia, Queenslan:. Highway drain stabilized with vetiver grass hedgerow. Note the trapped silt behind the hedge. Photo Credit: **Paul Truong.**

Australia: Queensland: The bitumen edge of a highway stabilized with vetiver grass hedgerow. Photo Credit: **Paul Truong.**

China, Guangdong Province: A coastal area subjected to highwinds. Here vetiver has been planted between casurina trees on sand dunes close to the sea to help reduce wind erosion. Photo at right is a close up of well grown vetiver on beach sand. Photo Credit**: Xia Hanping.**

China, Hubei Province: Vetiver planted in 1998 as hedgerows to protect terraced land. Photo Credit: **Liyu Xu.**

Haiti: Vetiver Grass Hedgerows planted to protect vegetable gardens on degraded lands. Photo Credit: **Calvin Bey**.



Spain, Lorca: These vetiver hedgerows were planted four years ago to protect a fill sesction of a highway. Note the control section in the center where major and deep rilling has occured. Once the vetiver is properly established (right) natural vegetation colonizes the inter hedge areas. The climate here is Mediterranean with a rainfall of only 250 mm per year. Photo Credit: **Mike Pease**

Philippines: Vetiver hedgerows under partial shade protecting a fruit orchard. Rainfall over 2000 mm annually. Photo Credit: **Noah Manarang.**

Philippines: Containerized vetiver plants being readed for planting on a steep highway cut. Photo Credit: **Noah Manarang.**

Sri Lanka: Vetiver hedgerows used to protect tea gardens and to reduce silt from filling the old silt traps in the tea gardens. Photo Credit: **Andrew Taylor.**

Sri Lanka: Vetiver hedgerows used to protect the side of a black top road and adjacent tea gardens. Photo Credit: **Ananda Fernando.**

Table of Contents