

ECOLOGICAL IMPACT OF VETIVER IN FOREIGN ENVIRONMENTS

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Abstract

Organisms are considered non native when they occur artificially in locations beyond their known historical natural ranges. Non-native can refer to species brought in from other continents, regions, ecosystems and even other habitats. Invasive non-native organisms can be serious threats to the natural ecosystems. Vetiver grass (*Vetiveria zizanioides*), recently reclassified *Chrysopogon zizanioides*, originated in south India, is non invasive and has been proven so both technically and from observation. Nowhere has it ever been reported to be invasive. It is also the most robust and effective variety for use under the Vetiver System. Based on DNA fingerprinting data, it appears that almost all the vetiver used for erosion control outside South Asia has been derived from a single genotype, which we call 'Sunshine'. Vetiver grass is tolerant to most pests and has not shown to be a problem host plant affecting other plants. Vetiver grass provides, apart from its uses under the Vetiver System, many associated and useful attributes. As a pioneer species it enables native species to establish on degraded sites where under normal circumstances it is impossible for the latter to develop. Vetiver grass provides habitat, shelter and forage to fauna. It provides a habitat to beneficial parasitic pests such as the parasitic wasp. In summary vetiver grass is a very well behaved grass, it is not invasive or a threat to other plants.

Key Words Vetiver grass, invasiveness, *Vetiveria zizanioides*, *Chrysopogon zizanioides*

Introduction

Every species of plant, animal, fungi, bacteria and other organism has a home in some part of the world, where it has existed for many thousands of years as a result of natural forces and influences like climate, storms, moisture, fire, soils, species interactions, and adaption. A native (indigenous) species is one that occurs in a particular region, ecosystem, and habitat without direct or indirect human actions.

Organisms are considered non native when they occur artificially in locations beyond their known historical natural ranges. Non-native can refer to species brought in from other continents, regions, ecosystems and even other habitats.

Invasiveness. The most important aspect of an alien plant is how it responds to a new environment. An invasive species is one that displays rapid growth and spread, allowing it to establish over large areas. Free from the vast and complex array of natural controls present in their native lands, including herbivores, parasites, and diseases, exotic plants

may experience rapid and unrestricted growth in new environments. Invasiveness is enhanced by features such as strong vegetative growth, abundant seed production, high seed germination rate, long-lived seeds, and rapid maturation to a sexually reproductive (seed-producing) stage. Invasive plants reproduce rapidly, either vegetatively or by seed. Their phenomenal growth allows them to overwhelm and displace existing vegetation and form dense one-species stands.

Impacts of Invasive Alien Plants. Invasive non-native organisms can be serious threats to the natural ecosystems. These unwelcome plants, insects and other organisms can disrupt the ecology of natural ecosystems, displace native plant and animal species, and degrade a nation's unique and diverse biological resources. Aggressive invaders reduce the amount of light, water, nutrients and space available to native species, alter hydrological patterns, soil chemistry, moisture-holding capacity, and erodibility, and change fire regimes.

Some of the known ecological impacts of invasive plants are summarized below, and include:

- reduction of biodiversity
- loss of and encroachment upon endangered and threatened species and their habitat
- loss of habitat for native insects, birds, and other wildlife
- loss of food sources for wildlife
- changes to natural ecological processes such as plant community succession
- alterations to the frequency and intensity of natural fires
- disruption of native plant-animal associations such as pollination, seed dispersal and host-plant relationships.

Invasive alien plants:

- compete with and replace rare and endangered species
- encroach upon limited habitat of rare and endangered species
- disrupt insect-plant associations necessary for seed dispersal of native plants
- disrupt native plant-pollinator relationships
- reduce and eliminate host plants for native insects and other wildlife
- serve as host reservoirs for plant pathogens and other organisms that can infect and damage desirable native and ornamental plants;
- replace nutritious native plant foods with lower quality sources
- prevent seedling establishment of native trees and shrubs
- reduce the amount of space, water, sunlight and nutrients that would be available to native species
- increase erosion along stream banks, shorelines and roadsides
- change characteristics of the soil structure and chemistry
- alter hydrological flows and conditions

Impact of Vetiver grass in a new environment

The above paragraphs set out characteristics of what we do not want in an introduced species, fortunately the variety of vetiver grass used around the world when applied under the Vetiver System does not exhibit any of the above negative characteristics - on the contrary, as has been seen during the series of presentations, it exhibits characteristics that actually enhance the growth and development of native species and the ecology in general.

Vetiver grass (*Vetiveria zizanioides*), recently reclassified *Chrysopogon zizanioides*, originated in south India, is non invasive and has been proven so both technically and from observation. It is also the most robust and effective variety for use under the Vetiver System.

Is vetiver grass invasive? The south Indian cultivar of *Vetiver zizanioides* has over time evolved into a domesticated variety was introduced by the colonial powers and migrating Indian labor to most of the world's tropical countries, and has been present in these countries for probably 200 years. Nowhere has it ever been reported to be invasive, in fact it is so well behaved that it has never moved from where planted by man, and many citizens do not even know of its existence in their own countries. The reason why it is not invasive and is not considered a weed is because often the plant never flowers, or when it does it produces seeds that are sterile. Further the plant reproduces vegetatively through root/tiller division, and is not stoloniferous – thus its roots do not invade adjacent areas, as do grasses like, Bermuda, Kikuyu, and couch grass.

A country such as Australia applied very strict controls and test before allowing the 'Monto' cultivar of vetiver to be generally released in Australia. Even so it was probably due to the fact that the grass has existed in the zoological gardens in Brisbane for decades without exhibiting invasive tendencies that allowed its use and release in Australia.

“Fears of the possibility of vetiver grass (Vetiveria zizanioides) becoming an environmental weed on Cape York Peninsula led to an investigation of the risks. As part of the investigation an assessment of the prospect of its uncontrolled spread by seed from plantings made for roadside stabilization was undertaken. Seed heads of plants of the apparently sterile cultivar Monto established vegetatively on road works in Cook Shire were screened for their ability to produce true seeds (caryopses). Samples averaging about 38 seed heads each had been collected for screening from eight sites on 2 occasions in March 2002 when the heads were ripe. In all, about 119,000 potentially fertile seed structures (sessile spikelets) were processed, but only 3 caryopses were found, a level of fertility of almost 1 in 40,000 or 0.0025%. The caryopses appeared to be structurally perfect, which was taken as an indication of the ability of Monto vetiver to produce viable seed in the conditions where it is grown, albeit with an extremely low level of success. The level of fertility is considered far too low to allow significant natural spread of vetiver by seed. The likelihood of fertility levels rising significantly in subsequent generations of plants derived from Monto vetiver, judged from overseas experience, is also very low. The only foreseeable risk of a rise in fertility of vetiver would come from the introduction of entirely different seeding types.”¹

Tim Low is the author of the book “Feral Futures”, he is highly regarded by various environmental groups world wide. TVN asked Tim to check out Vetiver weediness. This was his findings:

From: Tim.Low@uq.net.au 29-Jul-2001

I will put out a message over the Aliens list-server, which focuses on exotic pests, asking about the weediness if any of seedless vetiver.

Does anyone have evidence of seedless vetiver grass becoming a weed? Is it safe to use this plant in soil stabilisation projects?

From: Tim.Low@uq.net.au

It looks like vetiver comes up clean. I posted a message all over the world and no one has come up with firm evidence against it. This doesn't mean it is entirely safe, but certainly that it isn't known to be a risk.

Tim

Some Responses to Tim Low's enquiry:

Rod Randall

Weed Science Group
Department of Agriculture
Western Australia 6983

Tim,

As far as I am aware the clonal sterile form of *Vetiveria zizanioides* is pretty well behaved. Make sure however that anyone decides to use this species only uses clonal cuttings from a reliable supplier. We have seeding plants in Western Australia around Geraldton that were planted by people who thought they had researched adequately but were not aware of the difference between seed and clonal cuttings!!!

Cheers,

Rod

From: Dr. Christophe LAVERGNE

Environmental Weed Ecologist
Laboratoire de Biologie Végétale
Université de La Réunion - Faculté des Sciences et Technologies
Ile de La Reunion (France)

Tim,

In Reunion Island, it is cultivated for a long time for essence (100 or 150 years). And we never have any problem at that time. It is now more and more planted along track and foot-path to ornament and to stabilize soil.

From: "David Le Maitre"

Environmentek CSIR

Stellenbosch 7599

South Africa

Hi Tim

Vetiver has been used quite a bit in South Africa but I am not aware of any case where it has become a weed. Let me know if you do find a case of it being invasive.

From: Duncan Hay [<mailto:Hay@nu.ac.za>]

Director, Natural Resources Institute,
University of Natal
Natal, South Africa

Hi Tim,

I must have seen hundreds of applications over the last four years and together with my colleagues it must amount to thousands. In no instances were there any signs of spreading beyond discreet hedges. As vetiver has been used in South Africa for at least 60 years and might date back further we would have seen some sign of invasiveness if there were any.

Another curious phenomenon is that when researchers were doing genetic analysis on vetiver they found no viral DNA and I have never seen any sign of disease on plants. This would seem to indicate that vetiver does not carry much in the way of plant pathogens to spread to indigenous grass species.

The north Indian variety – *Vetiveria zizanioides* – bears the same generic name as the south Indian domesticated variety and is weedy. The two plants are distinctly different and should be classified differently. The north India - Gangetic basin vetiver grass that extends into Bangladesh and Nepal is not recommended.

Studies on the DNA of *Vetiveria* spp. show “*Based on DNA fingerprinting data, it appears that almost all the vetiver used for erosion control outside South Asia has been derived from a single genotype, which we call 'Sunshine'. Nevertheless, discontinuities of geographic and genetic patterns in our analysis imply much vetiver diversity awaits discovery*”.²

The cultivars of vetiver used in Australia, South Africa, Portugal, Italy, China, Central and South America, Vietnam, Indonesia, Madagascar, West Indies and East and West Africa, amongst others, under the Vetiver Systems program are nearly always of the “Sunshine” derived genotype. This means that they all exhibit non-invasive characteristics as well as the other characteristics of vetiver grass for conservation and slope stabilization. It also means that except for some minor use adjustment to specific areas and needs this genotype can be used reliably without repetitive research.

The north Indian variety of *Vetiveria zizanioides* and the African *Vetiveria nigritana* are fertile. They have distinct characteristics. They have been used for soil conservation purposes, but they are not as robust. Even these varieties have not shown strong invasive characteristics, they normally do not thrive outside of wetland conditions. Livestock owners see them as important forage species in flood plain zones.

Pest problems associated with Vetiver Grass

“The main pest problems reported with vetiver have been few: fungal dieback from Helminthosporium and Bipolaris, bacterial leaf blight from Xanthomonas, sooty molds such as Meliola, stem borers and white grubs, maize cyst and root-knot nematodes, termites, and rats. The genus is susceptible to smuts from Tilletiaceae and from Ustilaginaceae. There is even an ascomycotina fungus called Phyllachora vetivericola indigenous to Gorakhpur, India. - members of the genus cause leaf-spotting (black spot, tar spot) and they may be genus specific (there are species named P. sorghi, P. sacchari, P. maydis; P. eucalypti, P. ficium, etc.).

None of these pathogens have caused a failure of vetiver in the field, nor is there evidence of transfer to other crops. There are no reported cases of vetiver serving as a reservoir for pests or plagues, even when infected plants grow next to hosts. Vetiver has been cultivated on a large scale as an essential-oil plant for centuries, generally in association with our other economic plants. Its vulnerabilities and their treatments are well-covered in the literature. Each of the pests, even the stem borers, is harbored by many other species, so vetiver is not forming a unique refugia. Proper maintenance reduces or eliminates them as problems. Extension officers in Fiji, where there is the longest scientific field experience with vetiver hedges, have pointed out that under a proper maintenance program all known problems can be adequately overcome.”³

Positive attributes of vetiver grass that enhances the environment. Vetiver grass provides, apart from its uses under the Vetiver System, many associated and useful attributes. As a pioneer species it enables native species to establish on degraded sites where under normal circumstances it is impossible for the latter to develop. In most instances where these “natives” have become well established they “shade out” and displace the vetiver. Vetiver grass provides habitat, shelter and forage to fauna. It provides a habitat to beneficial parasitic pests such as the parasitic wasp.

Vetiver grass has extremely good roots that can penetrate through hard pans and other difficult soil layers and types. This results in better drainage and better flushing of sweet water desalination of surface salts. Its’ leaves, if cut and used as mulch or compost,

improve soil organic matter and recycles normally unavailable nutrients to other plants and crops.

It improves soil moisture by reducing the rate and velocity of rainfall runoff; it protects stream banks, and removes unwanted toxic chemicals. It enhances overall water quality in river basins.

Vetiver has other attributes that impact the environment. Because of its great root mass it makes an excellent atmospheric carbon sink, (A close relative of vetiver grass, *Andropogon guyanus*, stores as much as 53 tons of carbon dioxide as organic matter per hectare per year), and if grown on a large enough scale could qualify for carbon offset credits. Vetiver has a greater root mass than *Andropogon guyanus* and therefore could be expected to store more carbon.

It also has, as oil prices increase, potential as an energy source for electricity generation. In the Dominican Republic vetiver grass produces as much as 70 tons of dry matter per ha from brackish water irrigation. 1 kg of dry vetiver grass produces 17,000 BTU compared to 45,000 BTU from oil. As the price of oil increases vetiver becomes an interesting and economic potential energy producer. Linked with carbon credit income, it is estimated that an economic rate of return of about 13% might be achievable if used for energy.

It is difficult to find a “downside” to Vetiver grass. It has been well researched, has great economic and environmental potential, and is easy and safe to use.

¹ Hopkinson, John. (2002). The Potential Of Vetiver Grass To Produce Fertile Seed When Used For Roadside Stabilisation In Cook Shire. Report to Paul Graham (Main Roads Dept, Cairns). Full paper at <http://www.vetiver.org>

² Adams, Robert, and Dafforn, Mark, R (2000) DNA fingerprints (RAPDs) of the pantropical grass vetiver, *Vetiveria zizanioides* (L.) Nash (Gramineae), reveal a single clone, 'Sunshine', is widely utilized for erosion control. Proceedings of the 2nd International Vetiver Conference, Thailand.

³ Dafforn, Mark, R (1996). Know Your Hedge Vetiver: Environmental Concerns About *Vetiveria zizanioides*. Office of International Affairs, National Academy of Sciences, Washington, DC 20418, USA.