VETIVER GRASS FOR ENVIRONMENTAL PROTECTION AND LANDSCAPING IN AUSTRALIA AND AROUND THE WORLD

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ABSTRACT

R & D works in several countries, particularly Australia, have established that vetiver grass can tolerate extremely adverse conditions including high nutrient load and heavy metal toxicities in the growing medium. As a result of these extraordinary attributes, vetiver has been used successfully in more than 120 countries for environmental protection purposes, particularly in the area of treating polluted or contaminated water.

Vetiver is a tall and erect grass; it has light purple flower heads but sets no seed. When planting close together in row it forms a dense hedge or in space planting, it can be easily incorporated into general landscaping plan.

Vetiver grass has been previously used for landscaping in Asia, Europe and Africa, but recently it has also been used successfully for both pollution control and landscaping at the same time in some Delfin Lendlease Corporation projects in Australia.

Delfin Lendlease is one of Australia leading Land Development Corporations, currently developing a number of prestigious housing estates in Queensland. The main focus of Delfin is to create an environmentally friendly atmosphere for their residents, hence environmental protection, improvement and landscaping are their major aims.

This paper describes how the Vetiver System is being used for environmental protection and landscaping at some Delfin Lendlease estates in Australia and examples of its uses around the world.

Keywords; pollution control, landscaping, vetiver flower

1.0 INTRODUCTION

R & D works in several countries in Asia, Africa and particularly Australia, have established that vetiver grass can tolerate extremely adverse conditions including high nutrient load and heavy metal toxicities in the growing medium (Truong and, Smeal, 2003). As a result of these extraordinary attributes, vetiver has been used successfully in more than 120 countries for environmental protection purposes, particularly in the area of treating polluted or contaminated water.

In addition to these special physiological attributes, vetiver grass also has a very attractive morphological appearance, which makes it highly suitable as an ornamental plant (Truong and Pease, 2001). The combination of the above characteristics makes vetiver grass an ideal plant for environmental protection and landscaping.

This paper present the results of a project carried out at Delfin Lendlease estates in Queennsland for pollution control and landscaping. In addition the use of vetiver as an ornamental plant around the world will also be included.

2.0 SPECIAL ORNAMENTAL CHARACTERISTICS OF VETIVER GRASS

The following features contribute to the ornamental value of vetiver grass:

2.1 Morphological Attributes

- Beautiful fine stem flower heads with light purple flower, turning to mauve colour later, (Photo 1).
- Stiff and erect stems, up to 2m high, which can be trimmed to form neat hedges, (Photo 2).
- Vetiver grass has no stolons, very short rhizomes so it does neither invade nor compete with near by plants
- A massive and penetrating root system that can grow very fast, up to 3-4m in the first year. This massively thick root system can penetrate hardpan, enhances the structural strength and organic content of the soil and at the same time makes it very tolerant to drought (Photo 3).
- New shoots develop from the underground crown making vetiver resistant to fire, frosts, traffic and heavy grazing pressure.
- New shoots continuously form from the crown so the base of vetiver is always thick, active and resume fast growth.
- New roots grow from nodes when buried by trapped sediment. Vetiver will continue to grow up with the deposited silt eventually forming terraces, if trapped sediment is not removed.

Photo 1: Light purple flowers, turning to mauve colour later

Photo 2: Trimmed to form neat hedges

2.2 Physiological Attributes

- Tolerance to extreme climatic variation such as prolonged drought, flood, submergence and extreme temperatures (-15^{0}C to 60^{0}C). Effective vetiver hedges have been established with annual precipitation levels as low as 300mm and with up to 6 month drought.
- Ability to regrow very quickly after being adversely affected
- Tolerance to a wide range of soil pH (3.0 to 10.5).
- Highly tolerant to growing media high in acidity, alkalinity, salinity, sodicity and magnesium.
- Highly tolerant to Al, Mn and heavy metals such as As, Cd, Cr, Ni, Pb, Hg, Se and Zn in the soils (Truong & Baker, 1998).

2.3 Ecological Attributes

- Vetiver is sterile, it flowers but produces no seeds, so it is not invasive and has no weed potential
- Vetiver planting can also provide wild life sanctuary:
    - In Australia very small native finches often nest on mature vetiver leaves as its thick and tall growth protects the nests from wind and birds of prey.
    - Other birds, particularly waterfowl, are attracted by the protection provided by a vetiver hedge, especially when it is planted around lakes and ponds.

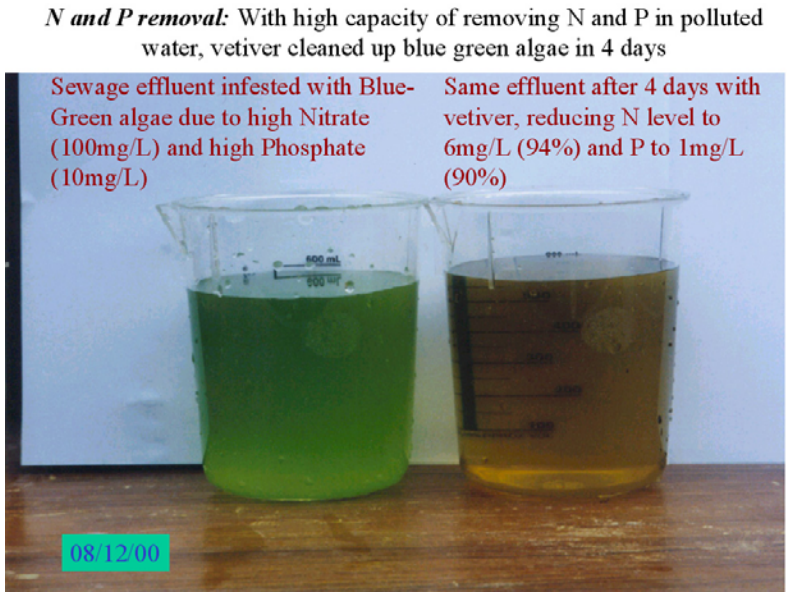
3.0 SPECIAL POLLUTION CONTROL FEATURES OF VETIVER GRASS

- Highly efficient in absorbing dissolved nutrients and heavy metals in polluted water (Zheng *et al.* 1997) (Photo 4).
- Highly tolerant to extremely high pollutant levels (Truong and, Smeal, 2003).
- High level of tolerance to herbicides and pesticides (Cull *et al*. 2000; Truong *et al*. 2000).
- When planted close together the stiff and erect stems will which form dense hedges. These hedges can stand up to deep and rapid water flow, and acting as water spreaders to reduce flow velocity and as bio-filters to trap sediment.

- Highly resistant to pests, diseases and fire, Vetiver does not harbour pests or diseases and does not act as a host for pests that may attack nearby plants (Chen, 1999).

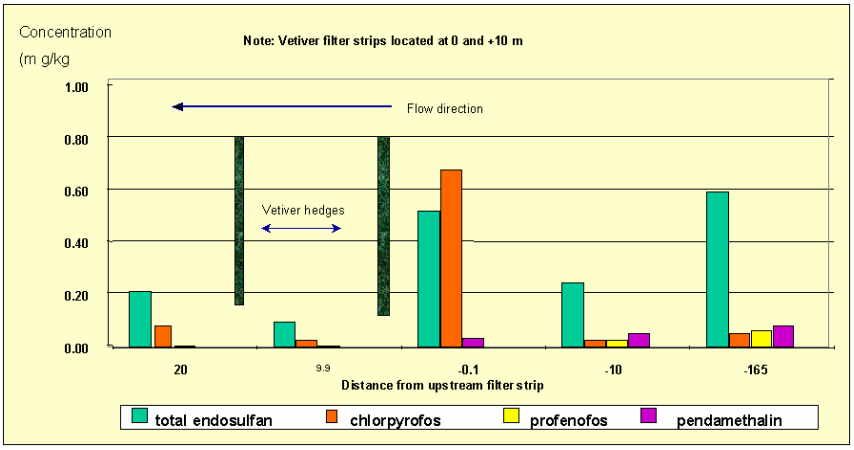
Photo 3: Extensive and deep root.

Photo 4:



Sediment and runoff research in tropical Queensland indicated that, in general, greater than 95% of the nitrogen and phosphorus lost in the runoff is associated with the particulate fraction. Therefore the key in controlling offsite pollution by nutrients and agrochemicals is to trap these chemicals at source. Vetiver hedges have been shown to be a very effective and low cost means of retention and decontamination of particle-bound agro-chemicals, especially pesticides (90% of Chlopyrifos) and nutrients (75% of N, 52 of P and 55% of S) in runoff water from agricultural lands (Fig. 1) (Truong *et al.* 2000). In China, for instance, vetiver hedges have been shown to be effective tools in controlling the eutrophication of waters polluted by run-off from surrounding agricultural lands particularly in regard to N and P. (Zheng *et al*, 1997).

Fig 1: Herbicide concentration in soil deposited upstream and downstream of vetiver filter strips



4.0 LANDSCAPING AND ENVIROMENTAL PROTECTION

When planted close together in line, vetiver grass forms a dense, uniform and attractive hedge under tropical and subtropical climates. In Australia, China and South Africa the use of vetiver hedgerows as a combined landscaping and land stabilisation tool also produce an aesthetically pleasing hedgerow system. In Thailand vetiver hedgerows are used very effectively as borders of vegetable plots and flowerbeds, for ~~to~~ filtering runoff water to farm ponds and for stabilising their banks.

Vetiver hedges have also been used to stabilise soils and control erosion in amenity sites such as golf courses and water park recreational areas. Similarly, vetiver hedges have been used within house development areas primarily for erosion control but also to control effluent seepage. The combination of the ornamental and pollution control features of vetiver grass mentioned above for environmental protection and landscaping has produced some stunning scenery in Australia (Photo 5).

Photo 5: A landfill leachate disposal site in Australia

Top surface of landfill dump

Two years after vetiver planting

Mature and in full flowers, two and half years after vetiver planting

5.0 POLLUTION CONTROL AND LANDSCAPING AT DELFIN LENDLEASE ESTATES

Delfin Lendlease is one of Australia leading Land Development Corporations, currently developing some prestigious housing estates in Queensland. The main focus of Delfin is to create an environmentally friendly atmosphere for their residents, hence environmental protection, improvement and landscaping are the Corporations major aims at their three housing estates: Springfield Lake, Forest Lake and Woodlands.

As their names imply, lakes are the central feature of these estates, with all roads leading to the lakes and surrounding houses. These estates were created from eucalyptus woodland with undulating topography, interspersed with several waterways and drainage channels, all leading to the artificial lakes. The soil is highly erodible with a thin sandy loam top soil and heavy clay subsoil. To maintain an open space and rustic atmosphere, the estates are covered with numerous parks and open space lands of various sizes and shapes. The master plan made the most of this topography by creating large swales along these drainage lines, which take runoff from storm water, parks and garden to the central lakes. In addition to the usual pollutants from the urban roads and traffic, the runoff waters are normally contaminated with nutrients from frequently fertilised parks and gardens, pets and wildlife. This high nutrient load often causes algal bloom and other aquatic weeds on the swales as well as the central lakes in the warm weather. Therefore the problems that Delfin has to deal with are:

- ***Soil erosion control:*** To reduce soil erosion along the newly created swales, lake banks and also from bare housing blocks under or waiting for construction.

- ***Pollution control:***
    - Firstly to trap and retain the eroded material at sources, preventing it from being washed down to the lake.
    - Secondly to remove the nutrient loads before they reach the lake.
    - Thirdly to treat the water in the swales and central lake to reduce the level of contamination which will cause algal and other water weeds infestation.
- ***Providing and maintaining an aesthetically pleasing vegetation cover:*** A flowering perennial ornamental plant is required.

Vetiver grass is ideally suited to solve all these problems by reducing soil erosion, trapping sediments and absorbing nutrients from runoff water and water body in the central lakes and also creating a very attractive landscape.

5.1 Springfield Lake

At Springfield Lake, for erosion control, vetiver grass was planted along the steep banks of the swales, on the swale beds and along the shore line of the central lake. For pollution control, vetiver was planted along the water edge of the central lake and on the swale beds (Photos 6, 7&8). In addition to these plantings, vetiver was also planted along the lake shore purely for its ornamental value (Photo 9&10).

Photo 6: Pollution control in Central Lake

Algal growth and muddy water

Mature vetiver cleaned up water and algae

Photo 7: Pollution control in swales

Trapping sediment

Contaminants in runoff water

Photo 8: Pollution control in Central Lake

In rock pool

On the rock lined shore line

Photo 9: Planting along the lake shore purely for ornamental purpose

Photo 10: Planting along the swale banks for pollution control and ornamental purpose

5.2 Forest Lake

At Forest Lake, for erosion control, vetiver grass was planted on the floor of several swales and a major drain, and spillway of a small retention dam. For pollution control, vetiver was planted along the swale beds, bio-retention ponds. In addition to these plantings, vetiver was also planted along the lake shore for purely for its ornamental value (Photo 11).

Photo 11: Planting on the swale floor and bio-retention pond for pollution control

5.3 Woodlands

At Woodlands, large areas of vetiver planting were carried out on the floor of several swales and drainage lines for the combination of pollution and erosion control (Photo 12). In addition to these plantings, for its ornamental value vetiver was also planted at the entrance of a small park (Photo 13).

Therefore by adopting the Vetiver System Delfin Corporations have effectively and successfully incorporated the ornamental and pollution control features of vetiver grass mentioned above for environmental protection and landscaping at their three housing estates.

Photo 12: Planting on the swale floor for pollution control

Photo 13: Planting at the entrance of a small park for ornamental purpose

6.0 ORNAMENTAL USE OF VETIVER AROUND THE WORLD

6.1 Australia

Erosion control and landscaping: After establishment and three years later

Erosion control and landscaping on a flood control dam wall, two years after planting

6.2 China

On the lake edges

Cut flower

As float in a pond

6.3 Portugal

In front of office

On traffic island

6.4 Senegal

Vetiver used to stabilise sandy garden beds on a beach resort

6.5 South Africa

Land stabilisation and landscaping on an industrial estate

6.6 Thailand

Vetiver planted on lake and pond edges for erosion control and bio-filter

6.7 Vietnam

As potted plants and around a lotus pond

6.8 Other Countries

Ethiopia, India, Indonesia and the Philippines have also combined the use of vetiver for environmental protection and as an ornamental plant successfully.

7.0 REFERENCES

Chen, S. (1999). Insect on Vetiver hedges. *The Vetiver Newsletter 20*, Leesburg Va, USA

Cull, R., Hunter, H., Hunter, M. & Truong, P. (2000). Tolerance of vetiver grass towards high levels of herbicides under wetland conditions. *Proc. Second Intern. Vetiver Conf.* Thailand January 2000

Truong, P.N. & Baker, D. (1998). Vetiver Grass System for Environmental Protection. *Tech.BulNo. 1998/1. Pacific Rim Vetiver Network.* RDPB, Bangkok, Thailand.

Truong, P., Mason, F., Waters, D. & Moody. P. (2000). Vetiver hedges as filters for trapping agrochemical and nutrients in agricultural lands. *Proc. Second Intern. Vetiver Conf.* Thailand January 2000.

Truong, P.N. and Pease, M. (2001). Vetiver hedgerow: A hedge for environmental protection and landscaping. Proc. Hedgerows of the World Intern. Conf. Birmingham UK.

Truong, P. and C. Smeal (2003). Research, Development and Implementation of the Vetiver System for Wastewater Treatment. S. S. Narong Chomchalow, Pacific Rim Vetiver Network.

Zheng, C., Tu, C., & Chen, H.(1997) Preliminary experiment on purification of eutrophic water with vetiver. *Intern. Vetiver Workshop*, Fuzhou, China October 1997.

A Brief Introduction to the First Author

Dr. Paul Truong, a Director and East Asia and South Pacific Representative of The International Vetiver Network, and recently Principal Consultant of Veticon Consulting. In the last 18 years he has conducted extensive R&D and Application of the Vetiver System in erosion and sediment control, and land rehabilitation in tropical and subtropical Australia, Asia and Africa.

His pioneering research on vetiver grass tolerance to adverse conditions, heavy metal tolerance and pollution control has established the benchmark for VS applications in toxic wastes and mine rehabilitation, wastewater treatment, which he has won several World Bank and the King of Thailand Awards.