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Vetiveria zizanioides (L.) Nash: A review of magic grass

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Abstract

North Bihar floodplains witness lush growth of *Vetiveria* [*Vetiveria zizanioides* (L.) Nash. syn. *Chrysopogon zizanioides* (L.) Roberty], locally identified as “Kataraghas” of the family Poaceae. The plant has an important role in addressing current environmental concern of human being all across the globe, specially in tropical and subtropical countries. This has attracted worldwide attention and several conferences on international basis have already been organized on its properties and uses.

The morphological & physiological characteristics of *Vetiveria* grass make it a unique bioengineering tool for utilization in various ways including the livelihood means. *Vetiveria* has multidirectional environmental application such as conservation and detoxification of degraded soil and water, check in erosion of soil during flood and landslide disaster, mitigation etc. besides having its perpetual need in performing some rituals of Indian culture.

Keywords: Handicraft, traditional medicines, industrial products, mulch, compost, bioengineering tool, perfumery and sikki

Introduction

Vetiveria is a perennial densely tufted C₄ poaceous grass, native to India. Indian name *Vetiveria* (In Tamil/Telugu language) form the basis of its international nomenclature. Peninsular India is held as the primary centre of origin of *Vetiveria* from where it may have dispersed to different directions. This plant of South Asia region has tremendous genetic diversity whereas those growing outside this region represent a single genetic stock (Adams and Srifah In: Lavania, 2003)^[17].

Plant deeply penetrates into the soil and develops tufted fibrous roots. The root shows initial growth potential of 3 cm/ day reaching up 2.5 meters in just 6 month (Lavania and Lavania, 2009)^[18]. *V.zizanioides* is reported to tolerate extreme flood submergence and temperature ranging from 20 °C to 55 °C. It can thrive well under annual rain fall ranging from 300mm to 6000mm.

In South India, cultivation is done from its underground stock only. Seeds are not produced in the South Indian population of *Vetiveria*. Its strains found in North India rapidly propagate through viable seeds, thus achieving an invasive status in this area.

Live plants are conventionally used in agricultural application such as soil and water conservation and non-agricultural applications include bioengineering (erosion control, slope stabilization and embankment stabilization) aspects, disaster prevention (landslide and mudslide prevention, flood prevention) and phytoremediation.

Non-conventional uses of live *Vetiveria* plants are mainly as fodder for animal (Verma *et al.* 2011)^[23], in construction related activities like roof thatching, fiber board etc. Other significant uses include handicraft, traditional medicine, herbal drinks, perfumery, flavour, aromatherapy, ethanol, greenfuel, coolant and brooms.

Material and methods

This paper is an outcome of the publication on the *Vetiveria zizanioides* characteristics and uses. Vetiver is a multifaceted grass. This plant is found growing naturally and luxuriantly in the flood plain wetlands and as such could be utilised by the local populace in various livelihood purposes. So, ethnobotanical importance were also identified for documentation of their diverse usages. Information also gathered from rural women mostly belongs to the weaker section of the society engage themselves in the business of vetiver items.

Vetiveria and its vernacular names

The present table showing the Indian name of *Vetiveria* in different language, is either commercially grown or known to exist in nature in wild stage and their common vernacular names.

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Communicating Language	Vernacular Names
Bangla	Benna Shoba, Ghonda Bena, Khas, Khas Khas, Khus, Khus Khus
Gujarati	Valo
Hindi	Bala, Balah, Bena, Ganrar, Khas, Khas Khas, Khus Khus, Panni
Kannada	Hallu, Kaddu, Karidappasajje Hallu, Laamancha, Lavancha, Vattiveeru
Malayalam	Ramaccham, Ramachehamver, Vettiveeru
Marathi	Vala, Vala Khas Khas
Punjabi	Panni
Sanskrit	Abhaya, Amrinata, Bala, Lamaja, Lamajjaka, Reshira, Sugandhimulu, Usira, Ushira, Virana
Telugu	Ayurugaddiveru, Kuruveeru, Lamajja Kamuveru, Vettiveellu, Vattiveeru, Vettiveerum, Vidavaliveru
Tamil	Ilamichamver, Vattiver, Vettiver, Vettiveru, Vilhalver, Viranam, Virkal, Vujal
Urdu	Khas



Fig 1: A Vetiver hedge (upper parts grazed by animal)



Fig 3: Vetiver hedges alongside a railway line

Result and discussion

Vetiveria as bioengineering tool

Vetiveria grass is generally famous by the names of VS (*Vetiveria* System) or VGT (*Vetiveria* Grass Technology). VGT was first developed by the World Bank in 1980s for check and control of soil erosion and water conservation. In India VGT has developed since last two decades. It is a natural low-cost method, effective in rehabilitation of landfills and now being increasingly used for such purposes in over 120 countries all over the world (Truong and Loch, 2004).

The morphological and physiological characteristics of this grass make it a unique bioengineering tool for land support and for uses in solving different problems related to water (Truong and Baker, 1998, Cull *et al.*, 2002) [22, 7]. This plant is also unique in the sense that it has high rate of absorption of nutrients especially ammonia, nitrogen and phosphorus, and high tolerance capacity to concentrated leachates as well. *Vetiveria* may thus be expected to serve well in wastewater treatment.

In India, The VT system was introduced in Assam in the beginning of the year, 2009 with the formation of a *Vetiveria* Network. Three demonstrations of bioengineering projects-1. To stabilize hill slope-2. To stabilize a big bridge approach and -3. To protect against the severe erosion of the Brahmaputra River in the North-East India of Assam were designed, supervised and monitored by Mr. Shantanoo Bhattacharyya (Executive Engineer, PWD, Assam). In India, VGT is now being used successfully for better stabilization on National Highways (NH) and alongside the railway line to serve as a living wall.



Fig 2: Vetiver hedges alongside NH-57

Interestingly, it was a common practice of North Bihar farmers in the part to use plant in demarcating the plot areas of the cropfields to avoid any dispute of territorial integrity. Some scientists have recently proposed a “*Vetiveria* Grass Model” (Lavana and Lavana 2009) [18] for sequestration of atmospheric carbon to sub-soil level. This proposal is aimed towards mitigating global warming by way of reducing the atmospheric CO₂. However, there is a fear that over exploitation of this plant may earn the weedy status in future and trespass the target area.

Utilization after harvest

Dried, partly dried or even fresh leaves, culms and roots of harvested *Vetiveria* plants are used for different purposes which may involve full processing or with some degree of processing or no processing at all. (Table-1 & 2).

i) Fully-processed product

- Essential oil and its derivatives
- Herbal medicine
- Pulp, paper

ii) Semi processed Product

- Handicraft (including containers, gadgets and wall hanging)
- Furniture
- Botanical pesticides
- Energy source (ethanol & green fuel)

iii) Non-Processed products

- As Animal fodder
- Roof thatch
- Mulch and compost
- Mushroom cultivation

Details of utilization of harvested *Vetiveria* general, and application of non-processed products in particular are described in Table- 1-2 as under:-

Table 1: Utilization of harvested *Vetiveria*

Parts of plant used	Processing mode	Product	References
Leaf	Dry leaves were first treated with alkali then SSF (Simultaneous, Saccharification and Fermentation) technique applied to convert into ethanol.	Source of Energy (a) Ethanol (b) Green fuel	Kuhirum and Punnapayak (2000) [15]
Leaves and culms	Leaves and culms mixed with water hyacinth in a proportion of 3:1. Then the mixture is compressed into shafts. Fuel shafts can burn easily and produce high temperature.		Babpraserth <i>et al.</i> (1996) [4]
Root	Nootkatone, a chemical extract of this plant is able to disrupt the body physiology of termite by causing the progressive death of the protozoa living inside the termite gut. This amounts to a progressive decline of its colony through starvation.	Botanical pesticides (a) Insecticides	Maistrello and Henderson (1999) [19]
Mulched plant	Fungi disappear from mulched plant	(b) Fungicides	Greenfield (2002)
Root	10% of <i>Vetiveria</i> oil from different ecotypes of this species were variably competent to control cowticks at both larval and adult stages.	(c) Agrocidides	Korpraditkul (1996) [14]

Table 2: Non Processed Product of Vetiver

Application	Parts of Plant	Condition of Plants	Economic uses	References
Fodder	Leaves & culms	Matured	Provide feed value during drought period when is mixed with other good quality feed and forages. However, analysis indicated that crude protein lower than that of other grasses is used for animal feed.	Aranon (1990b) [3], Panichpol <i>et al.</i> (1996) [20]
Low cost Rural houses Thatching	Laves	Matured	Provides better quality of roof thatching to rural houses because the culms and leaves are coated with wax (cuticle) and have unique scent that repels insect and fungal attacks.	Aranon (1990a) [2],
Mulch	Chopped root and Tops	Dried	Decreases the temperature and thereby conserve the moisture. More durable, long lasting repelling or killing common garden pests and termites.	Chomchalow, N (2003) [6]
Compost	Whole plant	Completely Decomposed	Soft, disintegrated, dark brown to black in colour and contains major nutrients out of mineralization process i.e. N,P,K, Ca and Mg with pH-7.0 & also provide humic acid.	Chomchalow, N (2003) [6]
Mushroom Cultivation	Leaves	Partially Decomposed	Leaves contain cellulose, hemicelluloses, lignin and crude protein as well as various minerals favouring greatly to certain mushroom cultivations.	Chomchalow, N. (2003) [6]

In addition to above uses, *Vetiveria* in its fully processed and semi-processed forms are also important sources of handicraft product, essential oil and its derivatives, medicine, pulp and paper etc.

1. Handicraft

Handicraft products made from *Vetiveria* leaves and culms/stalk (*Sikki* an exclusive term in North Bihar) Includes:-

- i. Handy accessories- Bags, hats, brooches.
- ii. Baskets, Pots, boxes, containers.
- iii. Home appliances – Chairs, stool, room partitions. Table, brooms.

The scented *Vetiveria* roots are used for making fans, clothhanger, and some fancy items.

In North Bihar, the *Sikki* artisans make hundreds of common and rare items both of traditional and modern uses. These include decorative items and containers of different sizes. *Sikki* traditional gadgets (small containers) are variously termed as *Mauni*, *Pauti*, *Changeri*, *Phuldali*, *virahara* etc. in North Bihar. Some decorative designs of items akin to plants and animal are made out of culms/*Sikki* of *Vetiveria* and such items are sold at a high price value (Jha *et al.* 2006, 2011) [11-12]. Large sized containers used in domestic life are also made of *sikki*. In Mithila of Northe Bihar, there is a practice of presenting gift (to daughter and their grooms) of spices, masticatories and dried nut in *Sikki* containers (Jha, 2004) [10]. Voluntary organisations like *Rachna sikki Hastkala Kendra*, in Rampur village near Sarisabpahi under Madhubani district of North Bihar are active in the field of *Sikki* handicraft, particularly in wall hangings. *Sikki* art has earned prosperity

to a good number of rural women artists and has evolved as a tool for their economic empowerment. Madhubani painters are well versed in the field of “*Sikki* art” as well.

Women of this region have earned laurels at national and international level. Late Vindeswari Devi of village Raiyam in Madhubani is known as an accomplished *Sikki* artist who was honoured by late Prime Minister Indira Gandhi with the national “Mastercraft women award” in 1969. Smt. Kumudini Devi of Sursand in Sitamarhi district of Bihar was an another women *Sikki* artist who earned a big name in this field (Jha *et al.* 2011) [12].

2. Essential Oil and its Derivatives

Vetiveria grass traditionally used for extraction of essential oil from its root has attracted worldwide attention. The world renowned “Khus” oil has considerable significance in perfumery and cosmetic industries. Commercial cultivation, method of extraction of oil and its properties have already been discussed by Chomchalow (2001) [5]. *Vetiver* oil is a viscous light brown oil having rich green-woody, earthy and nutlike fragrance (Dowthwaite and Rajani, 2002) [9]. In dilute form the oil provides soothing and cooling effect. It is utilized as a raw material for various fragrant products such as perfumes, deodorant, soaps, cosmetics etc. (Chomchalow, 2001) [5]. It is worth mentioning here that this oil has been an important ingredient in the making of a cream for male under Trade name “Fair and handsome” by Emami with Activator Corp., USA. *Vetiver* oil is also used for therapeutic purposes. It also replenishes moisture in dry and dehydrated skin and has rejuvenating effect on skin.

India produces only 20 tons of khus oil annually as against the world production of 300 tons/annum. In India, *Vetiveria* is

cultivated in Southern and Western region but the oil produced in Northern India holds high price. CIMAP (Lucknow) has developed agro-technology for *Vetiveria* as an annual crop that is quite popular amongst the farmer in Northern India specially in Sitapur and Barabanki District of U.P (Dhapola, and Krishna, 2011)^[8].

3. Medicine

An extensive review of the utilization of *Vetiveria* roots and leaves has already been made by Chamchalow (2001)^[5]. Rural people of Thailand use *Vetiveria* roots in the treatment of gallstones, reducing fever and in diseases related to bile and the gall bladder and healing stomach discomfort. Lavania (2003)^[17] described about the use of *Vetiveria* oil in Ayurvedic system. He mentioned relief from rheumatism, lumbago, headache on local application of oil. Roots are used as a refreshing drink in fever, inflammation and irritability of stomach. In hilly areas of Karnataka, India, the root part of the plant is now being used as refreshing drinks (Sastry, 1998)^[21].

4. Pulp and paper

Vetiveria can be used as a raw material for making pulp and paper. In India studies were carried out at the Forest Research Institute, Dehradun and it was revealed that pulps suitable for making strawboard can be made from *Vetiveria* by digestion with lime (Arnon, 1976)^[1]. *Vetiveria* has a high content of hemicelluloses. Its cellulose content is 45.8%. *Vetiveria* yield a chemical pulp that can be used for making writing and printing paper.

Conclusion

India is the native place of *V. zizanioides*. All over the world appreciate the multiple uses of this plant. Vetiver contains potential to fight against extreme climate and have medicinal properties also. It has an environment friendly multifarious application and sustainable solution for soil and water conservation, natural disaster mitigation, slope and embankment stabilization, agroforestry management, etc. *Vetiveria* System (VS) or *Vetiveria* Grass Technology (VGT) needs no engineers to lay it out. It can be planted as a hedge across the slope or alongside of National Highway, establish quickly and once established will last for decades. Vetiver system are indeed adopted, improvement in livelihood is almost immediate.

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