EXPERIENCE ON THE SURVIVAL OF VETIVER UNDER FLOODED CONDITIONS AT CARMEN TERESA FARM, VENEZUELA.

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ABSTRACT

There are many publications reported the survival of Vetiver under flooded conditions. But what are the principles or physiological behavior involved in such process? And how vetiver plant was affected under continuous submergence at different water depths, duration of exposure time and the water quality?

This paper reports the experience gained at a 4 ha Vetiver farm, “Carmen Teresa" Farm, near "Taiguaiguay Lake", in the Valencia Lake Basin system. Observation shows some aspects related to Vetiver survival, and the evaluation reported that a significant number of plants was died (at least 70 %), when inundated for 7 months in stagnant water, especially those submerged under more than 73 cm.

1.0 INTRODUCTION

The Vetiver grass (*Vetiveria zizanioides* L.) has been studied by many authors, and they have recorded a wide range of characteristics, properties and qualities which can be considered as an extraordinary, wonderful plant, a living nail and other epithets. The World Bank (1990) was the first institution that promoted it, for erosion control in agricultural lands and infrastructures, later on the Pacific Rim Vetiver Network (PRVN) through its Newsletters and Technical Bulletins provided information on the technologies of the Vetiver Grass. (Chomchalow *et al*. 1999). PRVN also published a manual to illustrate the use of Vetiver leaves for handicraft. Truong *et al*. 2001 established the principles for the treatment of wastewater waters with the System Vetiver (VS), this author emphasized that this plant is part of a new Phyto-technology for numerous applications related with the protection of the environment which were supported by research and development programs around the world in the last 15 years. The authors also pointed out that this bio-technology is being used in more than 40 countries, in tropical and sub-tropical climates.

Chomchalow (2005) reported that the Vetiver can grow in water under diverse conditions; it is used to protect banks of rivers, channels, to protect the areas with steep slopes, as well as to protect the river banks exposed to wave erosion. It is also used to treat polluted waters as in the Ecological Park in Guangzhou, China. Vetiver grass is able to survive under drought conditions and alternating dry and wet, and it can grow in places where it is not totally submerged; The author mentioned that Vetiver can adapt to grow without problems such as the case of the treatment of contaminated waters in lagoons, it has also been demonstrated that vetiver absorbs pollutants and the bad scents. Another applications is

growing Vetiver under hydroponics condition where it is placed in floating platforms. Truong (2005) reported that the Vetiver can survive semi-submerged in tidal zone where regular fluctuation of the water level occurs, without any physiologic effects on the plant.

This paper reports different Vetiver behavior under flood conditions, under stagnant water for 7 months at Carmen Teresa Farm, Venezuela.

(edited up to here)

2.0 ASPECTS OF GENERAL INTEREST OF THE VETIVER IN VENEZUELA

2.1 History

The Vetiver was introduced more than a hundred years ago in Venezuela, in the south region of the country, in Apure state (Rodriguez, 2004.) The principal use were for roof houses and to walls with a mixture of clay and dry Vetiver leaves. (Decanio, 2004).
There was70 year-old reference counted by people who lived in the region of "El Yagual" Apure State, that spoke about the planting and commercialization of the Vetiver for roof housings (Carmen T. Mirabal, 1999, personal communication).
Their handmade use dates approximately from 50 years ago, Mr. Evelio Paz, school teacher, was trained by a program of the extinct Council of Rural Well-Being in the city of Bejuma, Carabobo state, in making wallets and fabric of furniture of a well-known plant with the "sandal" name, maybe for the aroma of its roots, which turned out to be Vetiver. This program included the propagation of the gramineous in the garden of the houses. Mr Paz still maintains some plants from that period. (Luque, 2005). Vetiver Fundacion Polar Project Staff has founded plants with more than 60 years of life a farm of the region of "Barlovento", 10º 28´52"N; 66º 14´22"W, located at the center of the country.
The most recent references date from the years 1966-1967 (Fernandez, Personal commu nication) when the Vetiver was introduced to the experimental stations of the Central University of Venezuela. Faculty of Agronomy for Professor Henao Jaramillo, at the Experimental Station named "El Laurel", "Miranda state". He used Vetiver to protect coffee plantations planting at full solar exposition. Professor Napoleon Fernandez from the same University evaluated Vetiver barriers for erosion control in peach and horticultural crops at the Experimental Station of "Bajo Seco", Miranda state. The Professor Oscar Rodriguez Parisca continued these researchs at the beginning of the year 1987, and disseminating the Vetiver Systems, until the present days, together with Professor Gerardo Yépez Tamayo from the Conservationist Society of "Aragua". They begin a campaign of promotion of the Vetiver to national level and in Latin-American through the Vetiver Venezuelan and Latin-American networks.
Professor Adriana Florentino (personal communications) of the Central University of Venezuela encouraged to Professor Ernesto Andreu who introduced Vetiver in Las Guacamayas farm, Guarico state in 1997, as part of the activities of a program among "Romulo Gallegos University and "Agroindustrias Integrales C.A. (Agrointeca).
Fundacion Empresas Polar began the Vetiver Project at the region of Bejuma, Carabobo state in March 2001, and it has been extended to several states of Venezuela, centered in community development in the economic, ecological and social areas of populations of different level of poverty, until present days.

3. Dynamics of Taiguaiguay Dam and their effect on "Vetiver Carmen Teresa" Farm.

The Taiguaiguay Dam with a surface of about 15 km2 collected water from different sources, It is used for crops irrigation in rural farms surrounded the dam, especially sugar cane, bananas and mangos. A reference point is the geographic coordinates 10º 07´34" N; 67º 28´ 56" W. The Aragua river is the principal tributary of the dam, it picks up the waters of drainage of an important basin, equally toward the dam drain waste waters of several neighboring populations (Santa Cruz and Cagua), and the water from the Maracay Water Treatment Plant with at least 5.000 l/sec. Occasionally , in the wet season (April-September) the waters flood many agricultural farms; among them, the lands of the Carmen Teresa Farm, located in one border of the lagoon, this effect has been more marked in the last years, the last one, before the year we made this study was in 1999; due to the fact of changes in the hydrology. The depth of the waters that flooded the four ha of Vetiver, and remained stagnated by the lapse of 7 months, was variable from 0 centimeters up to 140 centimeters affecting the Vetiver in different ways

4. Methodology of the Study

The study was carried out during the flooded time from at the end June 2005 until January 2006. The observations were carried out once per month with two measurements; one, on July, 23 2005; and other, on January, 22 2006, when the waters was retired. We made a 150 meters transect in the throughout of 2 % slope.

The soil profile studied at Carmen Teresa Farm, lot 19 of Zamora Municipality of the Aragua State, Venezuela, was localized at 10 º 07´11"N 67º 29´07" W, at Vetiver planting area. Prof Stalin Torres from the Central University of Venezuela, Faculty of Agronomy, Soils Information and Reference Center, described and classified it, as a Typic Endoaquerts, fine, mixed loamy, isohyperthermic. According to Holdridge Live System, belongs to the area of life of Tropical Dry Forest, with a geomorphologic position of lowland. The most principal feature is the low internal drainage in all soil profile. The predominant texture in the profile (up to 2 meters), were loamy silty to loamy silty-clay. Abundant presence of Vetiver thick roots until 48 cm, while from 48 cm to the 200 cm deep the fine and very fine Vetiver roots were plentiful. A weak reaction was detected to HCl 10% starting from the 10 centimeters throughout the complete profile; it indicates presence of free carbonates, possibly of calcium. The pH values oscillated between 7, 43 and 7, 30. The lands were classified as IV class, with soils limitations and external and internal drainage.

5. Results and Discussion

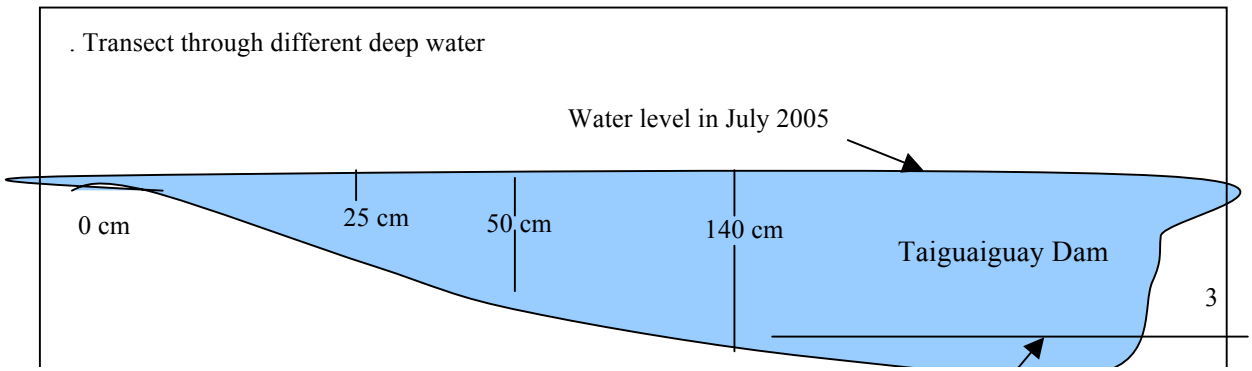
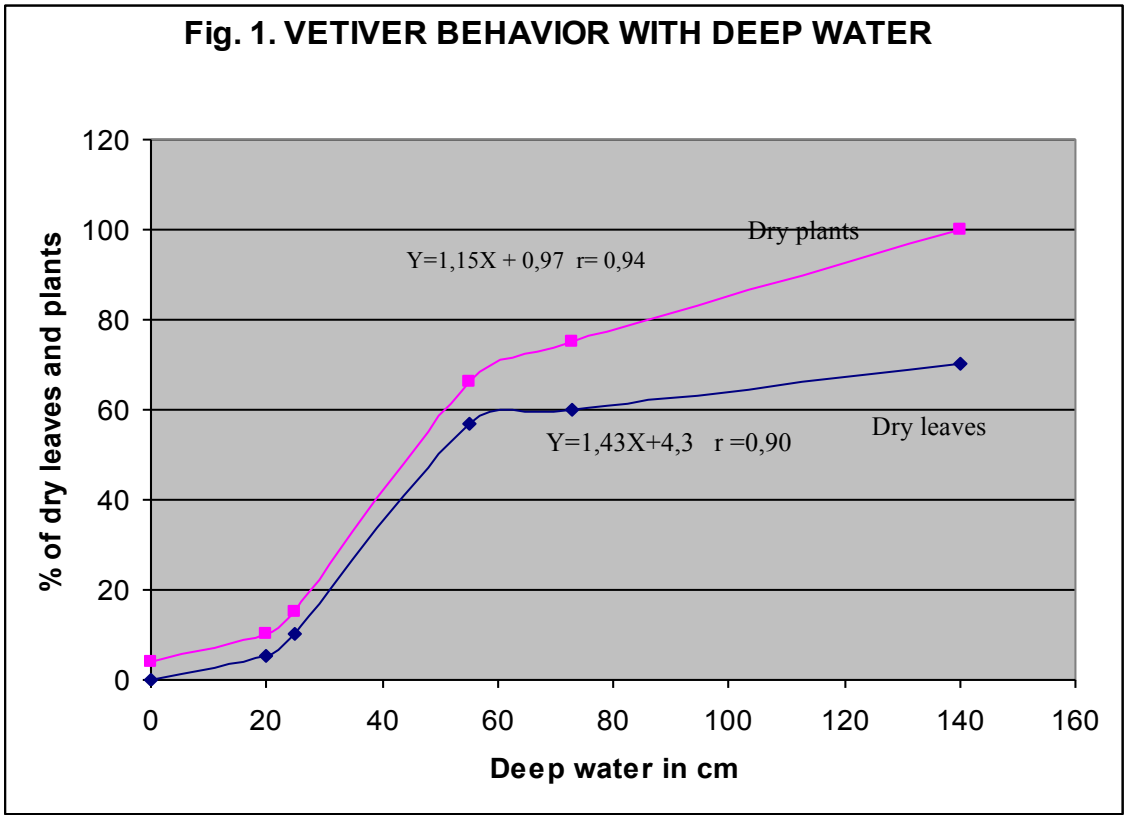
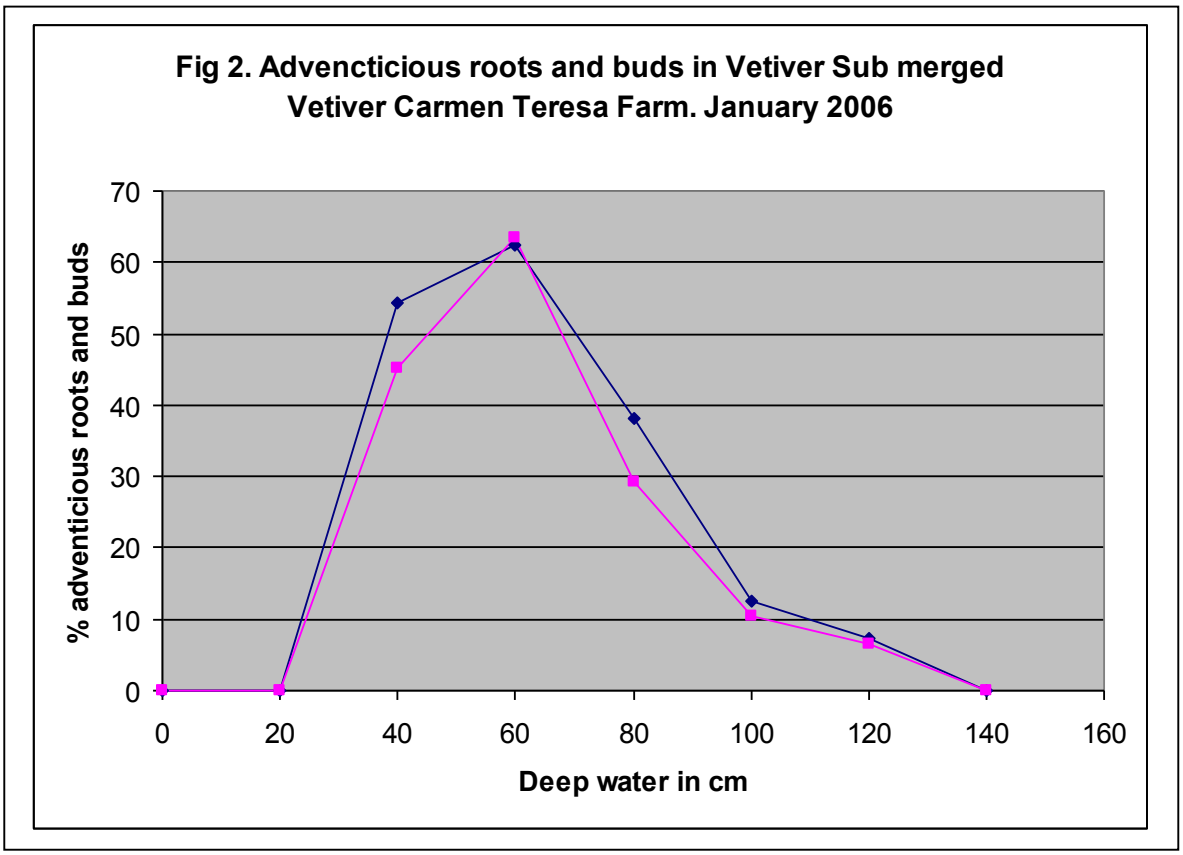


Figure above shows 150 meters transect affected with deep water from 0 until 140 centimeters from the Taiguaiguay Dam that flooded the 4 ha of Vetiver Farm. The first set of measurements was on July, 23 2005. It was observed that the plants that had a sheet of water from 30 up to 73 cm began to produce great quantity of adventitious roots that were located into the water; equally the presence of vegetative buds was observed, this was more pronounced in August and September, 2005.



The leaves began to dry off, especially, after 50 cm of water while those plants that were from 0 centimeters of water up to 20 centimeters of flooded remained green. For January 2006 the definitive retirement of the waters was observed. At this time, the evaluation gave the results showed in fig 2. The concentration of roots and new buds, ranged from 40 % to 62 % in the section affected with 30 cm to 73 cm of deep water. The parcels that had the dry Vetiver were burned and new buds began on many plants 8 days after. Those plants submerged with 140 centimeters of water did not recover. The recovery percentage was inverse to the depth of the water, and the total losses were calculated in 70% of the whole planting surface.

The presence of vegetative buds and adventitious roots until the 73 centimeters of sheet of water was decisive in the survival of the Vetiver in whole area.



Conclusions:

1. The experience showed that Vetiver can survived under extremely conditions of flooded with stagnated water, especially under deep water les than 73 cm.
2. Once the plant was covered totally for a period of 7 months they died in 100 %, perhaps for the presence of some interaction of toxicities (high Chemical Oxygen Demand) plus the time of sub-merged on stagnated water.
3. The presence of new buds and adventitious roots can be the mechanism use for Vetiver to survive of former conditions of flooded in this kind of water.
4. There have been new plants regenerated from the buds that fallen to the soil, especially those growing with a deep water until 73 cm. It happened when the water was retired or drained out.
5. The Vetiver survive at least in more than 95 % when was flooded with a deep water from 0 (saturated soils) to 50 cm. during 7 months. This occurs in the areas more far away of the heavy contaminated water. So, there is some hypothesis: The Vetiver helps to decontaminated water that passed throughout of deeper zone, and moved to this area, in consequence the zone received water with less COD
6. The farmer continues its works once the flooded conditions specially to produce fiber for Vetiver handicraft and for roof of construction named “Churuatas”

7. The Vetiver flooded help the cattle grazed as a good alternative for the shortage of animal food.

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