# QUANTITATIVE STUDY OF THE ROOT SYSTEM AND SPROUTS OF THE ANTIEROSIONAL PLANT VETIVER(*Vetiveria zizanioides*, L. Nash)

*Givi Gavardashvili*[1)], *Goga Chakhaia*[1)],
*Levan Tsulukidze*[1)], *Natia Gavardashvili*[2)]

[1)] Georgian Water Management Institute, 60 Ave. I. Chavchavadze,
0162 Tbilisi, GEORGIA, E-mail: givi_gava@yahoo.com

[2)] Ivane Javakhishvili Tbilisi State University, 1 Ave. I. Chavchavadze,
0128, Tbilisi, GEORGIA, E-mail: n.gavardashvili@gmail.com

## ABSTRACT

In order to study the quantitative dynamics of the root system and sprouts of the anti-erosion plant vetiver (*Vetiveria zizanioides,* L. Nash) scientific studies were carried out in hothouse, in Israel in 2004-2008 and in field conditions on a vetiver plot in Georgia.

Taking into consideration the principal geological, ameliorative, hydrological and climatic factors of the soil, the irrigation norms and watering of vetiver, the coefficient of evaporation and transpiration were determined, as wall as the dynamics of growth of the height and root system of vetiver.

Using the theory of reliability and risk and taking into account the basic characteristics of the slope and soil, the soil antierosional effect of the so-called biological wall formed of vetiver has been determined, taking into consideration the principal parameters of the maximum intensity of rainfall, the washout rate of the soil particles and other biological, hydrological and hydraulic parameters.

KEY WORDS**:** vetiver plant, root system, Evapotranspiration, erosion;

As a result of analysis of long-term researches conducted by Water Management Institute it was determined that erosive processes occurring at mountain slopes, transport or energy corridors as well as agricultural lands are mainly caused by anthropogenic pressures on environment representing one of the reasons for activation of mudflow occurrences. Selection of relevant strategy for fighting them is absolutely necessary. Scientific researches of world known antierosional plant vetiver (Vetiveria Zizanioides, L.Nasha) conducted in 2002-2008 in Israel and Georgia were aiming to define the above mentioned issue (Mirtskhoulava,. 2007).

Researches were conducted foreseeing main geologic, land-reclamation, hydrologic and climatic factors required for the plant.

In order to determine type of granulometry of plant useful soil required for vetiver root system development as well as for general vegetation of the plant we have selected mixture of 8 soil types with repeating each of 7 samples with the total amount of 56. Weight of soil mixture in plastic buckets fluctuated between 8 and 15 kgs., specifically: 1) plastic baskets (#1, 2, 3, 4, 5, 6, 7) filled with calcium carbonate 2). 90% calcium carbonate was mixed with 10% humus - (#8, 9, 10, 11, 12, 13, 14); 3). Soil suspension 80% calcium carbonate 20% humus (#15, 16, 17, 18, 19, 20, 21); 4). 50% peat and humus suspension (#22, 23, 24, 25, 26, 27, 28); 5). Surface of 90% calcium carbonate is covered with 10% humus (#29, 30, 31, 32, 33, 34, 35); 6). Surface of 80% calcium carbonate 20% humus (#36, 37, 38, 39, 40, 41, 42); 7). 25% peat and 75% tuff conglomeration (#43, 44, 45, 46, 47, 48, 49); 8). 50% peat and tuff suspension (#50, 51, 52, 53,

54, 55, 56). The forth photo shows general view of vetiver plant in two months after the replantation (see Figure 1 and Figure 2.).

For the purpose of studying vetiver root system vegetation, number of plantings was planted in lysimeters at Water Management Institute demonstration plots. During the period of vegetation observations on average monthly temperature and amount of sediments as well as observation on dynamics of plant growth were conducted twice a month. In autumn of 2006 experimental plants were removed from the ground.


Figure 1. Plastic Buckets prepared for Vetiver Plants

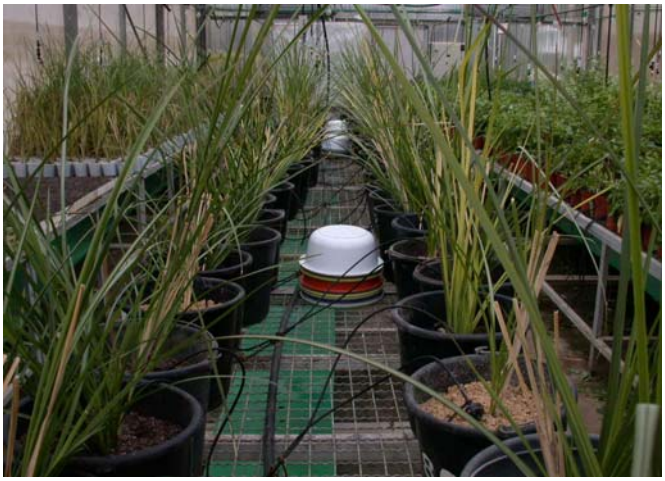

Figure 2. View of Two Month old Vetiver Plant in the Greenhouse

During the observation period the root system length of removed plants constituted around 1.5 – 2.64 m (see Figure 3).

For the purpose of studying vetiver vegetation watering graphic was defined at Israel experimental laboratory where climatic showing required for the plant was being measured as well as after watering measuring of catchments water volume was undertaken by conducting respective summarising analyses; also height of plants was measured as well as amount of shoots and evapotranspiration coefficient.

By processing obtained statistical numbers empirical approach has been received by means of which vetiver height (H) is calculated, soil volume weight ($\gamma$) and according to the time

(T) of the day (day-night) equation looks like following (Gavardashvili, 2005):

$$H = 81{,}92\gamma^{-3{,}33}T^{0{,}26} \text{ (cm)} \quad (1)$$

For the purpose of determining evapotranspiration coefficient surface of plastic buckets was covered with thin aluminium sheets to prevent expulsion of water from buckets;

Figure 3. Vetiver developed root system (Length - 1.53 m) in two years after planting. (From right to the left, professors: M. Ben-Hur (Israel), G. Gavardashvili (Georgia), N. Dudai (Israel).

Evapotranspiration coefficient was determined on the day of watering every hour in three hours from 8:00 AM till 17:00 PM; statistical showings necessary for determining evapotranspiration are provided in Table 1, (Gavardashvili, 2008):

Table 1. Statistical showings of vetiver evapotranspiration of March 3, 2005.

| Vetiver number # | March 3, 2005 | | | | | | |
|---|---|---|---|---|---|---|---|
| | Time (hours) | | | | | | |
| | 11.00 | 12.00 | 13.00 | 14.00 | 15.00 | 16.00 | 17.00 |
| | Temperature ($C^0$) | | | | | | |
| | $28.5^0$ | $28.0^0$ | $27.8^0$ | $27.2^0$ | $25.5^0$ | $21.4^0$ | $20.8^0$ |
| 4 | 0 | 0.004 | 0.008 | 0.014 | 0.018 | 0.020 | 0.021 |
| 11 | 0 | 0.004 | 0.010 | 0.014 | 0.019 | 0.022 | 0.020 |
| 20 | 0 | 0.002 | 0.010 | 0.020 | 0.022 | 0.024 | 0.026 |
| 25 | 0 | 0.004 | 0.010 | 0.014 | 0.017 | 0.020 | 0.020 |
| 30 | 0 | 0.004 | 0.008 | 0.014 | 0.018 | 0.020 | 0.018 |
| 41 | 0 | 0.002 | 0.006 | 0.014 | 0.016 | 0.018 | 0.016 |
| 44 | 0 | 0.004 | 0.014 | 0.018 | 0.022 | 0.024 | 0.022 |
| 53 | 0 | 0.002 | 0.008 | 0.012 | 0.015 | 0.018 | 0.015 |
| 55 | 0 | 0.002 | 0.004 | 0.012 | 0.015 | 0.016 | 0.016 |

Calculation schedule of vetiver evapotranspiration coefficient is built on statistical showings of plastic bucket #30 of Table #1, shown in Figure 4.

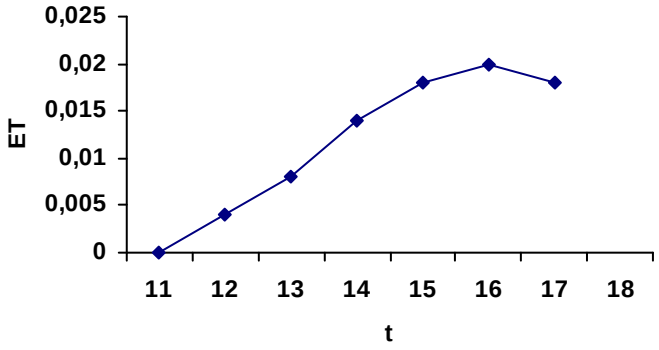


Figure 4. Schedule of vetiver evapotranspiration.

Schedule of quantitative increase of vetiver #30 plant is shown in Figure 5.

***(Each)***

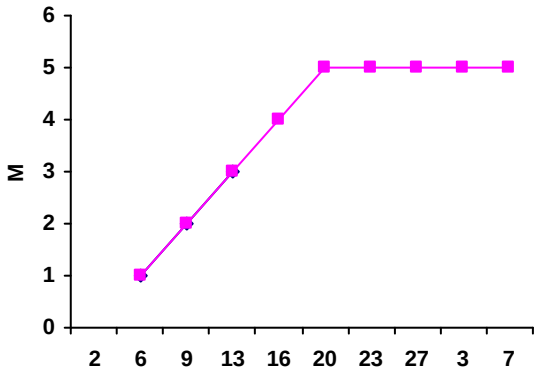


Figure 5. Schedule of quantitative increase of vetivere shoots.

Thus, researches conducted in Israel and Georgia make it possible to recommend planting vetiver at mountain slopes of transport and energy corridors as means to fight erosive processes and small mudflows, that provides opportunity for selecting anti-mudflow process strategy as well as opportunity for conservation water and soil natural resources for the future.

## REFERENCES

Gavardashvili G.V., Chakhaia, G.G. and Balamtsarashvili, V.I. 2005. Investigation of the antierosional plant vetiver //Science and Technologies, № 10-12, Tbilisi.

Mirtskhoulava, Ts.E., Natishvili, O.G., Tevzadze. V.I., Gavardashvili G.V., Chakhaia, G.G., Tsulukidze, L.N. and Balamtsarashvili, V.V. 2007. On the sediment-trapping and antierosional capacity of vetiver plants. Coll., Papers of the Institute of Water Management, №63, Tbilisi.

Gavardashvili G.V., Chakhaia, G.G and Gavardashvili, N.G. 2008. Results of the investigations of vetiver (*Vetiveria zizanioides*, L. Nash)in greenhouse. //Herald of Agrarian Science, vol. 6, №1, Tbilisi.