VETIVER NEWSLETTER

NEWSLETTER OF THE VETIVER INFORMATION NETWORK, ASTAG*, WORLD BANK, NUMBER 5, MARCH 1991

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THE NEWSLETTER

This is the fifth Newsletter put out by the Vetiver Information Network. Since the last Newsletter (#4) was sent out the rate at which we have been receiving examples of research and information on the usage and impacts of vetiver grass hedges has increased dramatically. As these results come in, a more coherent picture of the function of the hedgerows has begun to emerge. For example, information on vetiver hedge interactions with associated crop plants is beginning to show that some yield reduction may be observed in the rows nearest the hedges in certain crops (e.g. maize) in certain soils. Whether these reductions result in an overall decrease in yield is not yet clear — that is, yield gains in the other rows may offset losses in the nearest row and the spacing between hedges will effect the total number of "effected" versus "non-effected". Also, to a great extent, the information available comes from non-replicated plot studies where the results can only be treated as indicative; in single plot studies the differences caused by between plot variation (such as soils, slope position, crop management, etc.) cannot be ruled out as causes of yield differences. This Newsletter contains two examples where preliminary results have shown some competition effects (maize) and another showing no such effects (rice and mungbean). In the next Newsletter we will summarize all the current data on vetiver hedge and crop interactions.

VETIVER AWARDS

The March 15 deadline for the Vetiver Research Incentive Awards has passed and the Network has received some excellent reports from countries such as Australia, China, India, and Malaysia. The Network wishes to thank all of the contributors and to let them know that their work will be going to the independent review panel and the awards announced to them prior to the next Newsletter in June.

In this edition of the Newsletter we would like to give the readers a preview of some of the reports that we received and that will be synopsized for the June Newsletter. The first is a report by Dr. P.K. Yoon, Malaysia. In only two years Dr. Yoon has produced an impressive amount of research. In his own words : *"My knowledge of Vetiver grass starts from 12/4/1989, when I first saw a clump of rather undistinguished-looking grass collected by my colleague, Encik Ahmad Azly, at my request. It looked so ordinary and so frighteningly similar to the horrible "Lalang" !* (Ed. Note - Imperata cylindrica) *However, I had been stimulated by the Handbook: "Vetiver Grass - The Hedge Against Erosion" and, having spent more than 30 years visiting rubber plantings and having seen massive erosion problems especially on steep hills, I was prepared to have a look-see at any economic method. 1989 was the time to get to know the plant and to multiply it for distribution. 1990 was the main period for distribution, start some ad hoc trials and set the stage for 'proper' trials in co-operating estates. This report summarizes mainly efforts of 1989 and 1990. 1991 should see better progress."*

"Research and Development must be well targeted and take cognizance of local situation. Whereas, Vetiver is promoted by the World Bank as a low-cost hedgerow system for controlling soil-loss and improving soil moisture, this may be true only for the poorer developing countries. Malaysia is well developed agriculturally and

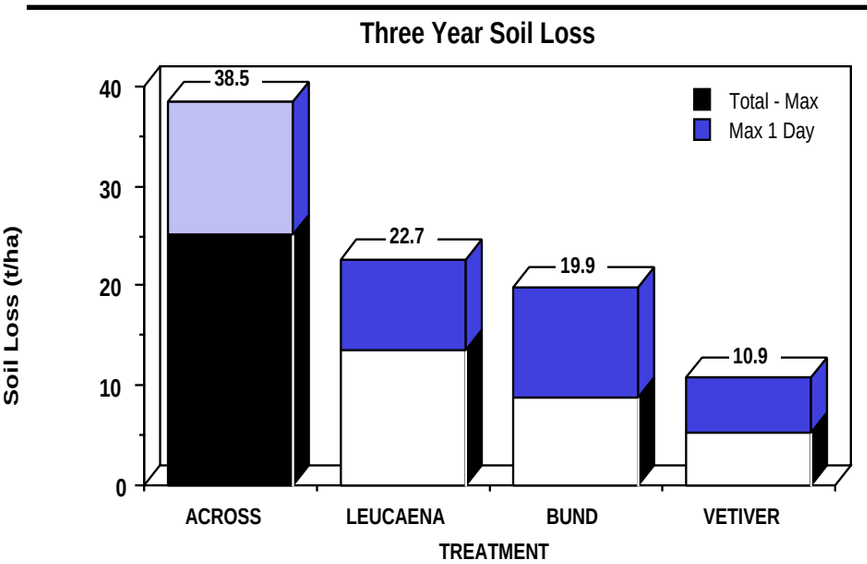


Figure 1. Three year total soil loss from runoff plots in Akola, India. Treatments are Across slope cultivation, contour hedges of Leucaena, graded earthen bund (0.2% slope) and contour hedges of Vetiver grass. Numbers on top are total soil loss (t/ha), lighter areas represent the maximum one day soil loss.

money is readily available for any cost-effective technologies. My research targets assess the potential values of Vetiver from both ends of the economic spectrum and, therefore, the early results and discussions presented could be easily adapted to suit different input requirements."

"The report presented here covers work done over a short period of less than 2 years. Even so, the results clearly show the vast potentials of Vetiver which are too tempting for any one not to look further into it! The future is being written ....."

Dr. Yoon's report provides information on:

Vegetative Multiplication : (i) By tillers; (ii) By culm-branches; (iii) By culm-cuttings.

Growth Rates : (i) Effect of shade; (ii) Effect of soil types; (iii) Effect of bag sizes; (iv) Effect of fertilizer ; (v) Effect of spacing cum fertilizer; (vi) Effect of different starting materials on variability of tiller formation and growth rates; (vii) Study of the root systems.

Effect of Vetiver On Soil Erosion : (i) Demonstration of effectiveness against top-soil loss; (ii) Growth of vetiver and its effect on filled earth; (iii) Growth of vetiver and its effect on cut-earth

Diseases

Adaptive Use Of Vetiver By End-Users : (i) Production of planting materials; (ii) Ponding; (iii) Erosion control in irrigation piping; (iv) To protect terracing; (v) Erosion control and moisture conservation.

Ad Hoc Notes : (i) Different cultivars; (ii) Labor; (iii) Weather conditions; (iv) Fodder production; (v) Mulch; (vi) Tolerance to contact weedicide spray drift; (vii) Competition with rubber; (viii) Competition against other weeds.

Another excellent piece of work received by the Network was carried out by Drs. P. N. Truong, L.J. Gordon & M.G. McDowell of the Land Management Research Branch Queensland Department of Primary Industries Brisbane, Australia on the "Effects Of Soil Salinity On The Establishment And Growth Of *Vetiveria zizanioides* (L.) Nash". In the introduction to the paper, the authors write :

"Vetiver grass [Vetiveria zizanioides (L.) Nash] is believed to have been first introduced into Queensland, Australia in the 1930s as a potential crop for its essential oil. In Queensland, its role in soil and water conservation was not realized until 1986 when it was promoted by the World Bank as a natural, effective and low cost method of soil and water conservation. Vetiver grass is presently being evaluated as a means of gully stabilization in grazing lands."

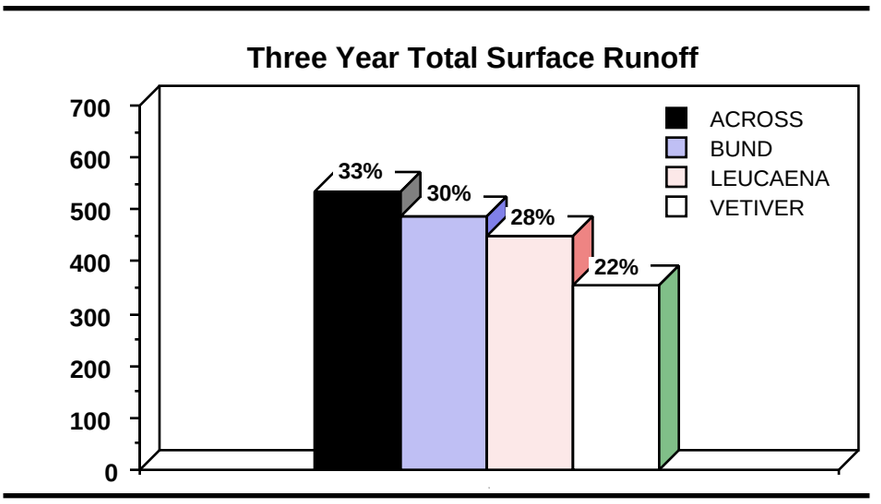


Figure 2. Three year total surface runoff from runoff plots in Akola, India. Percentages on top express total runoff as a percentage of rainfall occurring in those storm events which resulted in surface runoff. The difference between the Vetiver and the Across slope cultivated plots amounts to almost 200 mm of rainfall, or about one-quarter of the average annual rainfall of that area.

"One of the characteristics of the soils in the semi arid regions of sub tropical eastern Australia is the presence of soluble salts and exchangeable sodium in amounts likely to affect plant growth. Solodic soils frequently contain high levels of exchangeable sodium and magnesium and low levels of exchangeable calcium (Isbell 1957)."

"In Queensland, most grazing land degradation (sheet and gully erosion) in semi arid regions is often associated with saline - sodic soils and to be effective in stabilizing gullies on these soils, Vetiver needs to be moderately salt tolerant. There are practically no references in the literature on the salt tolerance level of Vetiver grass. Only one reference is listed in the comprehensive bibliography, Plant Response to Salinity (Francois and Mass, 1978) but this does not give any details on the soil salinity level where Vetiver was evaluated for its essential oil production (Chandra et al, 1968). As a result, a series of glasshouse and field experiments were conducted to determine the salt tolerance of Vetiver grass. The objectives of these trials were:

(i) To determine the salt tolerance of Vetiver grass in comparison with some well known pasture grasses; (ii)To determine the effects of shallow saline groundwater on Vetiver growth and; (iii) To determine the soil salinity level and plant chloride content of Vetiver grass at which toxic symptoms appear and describe these symptoms."

UPDATE ON VETIVER RESEARCH IN AKOLA, INDIA - SYNOPSIS OF THREE YEARS DATA

Drs. G.M. Bharad and B.C. Bathkal from PKV University in Akola, Maharashtra, India have provided the Network with another season's data on the impacts of vetiver grass hedgerows on soil loss and surface runoff. Figures 1 and 2 show the soil loss (total and maximum one day soil losses) and surface runoff from the plots over three years and Figure 3 compares these rates to the control plot (ACROSS) from the top 10% largest storms over the three years. The individual treatments are : ACROSS = across slope cultivation only; BUND = a graded (0.2%) earthen bund at a 1 meter vertical interval with contour cultivation; LEUCAENA = Leucaena leucocephala contour hedgerows at a 1 meter vertical interval with contour cultivation; and VETIVER = Vetiveria zizanioides contour hedgerows at a 1 meter vertical interval with contour cultivation. Plots are approxi-

mately 0.35 ha, slopes are less than 2%, soils are vertisols, climate is semi-arid.

Referring to Figure 1, in all plots the majority of the soil loss occurred in year 1 (68% - 79% of the totals) with a substantial proportion of that loss coming from one storm event; year 1 was an unusually wet year. The numbers on top of the histograms are the total three year soil losses and the lighter areas represent the soil lost in the one major storm event in year 1. As illustrated here, the adequacy of a soil conservation treatment must be judged not on the "average" event but on performance during exceptions to the average.

Figure 2 shows the total amount of surface runoff from all treatments. The numbers on the top of the histograms are surface runoff as a percent of the rainfall from storm events which caused surface runoff. The difference between vetiver and the across slope treatments represents almost 200 mm of rainfall. In year 2, a droughty year, surface runoff from the vetiver plot was 55%, 35% and 41% less than from the across slope, leucaena, and bunded treatments, respectively.

Figure 3 is a followup on the comment made above regarding performance of conservation treatments during the extreme events. This figure represents the data from the top 10% largest storms over the three years. These storms also represent the events which resulted in the greatest volumes of surface runoff. The figure shows soil losses and surface runoff from the leucaena, bunded and vetiver plots as a percentage of losses from the across-slope "control" plot; the absolute amounts of soil loss and surface runoff for each treatment are given on top of the histograms. Across all three treatments, it was in this 10 percentile of storm events that one-half to two-thirds of the three year total soil loss occurred and about 50% of the total volume of surface runoff.

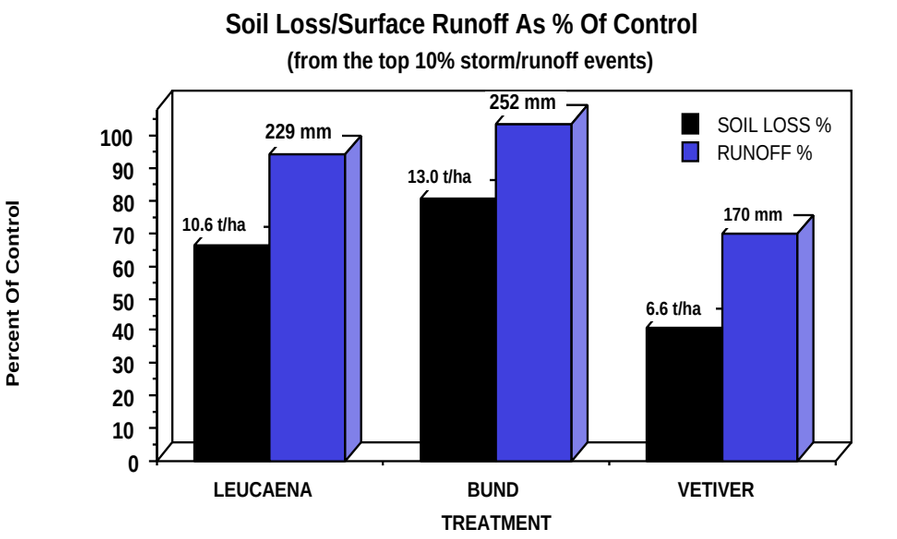


Figure 3. Soilloss and surface runoff from the largest 10 percentile of storm events occurring over the three years of observation on runoff plots in Akola, India. The great majority of soil losses and runoff damages are incurred during the "non-average" storm events; conservation treatments must be effective during these extreme events if long term losses are to be minimized. In all plots, 68% to 79% of the total three year soil losses occurred in one storm event in Year 1, prior to the Vetiver and Leucaena hedges becoming fully functional.

On-contour Vetiver Grass Hedge For Conserving Soil and Water, and Enhancing Crop Productivity On Sloping Lands

The Network recently received the following preliminary report by Drs.T. Woodhead and T.N. Chaudhaly at the International Rice Research Institute, Los Baños, Philippines on their work with Vetiver grass :

"On sloping lands, barriers are established across the flow path of running water to reduce its flow volume and velocity, and thereby to conserve soil and water which is associated with enhancement in crop productivity. The traditionally advocated earthen embankment barrier/contour bund is not attractive to farmers because of constructional flaws and poor economics on small land holdings. An alternative is the vegetative barrier in the form of grass, shrub or tree hedges and among them, the one which creates a dense barrier at the ground surface without a long establishment period and does not interfere with crop production process by way of inconvenience in farming, crop shading and competition for water and nutrients can be preferred. Keeping these parameters in view, a field study was designed to evaluate the effectiveness of on-contour Vetiver hedge in conserving soil and water, and enhancing crop productivity on gently sloping land (about 2% slope; south-east aspect) at the IRRI farm. The study site has medium deep soil of silty clay texture and receives mean annual rainfall of about 2500 mm."

"Single-line hedges (slips spaced 8 cm apart) were planted at 0.25 and 0.50 m vertical intervals (V.I.) on 18 June 1990. The test crops of rice (IAC - 25) and mungbean (M79-13-60) were planted in the intervening alleys on 19 June and 3 July, respectively. Six treatment combinations involving rice and mungbean crops with hedges at 0.25 and 0.50 m V.I., and a non-hedged control were established in plots of 4.3 m width and varying length (26-41 m) with three replicates in RCBD."

"Observations on depth of soil accumulation, soil water content in the crop root-zone, and crop growth and yield were recorded in the upper and the lower parts of each alley."

"The hedges planted almost concurrently with the test crops took time in establishment but became continuous in the latter part of the crop growing season. They allowed thereafter substantial accumulation of eroded soil on their upslope sides that otherwise would have been transported further downslope compared to the non-hedged control where only the crop rows allowed some retention of the eroded soil. Since the hedges were not

Table 1. Seasonal soil accumulation, soil water content (0 - 60 cm depth) and crop production averaged over upper and lower alleys and across blocks under various treatments. **(IRRI Data)**

Treatment (Hedge)	Soil accumulation depth (mm)		Soil water content (mm)		Crop production (t/ha)	
	Rice	Mungbean	Rice	Mungbean	Rice	Mungbean
0.25 m V.I.[a]	25±3	28±2	319±8	324±8	1.42±0.12	0.81±0.05
0.50 m V.I.[a]	16±3	18±4	308±10	314±12	1.29±0.11	0.72±0.03
Non-hedged control	8±2	15±2	314±10	317±14	1.25±0.10	0.73±0.03

[a]Vertical Interval

fully established during the major part of the crops' active growth phase, a distinct advantage in respect of soil water regime and productivity of the concurrently grown crops was not realized during this first season. However, the hedges established at a shorter VI of 0.25 m gave marginal increases in crop available soil water retained within the rootzone and in rice and mungbean grain yields (Table 1). The mungbean crop (grown without fertilizers) gave grain yields of higher economic value than the rice crop (grown with fertilizers). Comparison of grain yields of the crop rows adjacent to and away from the hedges suggested no shading/competitive effect of the hedges on the growth of adjacent crop rows."

CONCLUSIONS

"The preliminary results suggest that a fully established on-contour Vetiver hedge can provide adequate protection against soil erosion on sloping lands. It should be acceptable to farmers since the hedge occupies a narrow land strip, the cost of hedge establishment is low as the farmers can use their own labor in hedge planting and there is no maintenance expenditure after it gets established. A greater efficacy can be expected by establishing the hedge at a relatively shorter than a longer V.I., and this may be realistic as well since it can serve as a more appropriate guideline for cultivation and crop planting."

"The effectiveness of more fully established hedges in conserving soil and water and in enhancing crop production as also the competitive effect of the hedges on the growth of adjacent crop rows needs to be further evaluated. With availability of more data, it may be feasible to assess relative productivity/profitability of rice and mungbean as alternative wet-season crops for uplands."

VETIVER RESEARCH IN MALAYSIA - SOME PRELIMINARY RESULTS ON SOIL LOSS, RUNOFF AND YIELD

Drs. K.F. Kon and F.W. Lim have begun trials with Vetiver grass hedges at the CIBA-GEIGY Agricultural Experiment Station in Negeri Rembau, Malaysia. They have sent a copy of preliminary research results to the Network detailing the following :

"We planted single tillers of vetiver grass (source: MARDI, Serdang) in rows at 4 m apart in plots on an Ultisol in our station. The plots were 8 m long by 1.5m wide; three hedges were planted on each at the bottom, middle and top of the plot. Within the hedge tillers were 10 cm apart within rows and they established quickly and, within 6 months, the gaps between tillers were closed. Plots of 1.5 m by 8 m were established for observational purposes as we did not have enough vetiver tillers to initiate a replicated trial. The vetiver plot was compared with a bare-soil plot for run-off, soil erosion and growth of maize."

"From June 13, 1990 to January 22, 1991, we took 19 measurements of rainfall, run-off and soil erosion. Over this period of time, the total run-off was 73% less in the vetiver plot than in bare soil and the total eroded soil was 93% less (Table 2). The maize crop was sown late and we did not take

Table 2. Conservation of soil and water with Vetiver grass on an Ultisol with a 4% slope at Rembau (CIBA-GEIGY Data)

Treatment	Rainfall[A] (mm)	Run-off (l/12 m^2)	Eroded soil (g/12 m^2)	Dry matter of maize (kg/12 m^2)
Bare soil	851	28.00	277	2.02
Vetiver grass	851	7.51	20	1.83

A - There were 63 raindays from June 13, 1990 to January 22, 1991.

it to grain yield. However, dry matter production indicated that vetiver grass competed with maize, and yield reduction was about 10% (Table 2)" .

CONCLUSIONS

"The preliminary results are interesting. We conclude that vetiver grass hedges reduce run-off and erosion considerably as was claimed in reports that have been published elsewhere. The disadvantage is that it competes with crops for nutrients at a planting distance of 4 m apart. We presume competition can be reduced by spacing the vetiver rows further apart, say 6 m or 8 m."

"The vetiver grass on our station appears to be drought tolerant. Leaves remained green and plants grew despite the dry weather. It attracted a lot of white flies that fed on its leaves. Other than this, we have not observed other pests or diseases" .

Editors Note: In a followup to the authors, the Network requested further information regarding competition effects. The authors responded :

"*Yes, we could see competitive effects on the maize plants. The nearest two rows to the hedgerow were affected. The distance between the first rows to the hedgerows varied from 15 cm to 60 cm, there was 70 cm between the rows of maize; the maize on the downslope side of the hedgerows was more affected. Each hedgerow grew to about 10 cm width at the base (3.8% of the plot) with the aerial parts at 50 cm height about 40 to 50 cm wide (17% of the plot."* The Network wishes to point out that the authors state that the planting distance of 4m apart may be the main factor here. For this slope class (4%) hedges would probably be spaced 15m to 25m apart in a farmer's field.

Hedgerow Establishment - Plant spacing & density

Information received by the Network on planting practices for vetiver grass is presented below.

- RAK College of Agriculture, Sehore, India (soils are heavy black clay (Vertisols); high moisture holding capacity; climate is semi-arid) — 3 slips at 5 cm intervals gave the best survival (86%).
- University of Agricultural Sciences, Bangalore, India (soils are reddish sandy loam to sandy clay loam (Alfisols); moderate moisture holding capacity; climate is semi-arid) — 3 slips at 5 cm intervals gave very good survival and rapid hedge closure.
- Andhra Pradesh Agricultural University, Pahadi Sharif, Andhra Pradesh, India (soils are reddish sandy loams to loamy sands (Alfisols); poor to moderate moisture holding capacity; climate is semi-arid) — 4 slips at 15 cm intervals is reported to give the best results.
- Nanping Prefecture, Fujian, China (climate is temperate) — 5 to 7 slips at 15 cm intervals for poor soils and 3 to 5 slips at 20 cm intervals for good soils.

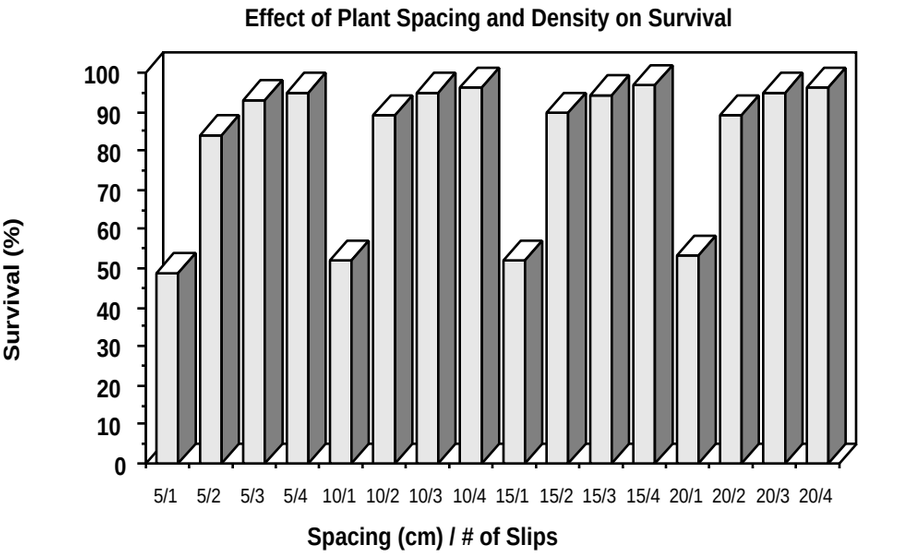
The differences between these recommendations probably results from differences in the planting materials, the soils, the climate and to a lesser extent, the planting techniques. What this shows is that the question of optimal practice for hedgerow establishment in a given location is going to be a location specific answer. This data can only be used to suggest general guidelines for management in other locations with other planting materials. It should be recognized, though, that the optimal solution is not strictly necessary or always practical. This can be illustrated from the trial data presented by the Operational Research Project in Kabbalanala, Karnataka, India. The project researchers planted vetiver at densities of 1 to 4 slips at intervals of 5, 10, 15, and 20 cm (16 treatments — 4 planting densities X 4 spacings) and obtained the following results :

Survival. Percentage survival was about 90% to 95% at six months for all plantings with 2 or more slips at all planting intervals; practically there was little difference in survival (under trial conditions) as long as at least 2 slips were planted. The data is shown in Figure 4 where the horizontal axis along the bottom (X-axis) shows the plant spacing and the planting density, for example, "5/1" means that every 5 cm there was 1 slip planted.

Average Gap Size. Researchers also measured the average gap size at six months (the end of the growing season) for each of the 16 treatments (Figure 5). The best results, in terms of hedge closure came from planting 4 slips at 5 cm intervals.

Looking at Figures 4 & 5 it can be seen that while there is an "optimal" approach, the majority of the other approaches are quite successful as well. As such, the data shows that there was a good deal of insensitivity to the approach taken. So even without access to location specific research one could feel fairly confident that within that region, by planting 2 or more slips at each spot and providing some management inputs (gapfilling, occasional pruning), a hedge will eventually result. Generally then, the worse the site the more slips one might wish to plant; the faster one wishes to form a hedgerow, the

Figure 4. Percentage survival at six months of Vetiver grass plantings at various spacings and planting densities. The horizontal (X-axis) is read : "5/1" = each 5cm 1 slip was planted.



closer together one should plant the slips.

From the survival data it can be seen that planting only 1 slip probably is not a good idea, and this is confirmed by looking at the data on the average gap sizes. It appears that planting 4 slips every 5 cm is the best way to go. However, this would require a large amount of planting material and more time for planting so that establishment costs would be higher and perhaps a smaller area would then be treated. What is needed in addition is an estimate of how long it will take to form a functional, closed hedge so that the tradeoffs between costs, time and area to be planted can be explored and an informed decision on how much material to use and how to space the plantings can be made.

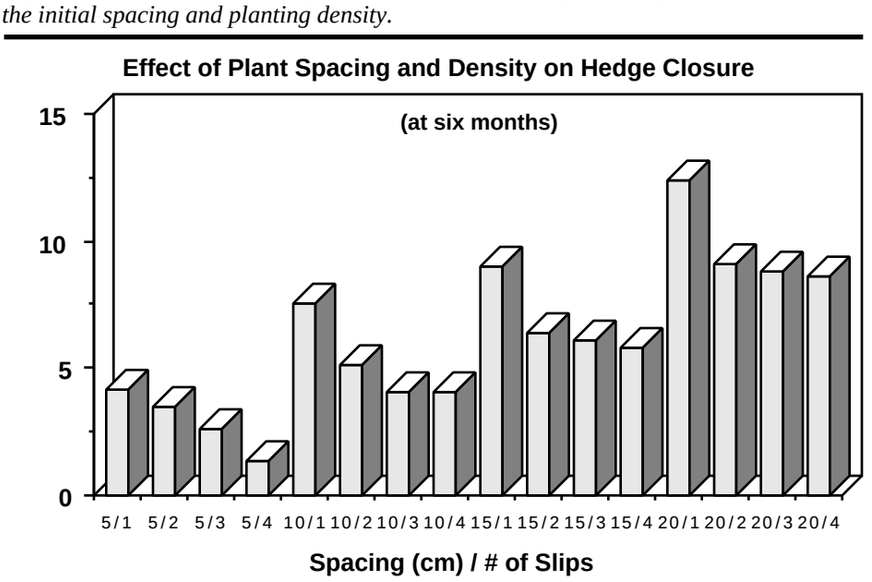
Estimated Rate of Closure. Using Figures 4 & 5, there are four possible approaches : every 5 cm planting 4 slips; every 10 cm planting 3 slips; every 15 cm planting 2 slips; and every 20 cm planting 2 slips. Comparing the 4 planting strategies, we could calculate that hedgerow closure with:

- 4 slips at 5 cm would be about 80% to 120% faster than with the other 3 strategies;
- 3 slips at 10 cm would be about 10% to 20% faster than with the other 2 strategies;
- 2 slips at 15 cm would be about 10% faster than with the other strategy; and
- 2 slips at 20 cm would be the slowest.

The location specific conclusion from this data would be that the last three strategies do not involve great differences in time to hedgerow closure (except if the growing season is very short, for example only 2 or three months each year). Unless rapid protection is required (for example in gully stabilization or protection of high value infrastructure such as road cuts & fills) the extra costs associated with planting 4 slips every 5 cm can be foregone. Depending on existing planting material and labor costs, one of the other three strategies could be chosen.

At present, there are a considerable number of countries, soils, and climates where various planting material-types of vetiver have been planted. If you know of the location of some hedgerows, why not go out and take a few measurements (original spacing, % survival over 3 to 5 randomly selected sections of 100 meters each, average gap size over 10 or so randomly selected sections of 10 meters each) and send the information to the Network where we can compile it and pass it on to practitioners in that area. Do not forget to let us know something about the soils, the rainfall, the slope of the land and anything you think of that might be of interest (is the vetiver freely grazed ?, has it been pruned or managed ?, etc.).

Figure 5. Average size of a gap, at 6 months, in Vetiver grass hedgerows as a result of the initial spacing and planting density.



Research On Vegetative Hedges at Regional Research Station in Tamil Nadu

Dr. S. Subramanian, presented a paper entitled "Vetiver Vegetative Hedge - Experience At Regional Research Station, Aruppukkotai" (he is the Head of the Station) at a seminar on Vetiver Grass for Soil and Water Conservation. The seminar was sponsored by the Indo-Swedish Forestry Program. In his paper Dr. Subramanian reported that his work began in 1987 with the planting of Vetiver grass and 1988 with, Kolukattai grass (*Cenchrus glaucus*), hedge lucerne (*Desmanthus virgatus*), and subabul (*Leucaena leucocephala*). According to his paper, the establishment and growth of Vetiver and Cenchrus into hedges was encouraging, whereas Desmanthus and Leucaena *"experienced difficulty in establishing as a hedge"*. He attributed this, in part, to the latter being established from seed and the former vegetatively. Soil moisture was monitored, comparing an unhedged control to the other treatments. Results showed greater levels of soil moisture in the hedged plots with the Vetiver plot having the highest percentage soil moisture of all treatments at all stages of crop growth, followed by the Cenchrus treatment. During the 1989-90 period (September through February), the Vetiver treatment averaged 26% higher soil moisture than the control and 3%, 9% and 7% greater soil moisture than the Cenchrus, Leucaena, and Desmanthus treatments, respectively. Dr. Subramanian reported that he intends to expand his research to compare Vetiver and Cenchrus grasses within paired 8 ha watersheds. Research on this scale should provide very useful data.

Stemborers In Vetiver Grass - Chinese Research Results

In 1989 Mr. Hu Jianye from the Jiangxi Agricultural Development Corporation reported that an unidentified stemborer was in about 8% of the vetiver plantings over a 200 ha area. In result,

a field survey of stemborer damage was carried out and some larvae were collected for observation. Damage to the vetiver was caused by the borers entering the new tillers from the leaf sheathes and bases of stems to feed on the inner parts and fibrovascular bundles. Feeding activity resulted in wilting of the effected stems and leaves.

The borer was identified as a Grass Webworm (*Chilo spp.* , Lepidoptera, Pyralidae) by Professor Zhang Shimei of the Jiangxi Agricultural University. Only vetiver was found to be a host in that area; the other surrounding vegetation (tea, sweet potatoes, peanuts, citrus, napier grass, watermelon, various vegetables and paddy rice) was unaffected. At present, the recommended control method is to trim the hedges to about 3 cm above ground at the end of the growing season (end of Autumn) and the prunings used for pig or cattle bedding, as fodder or as fertilizer mixed with farm yard manure and allowed to sit for a couple of months. Prunings should not be piled up until the next spring.

United States Department Of Agriculture's Soil Conservation Service Workshop On The Use Of Grass Hedges For Erosion Control

In November of 1990 a workshop was held to report, in part, on work that had been carried out on vetiver grass by various Department of Agriculture agencies in the United States. One of the main issues was cold tolerance with reports that vetiver grass had : (i) "considerable" survival through the cold spell of December 1989 in Americus, Georgia — about 34° North; (ii) that in north Texas vetiver was killed when temperatures dropped as low as - 16° to -18° C over a three day period; (iii) that a two year old, 38 cm diameter clump of vetiver in Griffin, Georgia was mostly killed (the clump regrew from surviving material on the perimeter) when temperatures dropped to as low as -13° and -15° C over a two day period; (iv) in Coffeeville, Mississippi vetiver plants that had survived a frost in March of the year were killed when temperatures dropped down to - 16° C in December; (v) reports that Mr. Eugene LeBlanc, whose family has grown vetiver in Sunshine, Louisiana for over 100 years, says that when temperatures drop below - 13° C that the vetiver is damaged.

"The farmers believe that the Vetiver grass is more resistant, requires less care and as it grows erect it interferes less with cleaning practices...If you see the Vetiver rows, regular and compact, erect, there is no comparison with Lemon grass with its irregular rows, lots of blanks, and leaves in all directions."

Other information of interest on vetiver was regarding a trial in Louisiana with vetiver planted across several small gullies in a military tank testing facility where vegetation has not grown for many years and erosion is a severe problem. The vetiver was reported to have grown rapidly, and even in the early stages before hedge closure it caused a significant stoppage of sediment. It was also reported that native vegetation began to establish soon after the vetiver lines began to stabilize the area. This supposedly was the first time in any ones memory at the facility that vegetation had grown on this severely disturbed site. Also, an herbicide trial with vetiver grass showed that there was no retardation of growth with use of atrazine or metachlor. In fact, growth was better with the use of herbicides as other weed competition was reduced.

The workshop suggested that a criteria be designed for evaluating the potential for grasses as contour vegetative barriers. Some suggested criteria were : tiller density (number/unit area); tiller diameter; rate of growth (increase in clump diameter, circumference, number of tillers); whether or not individual clumps will grow together into a hedge; whether the grass is killed or damaged by sediment accumulation in its crown; whether the grass can survive extended periods of submergence; whether the grass can establish and grow in deeply eroded and other harsh soil environments with the help of fertilization or organic soil amendments.

Notes & Letters From Correspondents

Australia

- The Department of Dairy Husbandry and Breeding in Queensland is testing Vetiver to control ersoion on its farm near Brisbane. After 9 months the grass was looking quite good, according to Mr. Chuck Antholt who was there on a recent visit from ASTAG/World Bank. The Network looks forward to receiving some good information from Mr. Pat Thorbon who is conducting this trial.

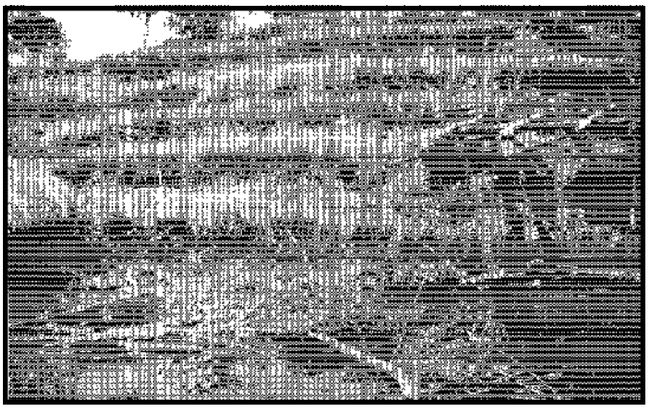
China

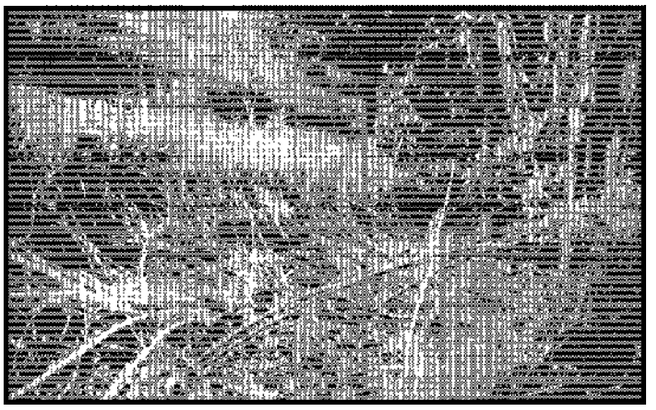
- Mr. Zhang Guangming of the Agricultural Development Corporation in Jiangxi writes :

"*By the end of last December 7,800 copies of the Chinese version of the Vetiver handbooks had been distributed free of charge to agriculture and natural resource agencies in the provinces of Guangxi, Hunan, Jiangxi, Fujian and Zhejiang; copies had also been distributed through the China Vetiver Network in Sichuan. The rest will be sent to to agencies of research and extension, key farmers and anyone else who needs it." He also writes that the demand for vetiver planting material is so high that it may be difficult to meet demands.*

Costa Rica

- Dr. Jorge León, a botanist and one of the world's foremost experts on Andean agriculture, reported in a letter to the US National Academy of Science that plantings of Vetiver grass hedges are increasing in an area of mixed agriculture (small farms) to the southwest of San José as borders to prevent erosion. He states that for this purpose farmers consider it to be superior to Lemon grass (*Cymbopogon citratus*) which had been the preferred species previously. The farmers believe that the Vetiver grass is more resistant, requires less care and as it grows erect it interferes less with cleaning practices.





Photos 1 and 2. The farm of Mr. and Mrs. Santa Anna in Central Luzon, Philippines. The Santa Anna's began planting contour vegetative barriers of Vetiver grass two years ago. From their experience, they believe that the Vetiver hedges will allow them to farm the same fields each year, rather than being forced to be shifting cultivators.

They say the disadvantage is that it is more difficult to separate requiring more labor, but as a whole it is preferred. The farmers also say that they never see it flower, but they explain that this is due to the fact that they cut the plants twice a year. Mr. León reports that the Vetiver sample in the national Herbarium flowers in October. In closing, he writes : "*If you see the Vetiver rows, regular and compact, erect, there is no comparison with Lemon grass with its irregular rows, lots of blanks, and leaves in all directions. It is more resistant to stemborers than Lemon grass and it lasts longer; Lemon grass has to be replanted in the rows every 4 to 5 years.*"

HONG KONG

- Mr. Ronald Hill, Reader in Geography at the University of Hong Kong reports that he obtained vetiver grass from south China last year and has begun multiplying it for eventual use on landslide areas. Mr. Hill reorts that he is "*currently multiplying* (vetiver) *on artificial terraces which are cut into the subsoil and weathered rock with a mixture of sawdust and pig manure to 20 cm depth. This hinders deep root penetration and allows easy removal of slips. We have had excellent growth with divisions at 4 month intervals.*"

KENYA

- Mr. V. Gibberd of the Ministry of Agriculture's E.M.I. Soil & Water Conservation Project writes that trial work has begun on vetiver grass in the more arid (< 800 mm/yr) zones of Kenya. So far early trial results indicate that the vetiver grass is out-performing the other species in their trials (*Panicum maximum* ,*Sehima nervosum*, and the officially recommended *Panicum makarikariense*) — "*It certainly established better and puts on far more impressive vegetative growth*". The trials were started in an attempt to find an alternative for fanyaa juu terracing as its adoption is reported to be constrained by its high labor requirements for construction and maintenance, shortage of tools to construct them, that the preferred season for construction work is the dry season when soils are hard, construction costs are relatively high, loss of land from production, and that the terraces require precision design and checking by competent people to assure that there are no low spots.

Mr. Gibberd also reports that he has found vetiver established on terraces in coffee country in the Machakos District where it was probably planted in the early 1960's, and even earlier than that (date unknown) are splits of vetiver that are thought to have been brought from the United States and used to protect a dam wall on a farm near Thika. He says they "*are still effectively protecting (the) dam wall*".

LAO, PDR

- Mr. J.P.Evenson, Chief Technical Adviser UNDP/DTCD, Nabong Agriculture School Project writes that his school is interested in vetiver for soil conservation in orchards and upland cropping areas. He discovered that the Lao he spoke with were very familiar with its common name (*Faek* or *Faek hom*); vetiver is reported to have medicinal uses in Lao PDR. As part of the school's program for making students aware of the importance and diversity of useful native plants they will launch a search for it in the vicinity of the school. Mr. Evenson also carried out a literature search where he found a reference in Vidal's 1960 publication on "The Vegetation of Laos" where it states that vetiver is :

Found in periodically inundated marshlands which are characterized by having a woody overstory and a perennial herbaceous layer (number of grass species limited to three). Places observed: Houey Kao Canal, near Vientiane.; Nong Bo Canal, north of Vientiane draining to the Mekhong via the Nam Pak Sa; Nong Thevada close to Vientiane and bordering the Mekhong; Nong Na Seng close to Thadeua, east of Vientiane; Than Tha Ngon some 28km to the north of Vientiane; Nam Khem north of Vientiane; Marshes around Pakse;Shallow pools near Paklung close to Louang Prabang.

- Mr. Somphong Pradichit from the Northern Regional Office of Environmental Protection, Ministry of Agriculture and Forestry, Luang Prabang writes that the Vetiver Handbook has been translated into Lao and the script for the Vetiver Slide Show is currently being translated. Also, a vetiver nursery has been established in Xieng Moak where some local varieties of vetiver are being compared with an Indian variety. He reports that the local varieties seem to be doing better at this time.

PHILIPPINES

- From Richard Grimshaw, Chief

of Asia Technical Department, Agriculture Division, World Bank:

"Recently I visited the farm of Mr. and Mrs. Santa Anna located near the Pantabagan Dam in Central Luzon, Philippines (see Photos 1 & 2). They established Vetiver hedges in August 1988, and now have effective hedges. The land is steep, slopes up to 50%, and highly erodible. Normally it would be subject to a cut and burn rotation and planted to cassava. Over two years the hedges on the Santa Anna's farm have become well formed and because of frequent cutting - at least every six weeks - the hedges are kept low (20 cm) and show little sign of having negative impact on adjacent crops. Erosion has been reduced significantly and already small terraces with risers of up to 50 cm high have been formed. The hedges also grow fairly well under partial shade. The Santa Anna's reactions include: hedges should be spaced no less than three meters apart; a clear recognition of reduction in soil loss and fertility decline; there is no competition with other crops; that it is too early to assess positive impact on yields. They believe that the Vetiver hedges will result in a stable form of cultivation (as against slash and burn); and that they intend planting Vetiver on a new farm they hope to soon have. Alex Coloma of the National Irrigation Authority was responsible for encouraging the Santa Anna's to use Vetiver, and he has promised to monitor its impact more closely now that the hedges are well established. One last point from Mr. Santa Anna : "If Vetiver hedges are to be properly established they must be managed and not neglected."

- Dr. Paul S. Teng, Plant Pathologist and Coordinator of IPM at IRRI, in a letter to the Unites States National Academy of Sciences writes : *During December 1990 I did pay a visit to a place called Guba which is approximately 25 km west of Cebu City on the island of Cebu, in the middle of the Philippines. Vetiver has been used for erosion here by an NGO group for several years and I saw stands on contours that were about a 0.75 m tall. Three points may be of interest to you: **(1)** There was quite a proportion of fertile seeds on panicles in at least a third of the clumps. I guess this may upset the view that the plant is sterile. However, I did not see any evidence of Vetiver establishment in areas outside where it was originally planted with cuttings. **(2)** The farmer leader I spoke to told me that Vetiver was not popular as the holdings in this sloping land topography were generally very small - < 0.5 ha - and farmers felt that the grass took up to much valuable land. He also noted that rainfall was not a limiting factor at this site, and that further north, where rainfall is limiting, there was some preference for Vetiver over other hedgerow species. **(3)** I must have examined some 50 Vetiver clumps and was "disappointed" to find no disease or insect infestations. I also now have a small colony of Vetiver growing at home, in pots, in the IRRI Housing compound for further observations" .*

Editor's Note : The Network has collected considerable information over the last two years on fertility in vetiver. There are no conclusions yet but we feel confident in stating that vetiver grass is not known to exhibit invasive behavior; based on empirical evidence from years to decades of observations in dozens of countries. Under the conditions found in farmer's fields (rainfed or irrigated), vetiver will not spread from seed and become a weed.

USA

- Mr. John Boutwell of the US Bureau of Land Reclamation carried out an investigation for his agency entitled "Evaluation of Vetiver Grass as a Biological Agent to be Used in Preventing Soil Erosion (Revegetation)". Figure 6, taken from his report, is a map of the United States with shading to depict areas that are potentially suitable in terms of temperature (30 days or less of mean annual minimum temperatures of 0° C and below) and rainfall (a normal annual precipitation of 255 mm or more) for Vetiver grass hedgerows.

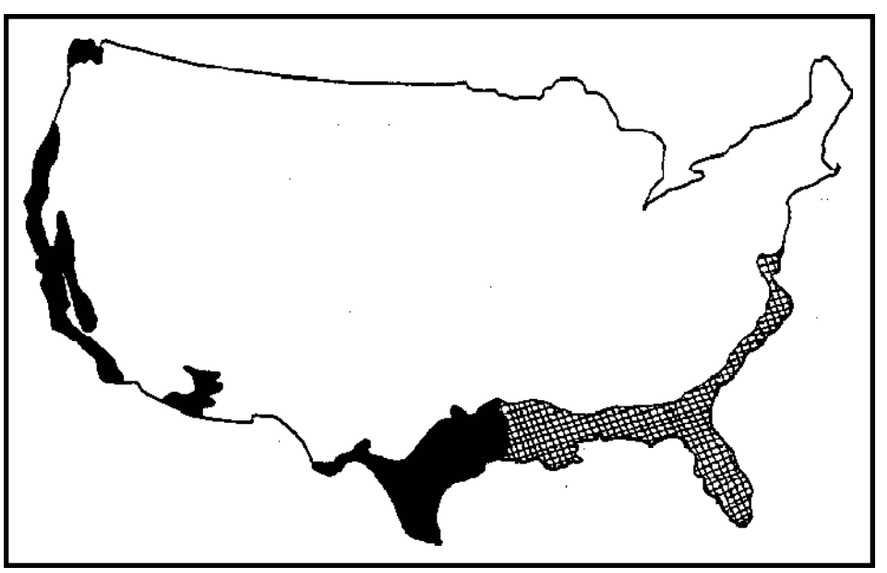


Figure 6. Shaded areas represent those parts of the United States where Vetiver grass may potentially be planted for soil and soil moisture conservation.

EXCERPTS FROM THE ALL CHINA VETIVER NEWS NETWORK NEWSLETTERS

The Chinese Vetiver Network, which was initiated in October 1989, has supplied this Network with copies of their 4th and 5th Newsletters. The following are some excerpts of interest from these:

SURVIVAL

"At the end of March this year, the Soil and Moisture Conservation Office of Sichuan Province and the Hilly Area Development Office of Chengdu introduced 12 tons of Vetiver slips from the Jingyang Prefecture of Fujian Province. These slips have been planted experimentally.... Since June, some of the experimental locations have sent

us growth condition reports and observation records. According to the Pingshan SM Office: Vetiver was planted on March 29, established itself in 25 days, survival rate was 90%.... At the nursery of Chiyang Village, Central Deyang Municipality, vetiver was planted on March 28, the slips recovered in 13 days, with a survival rate of 80%.... In the Kuokinguo Reservoir area of Fanjihua Municipality, vetiver was planted on April 21, recovered in 13 days, survival rate was 36%.... According to observation at the SM Experimental Station of Dujiangkin Municipality, the survival rate was about 40%.... Vetiver planted in the garden of the Chengdu Hilly Area Development Office had a survival rate of about 60%."

GROWTH

"According to the present condition of growth in different areas, the growth prospects are mixed, and in most places, the growth has not been satisfactory. The main reason for this has to do with weather conditions and management. In Sichuan this year, the drought between Spring and Summer had been more serious than normal, in most places, no rain has fallen since April. This caused serious water stress to the young vetiver seedlings which, if not irrigated in time, would die in large quantities. In sharp contrast to this, last years' plantings suffered less drought and have been growing well. According to the Chengdu Hilly Area Development Office, the hills planted last year sprouted this spring and maintained very rapid growth, the rate of growth was twice as high as any that was planted elsewhere last year (in Sichuan). From this we can deduce that vetiver in itself is drought resistent, but those introduced from Fujian need a period of transition and adaptation."

VETIVER FOR SOIL AND MOISTURE CONSERVATION

"Since its introduction last year, vetiver cultivation in Pingnan Prefecture of Fujian has achieved very good results....In our Prefecture, there has been a history of Vetiver cultivation of some years now, but only the roots were used for extracting fragrance.... After a year of experimentation, it proved to be a good plant for soil and moisture conservation: it has wide adaptability, rapid growth, low cost and significant benefits in soil and moisture conservation. This year's new plantings are not only extensive in area, but also of significant scale."

AN INSECT PEST ON VETIVER

"According to a letter from Weili County of Sichuan, a small number of "Sticky Worm" activities were discovered in their nursery on June 26. By July 4, "sticky worms" were found on every vetiver clump, ranging from 2 to 13 worms each. The large worm is about 5 cm long and 1 cm in diameter. There are red dots on the head. They are commonly seen in paddy and maize fields. In the nursery, the worms concentrate on attacking vetiver leaves and have left other weeds and grasses alone. From the experience of Weili County, the pesticide "Rifulene" is more effective and has already stopped the attack. We hope colleagues will pay close attention to the presence of pests and diseases on vetiver and inform us in a timely manner so that various experimental units could be notified and adopt their preventive measures."

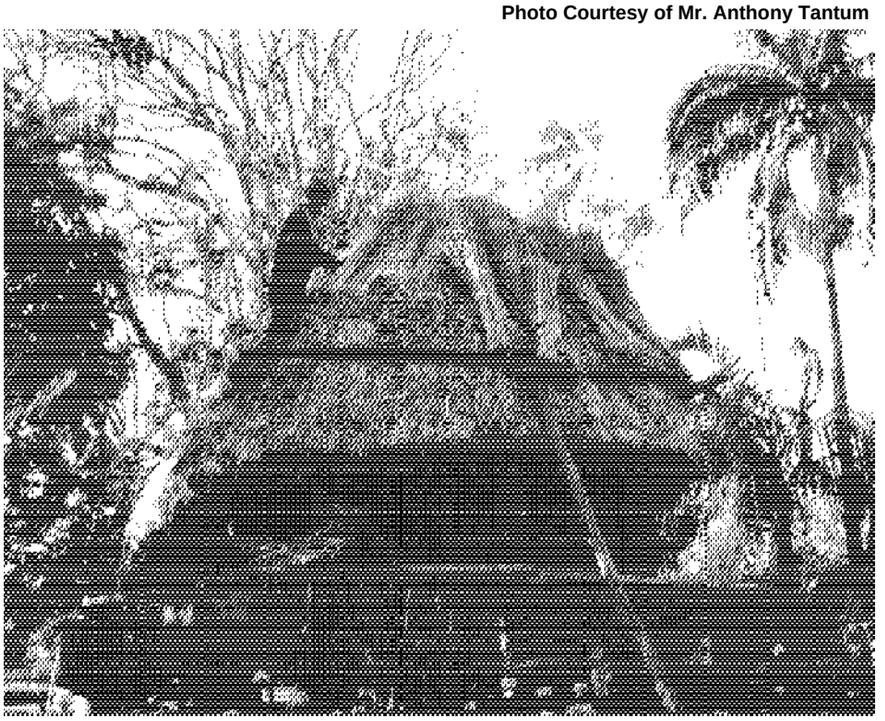
POTENTIAL AVAILABILITY OF FUNDS FOR NGO TRIAL/DEMONSTRATION WORK WITH VETIVER GRASS

Last year the Vetiver Network/ ASTAG was able to offer funding to a few NGOs (nongovernmental organizations) in Ethiopia, Nigeria, Guatemala, Philippines and Nepal. The funds provided startup costs for small vetiver grass nurseries to grow material for trial/demonstration work in cooperation with the farmers with whom the NGOs were currently working and to provide funds to the NGOs to pay the expenses (not salararies) for monitoring the vetiver grass that is planted (e.g. mortality rates, growth rates, silt buildup, crop yield, any other field observations pertinent to nursery management, and hedge establishment or maintenance) for the first two to three years. This information, as well as information on farmer and extension worker attitudes toward the use of the vetiver grass system was to be shared with the World Bank and any interested government agencies, organizations or individuals. Now, almost one year later, in each of these countries there are a few NGO groups who have started producing planting material and will be establishing their first trials with this coming rainy season.

This next year, there is a good possibility that the Vetiver Network/ ASTAG will have another grant with which it will be able to repeat the funding of another four or five NGOs in each of four or five countries. We would be

Photo 3. Vetiver grass thatching in South Africa

Photo Courtesy of Mr. Anthony Tantum



interested to hear from any NGO groups who are currently involved with agriculture/natural resource management cooperatively with small farmers and who are willing to and interested in trying vetiver grass hedgerows for soil and moisture conservation. If interested, write to the Network at the address given on the last page of the Newsletter. Tell us about your group, the work you are currently carrying out and something about where vegetative contour barriers fit within the needs and farming systems of your client farmers. To a large extent the countries selected will be dependant on the responses that the Network receives.

Where Vetiver Grass Is Not Known to Be

As the search for vetiver grass around the world expanded it eventually arrived at the point where it was no longer so pertinent to ask where vetiver is so much as where it is not. The Network recently contacted Mr. Mark Dafforn, who is studying the geographic distribution of vetiver grass for the Board of Science and Technology for International Development, National Academy of Science of the United States, to obtain the latest information on this subject.

Mr. Dafforn informed the Network that *Vetiveria zizanioides* can be considered pan-tropical. The breaks in Vetiver distribution are more likely information gaps rather than physical gaps. At present they have no reports or documentation on vetiver in the Andean Region (Bolivia, Peru, Ecuador or Uruguay), North Africa (Mauritania, Morocco, Libya, Egypt), or the Middle East (from between Israel and Turkey on the west to Pakistan on the east). Also, they have no reports of vetiver from : Benin, Cameroon, Ecuatorial Guinea, The Gambia, Guinea Bissau, Namibia, Swaziland, Togo; The Azores, The Canaries, Cape Verde, Principe or Sao Tome; Portugal or Greece. Mr. Dafforn explains however, that there are a number of reasons to expect that vetiver will be found in most of these countries — for, example countries surrounded by others where it does exist or historical use in the Mediterranean — he is confident that it will eventually be found in the majority of these countries. If so, vetiver would then exist throughout all the political divisions of the tropics, subtropics, and Mediterranean.

If you are aware of the existence of vetiver grass in any of these countries, please contact the Network at the address given on the last page of this Newsletter.

Institutions Currently Carrying Out Research On Vetiver Grass For Soil/Soil Moisture Conservation

The following is a listing of research institutions and organizations (of which we have information) that are pursuing research on one or more of the following topics : propagation, establishment, management or impacts of vetiver grass for soil and soil moisture conservation; the biology, ecology or pathology of the species *Vetiveria zizanioides* . If you are aware of any others, please contact the Network and let us know.

Australia
Dept. of Primary Industries, Agriculture Research Branch, Soil Conservation Research Lab., Queensland

China
Institute of Mountain Disasters and the Environment, Chengdu, Sichuan
Kunming Institute of Ecology, Kunming
Ministry of Agriculture (Fujian, Jiangxi, Sichuan, Hunan, Guizhou)
Red Soils Research Institute, Jiangxi
South China Inst. of Botany, Guangzhou
South China Soil and Water Conservation Technology Experimental Station, Guangzhou

Fiji
University of the South Pacific, Suva

France
French Institute of Agricultural and Environmental Engineering Research, St-Martin d' Hères

India
Andhra Pradesh Agricultural University, Rajendernagar, Hyderabad, AP
Central Soil and Water Conservation Research and Training Institute, Dehra Dun, UP
GBUAT, Pantnagar, UP
ICRISAT, Hyderabad, AP
Operational Research Project, Karnataka
PKV Agricultuaral University, Akola, Maharashtra
RAK College of Agriculture, Sehore
Tamil Nadu Agricultural University, Coimbatore
University of Agricultural Sciences, Bangalore
Watershed Management Directorate, Dehra Dun, UP

Malaysia
CIBA-GEIGYAgricultural Experiment Station, Negeri Rembau, Malaysia
Dr. P.K. Yoon, Head Plant Science Division, Agri-Bio Corp., West Malaysia

Nepal
Central Animal Nutrition Division, Khumaltar

Nigeria
IITA, Ibadan, Nigeria

Papua New Guinea
Lowlands Agricultural Experimentation Station

Philippines
IRRI, Los Baños

South Africa
King Williamstown College

United States
Alabama A&M, Normal, Ala.
National Academy of Sciences, Washington, D.C.
Ohio State University, Dept. of Agronomy (in Costa Rica, C.A.)
University of Georgia Experimental Farm, Griffin, Ga.
University of Texas, El Paso, Tx.
USDA-ARS National Sedimentation Laboratory, Oxford, Miss.
USDA-ARS Plant Introduction Center, Griffin, Ga.
USDA-ARS-NPS, Beltsville, Md.
USDA-SCS Plant Materials Center, Baton Rouge, La.
USDA-SCS Plant Materials Center, Beltsville, Md.
USDA-SCS Plant Materials Center, Jackson/Coffeville, Miss.
USDA-SCS Research Laboratory, Ft. Worth, Tx.
USDA-SCS Research Laboratory, Lincoln, Nebraska

Non-Governmental Organizations Involvement With World Bank

To further NGO involvement in project design, the World Bank has for the last two years regularly updated a "List of World Bank-financed Projects with Potential for NGO Involvement" to inform NGOs about upcoming possibilities for collaboration. The Bank has

also been mailing worldwide its "Monthly Operational Summary" to NGOs that request it. For further information or to order these items contact :

MR. CHRIS HENNIN OR MR. ART THOMAS
EXTIE/WORLD BANK NGO INFORMATION SERVICE; ROOM T8102, 1818 H ST., NW; WASHINGTON, D.C. USA 20433.

THE VETIVER INFORMATION NETWORK

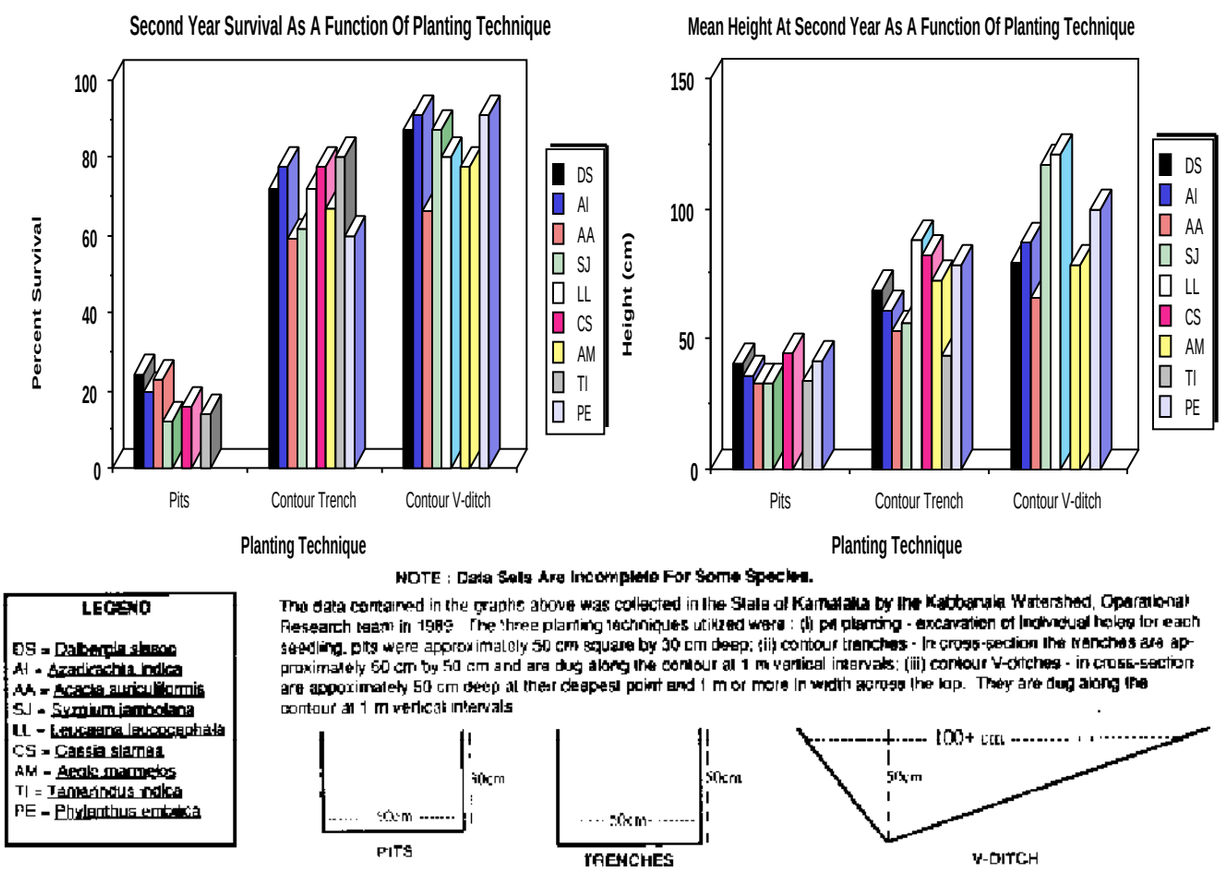
The purpose of the Network is to provide a central point where information on the use of contour vegetative barriers of Vetiver grass may be compiled and disseminated to all interested individuals free of charge. If you wish to join the Network, request further information or supply information to other users, please write to :

VETIVER INFORMATION NETWORK; c/o MR. J. SMYLE, ASTAG; RM. F 3027; 1818 H ST. NW, WASHINGTON, D.C., 20433; USA; TEL. (202) 458-2274; FAX (202) 477-1865

ALTERNATIVE TECHNOLOGIES

With this Newsletter we would like to begin providing the members of the Network with examples of other, simple low-cost technologies that can have a significant impact on how natural resources are managed. This first example comes from the State of Karnataka in south India. The histograms below show how by simply changing tree planting techniques the survival and growth rates are improved tremendously. Though this data is from a semi-arid zone, moisture stress is a major cause of mortality and poor growth rates even in humid zones, especially on hillslopes and where soil crusting is a problem. Tree planting in contour V-ditches optimizes the soil moisture regime for the individual plant to the maximum extent possible short of sub-soiling.

IMPACT OF PLANTING TECHNIQUE ON SURVIVAL AND HEIGHT GROWTH IN SECOND YEAR AFTER PLANTING



NOTE : Data Sets Are Incomplete For Some Species.

LEGEND

DS = Dalbergia sissoo
AI = Azadirachta indica
AA = Acacia auriculiformis
SJ = Syzygium jambolana
LL = Leucaena leucocephala
CS = Cassia siamea
AM = Aegle marmelos
TI = Tamarindus indica
PE = Phyllanthus emblica

The data contained in the graphs above was collected in the State of Karnataka by the Kabbanale Watershed, Operational Research team in 1989. The three planting techniques utilized were : (i) pit planting - excavation of individual holes for each seedling. pits were approximately 50 cm square by 30 cm deep; (ii) contour trenches - in cross-section the trenches are approximately 60 cm by 50 cm and are dug along the contour at 1 m vertical intervals; (iii) contour V-ditches - in cross-section are approximately 50 cm deep at their deepest point and 1 m or more in width across the top. They are dug along the contour at 1 m vertical intervals

The findings, interpretations and conclusions expressed here are entirely those of the authors and should not be attributed in any manner to the World Bank.