Vetiver grass system for erosion control on drainage and irrigation channels on severe acid sulfate soil in southern Vietnam

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Introduction

In Vietnam, the establishment of drainage and irrigation channels in ASS is the most important technique for improving agricultural and fishery productivity. However the embankments of these channels are highly erodible due both to its weak physical and extremely acidic conditions, where very few plants can survive; especially during the dry season leading to severe and costly bank erosion problem. Vetiver grass (*Vetiveria zizanioides* L.) thrives under tropical and subtropical climates and it is highly tolerant to adverse conditions including high acidity (Truong, 1999). Vetiver grass has been used very effectively to control channel bank erosion on ASS in both north and southern Queensland (Truong and Baker, 1996: Carlin *et al.*, 2002).

Experimental Design

Three trials were conducted to determine the tolerance level of vetiver grass under extreme ASS conditions and its effectiveness in reducing bank erosion. Table 1 shows the characteristics of the ASS at the three experimental sites.

Table 1. Soil characteristics at the three trial sites.

Trials	pH_{H2O}	pH_{KCl}	EC (mS/cm)	Al^{3+} (meq/100g)	SO_4^{2-} (meq/100g)	Active Fe (ppm)
1	2.80	2.50	3.93	32.4	7.56	882
2	2.50	2.35	3.14	31.0	6.25	1170
3	3.13	2.97	0.88	0.93	2.33	114

Note: the ratio of soil/water (solution) for pH and EC measurement was 1/2.5

Results and discussion

Trial 1: The objective was to determine the effect of liming on the establishment and growth of vetiver grass. Three liming rates: 0, 120 and 240g (as CaO) per linear metre row were used. After three months, plant height, tillers and shoot growth of the 240g treatment increased more than 3 times than that of the control.

Trial 2: This factorial experiment determined the effect of lime, N and P on vetiver growth. Five liming rates (0,50,100,200 and 400g/m) and three fertiliser rates (0,10 and 20g of DAP/plant) were used. Growth rate of grass in this trial was much lower than that in trial 1, and all those received no lime died in about two weeks after transplanting. This is possible due to the extremely acidic soil condition at this site. However, in general, plant growth increased with higher lime and fertiliser rates.

Trial 3: Establishment and growth of vetiver normally require abundant soil moisture, therefore the effect of flooding was tested. Results indicate that flooding between 10-20cm deep reduced vetiver growth markedly after transplanting.

Plant survival. With adequate liming all plants grew vigorously nine months after planting. During the six-month long dry season, all plants seem to be dormant, most leaves were scorched, but they all survived and resumed vigorous growth just after 20mm of rain at the beginning of the wet season.

Soil chemical properties. Soil pH and other chemical properties were not greatly changed by liming, even at the higher rates. This is possibly due to the very high pH buffering capacity of the soils, but the Al^{3+} and SO_4^{2-} and active Fe were markedly reduced in all treatments. Although soil pH was not affected, plants received lime continued to grow three months after planting, indicating vetiver grass needs only a small quantity of lime for neutralizing acidity around its root at the transplanting time. Once established vetiver plant apparently can survive higher acidity. The lime slot technique developed by CSIRO may provide the necessary initial environment for better vetiver establishment and subsequent growth.

Water quality improvement. Concentrations of some toxic elements such as Al, Fe, and SO_4. in vetiver grass were very high, much higher than those species considered tolerant to ASS. Moreover these concentrations trend to increase as the plant matures (Table 2). These results confirm the findings of Truong and Baker (1998). These high contents suggest the level of these elements could be reduced in both surface runoff and deep drain water before it reaches the channel, thus reducing the level of contamination and improving the quality of canal water.

Channel bank stabilisation. Stability of channel banks was greatly improved with vetiver grass planting. Over the period of four months, soil loss by erosion was markedly reduced, from 400-750tons/ha to only 50-100tons/ha, on both the inside and the outside of a channel embankment.

Table 2. Elevated levels of some toxic elements in vetiver grass

Days after transplanting	**Plant part**	**Toxic concentration**		
		Al (ppm)	Fe(%)	SO_4 (%)
70	Leaf	568	0.58	8.36
	Root	557	1.87	7.98
105	Leaf	663	0.44	8.27
	Root	646	2.82	10.26
270	Leaf	660	0.50	9.00
	Root	600	0.55	11.00

Conclusion

1. Planting of vetiver grass greatly improves bank stability and reduces bank erosion.
2. On severe ASS, liming is needed for vetiver establishment. At least 100g CaO/linear meter row are needed. Higher rate improves vetiver growth rate.
3.Only a small quantity of lime is needed to neutralize the high acidity around vetiver root at the transplanting time. Once established vetiver plant can survive higher acidity.
4.Vetiver grass stopped growing in dry season, but it re-grows vigorously with as little as 20mm of rainfall.
5.Vetiver grass could improve the quality of water in drainage channels by removing considerable amount of some toxic elements leaching from the ASS embankment.

References

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