VETIVER PHYTOREMEDIATION TECHNOLOGY FOR TREATMENT OF PIG FARM EFFLUENT

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SPECIAL CHARACTERISTICS SUITABLE FOR TREATMENT OF PIG FARM EFFLUENT

- Very high capacity for N and P uptake under Dry land, Wetland or Hydroponics conditions

- Highly tolerant to extreme levels of nutrients

- Very fast growth with very high water consumption under wet conditions

- Biomass up to 132t/ha

- Tolerant high levels of herbicides and pesticides

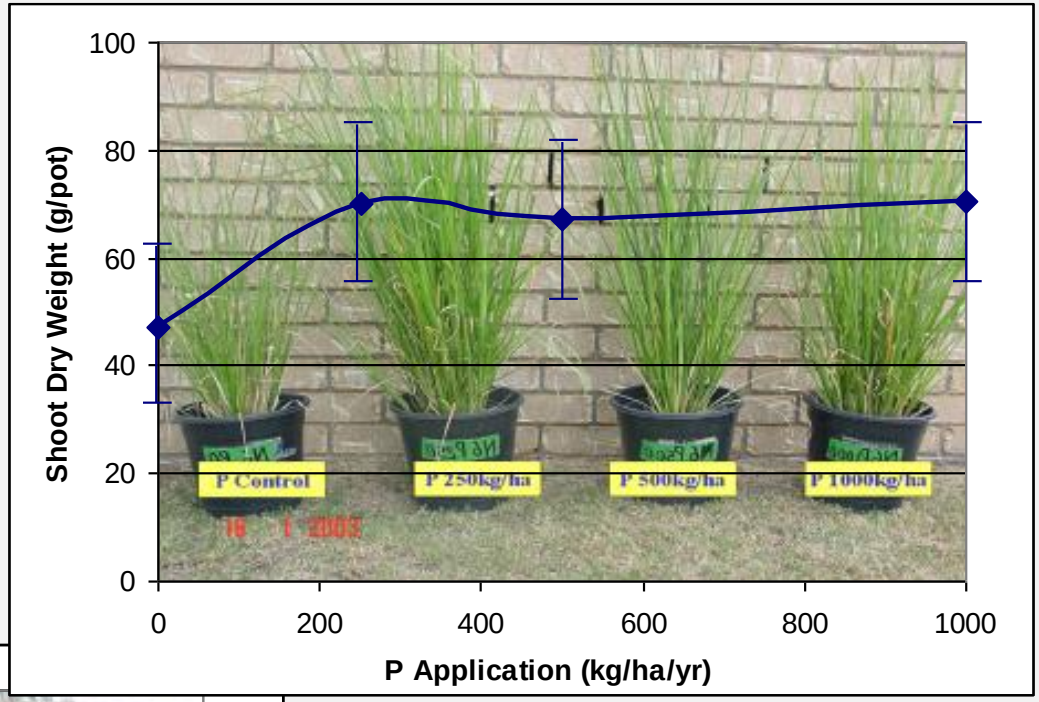
- Highly tolerant to heavy metal toxicities

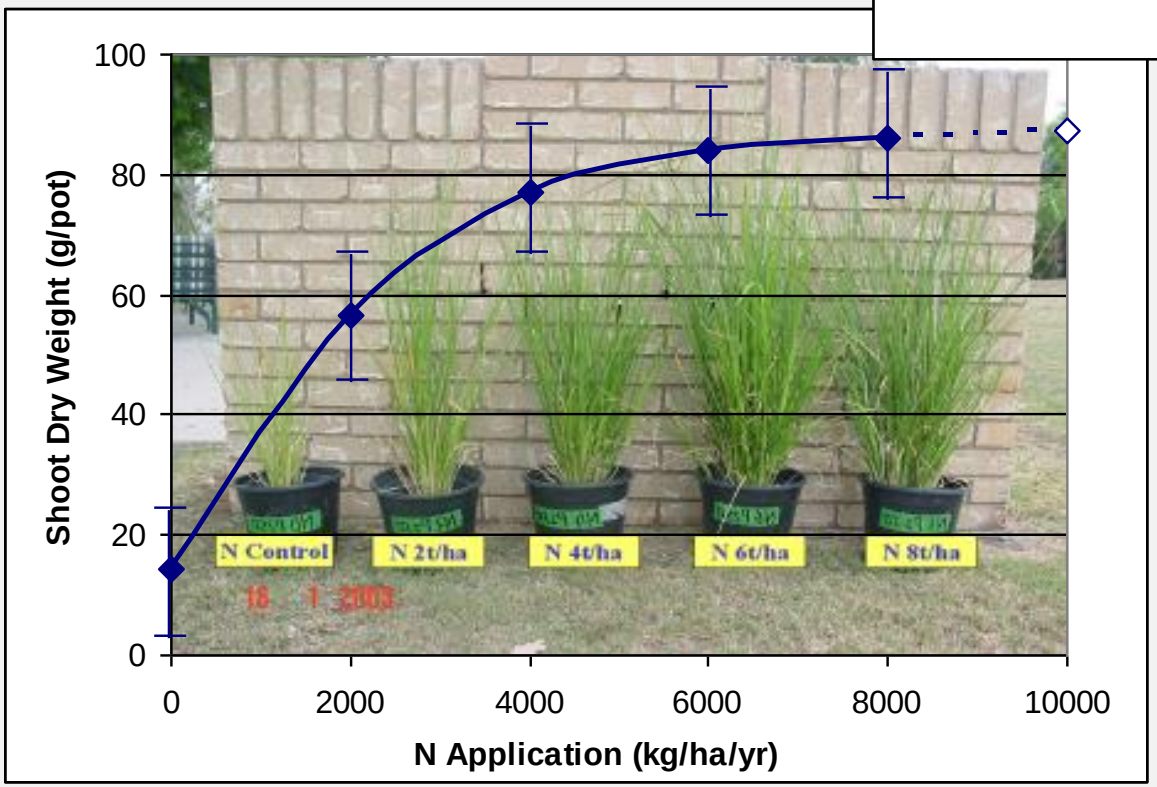
This Presentation includes

- Research in China

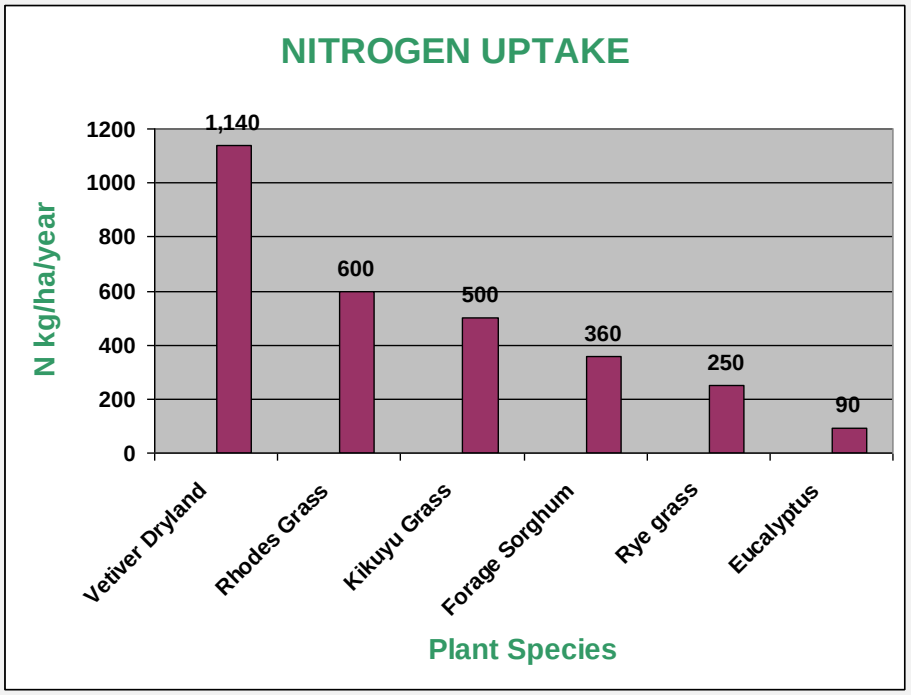
- Farm application in Vietnam

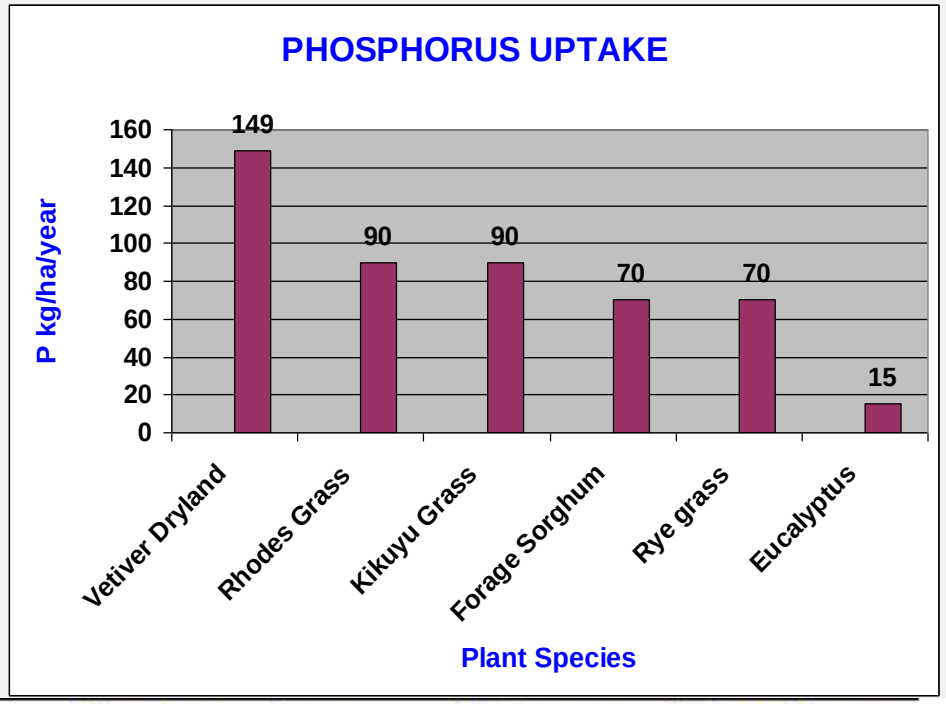
Special Characteristics Suitable for Treatment of Pig Farm Effluent



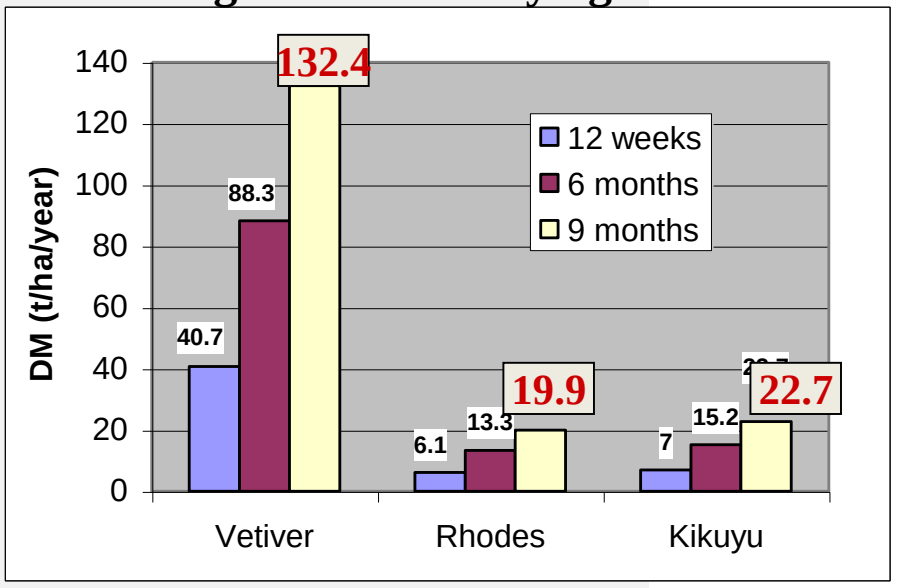


Tolerance to extremely high levels of nutrients





Comparative yield between vetiver, Rhodes grass and Kikuyu grass



Plant species	Nitrogen (kg/ha/year)	Phosphorus (kg/ha/year)
Vetiver hydroponic	13,688	1,026
Vetiver pot trials	2,040	153
Vetiver field trial	1,142	149
Rhodes grass	600	90
Kikuyu	500	90
Green Panic	430	70
Forage sorghum	360	70
Bermuda grass	280	30-35
Eucalypts trees	90	15
Rye grass	200-280	60-80
Wheat (6)	23-208	3-27

HIGH N AND P REMOVAL: With high capacity of removing N and P in polluted water, vetiver cleaned up blue green algae in 4 days

Sewage effluent infested with Blue-Green algae due to high Nitrate (100mg/L) and high Phosphate (10mg/L)

Same effluent after 4 days after treating with vetiver, reducing N level to 6mg/L (94%) and P to 1mg/L (90%)

Environmental Threats of Intensive Pig Production

China is the world's largest pig producer in the world. In Guangdong Province, there were over 130 pig farms each produced over 10,000 commercial pigs in 1998.

Most wastewater from pig farms has been directly discharged into natural waters, severely polluted water and soil in the surrounding environment.

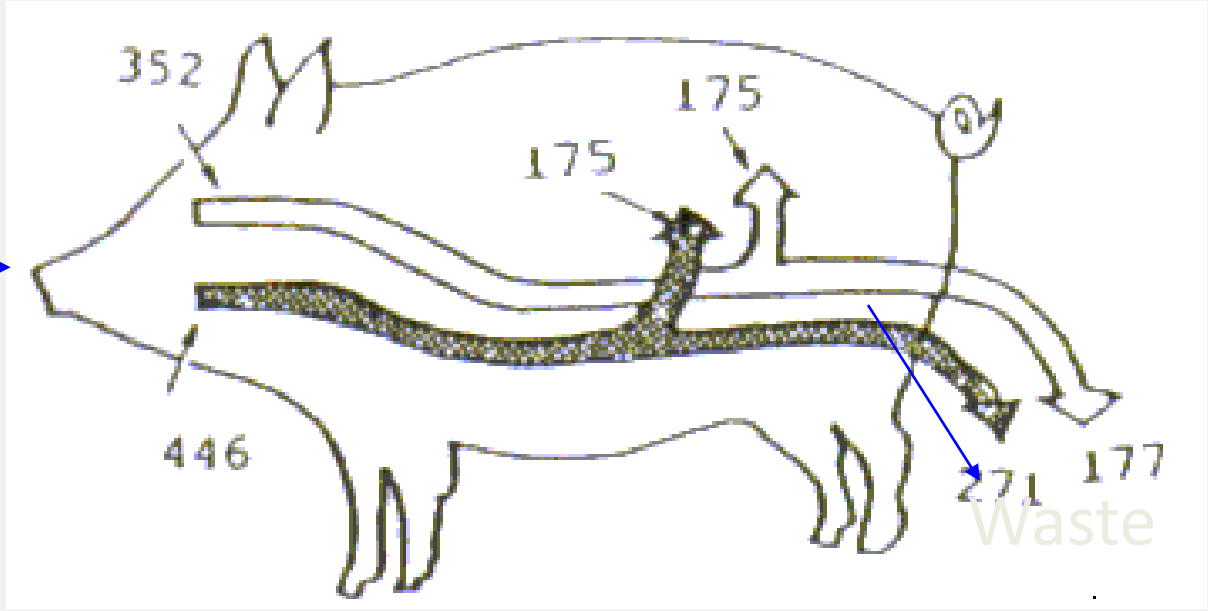
The major environmental threats of intensive pig production are:

- Eutrophication
- Accumulation of heavy metals
- Spreading of diseases and pathogens
- Odour
- Volatilisation of ammonia
- Production of Greenhouse gas Methane

MAIN COMPONENTS OF PIG FARM WASTEWATER

- **Organic (COD & BOD), N & P**
- **Mainly from nutrient digestion in animal**
- **Heavy metals from food additives**
- **Pathogen and others**

N, P, Cu, Zn



Pig Farm effluent Research in China

Xuhui Kong *et al* at the Guangdong Academy of Agricultural Sciences conducted research on Vetiver's Purification for Wastewater from Pig Farm under hydroponic conditions.

Containers

Bamboo float

Concentration, content of N, P and heavy metals in wastewater from pig farm prior to and after planting Vetiver

Elements	Prior to planting vetiver		After planting vetiver		Net uptake (mg/bucket)
	Concentration (mg/kg)	Content (mg/bucket)	Concentration (mg/kg)	Content (mg/bucket)	
Cu	0.0736	0.368	0.008	0.020	0.348
Zn	0.0878	4.39	0.086	0.215	4.175
Pb	0.0501	0.2505	0.029	0.0725	0.1780
Hg	3.02×10^{-4}	1.51×10^{-3}	2.52×10^{-4}	3.02×10^{-4}	88×10^{-3}
As	0.0366	0.1830	0.011	0.0275	0.1555
N	33	165	15	37.5	7.5
P	13	65	8	20	45

Uptake and purification ratios of Vetiver to N, P and heavy metals in pig-farm wastewater (%)

Elements / Uptake Rate	Cu	Zn	Pb	Hg	As	N	P
Root uptake rate	93.8	92.5	30.8	13.2	70.6	60.8	59.1
Purification rate	94.6	95.1	71.1	58.3	84.9	77.3	69.2

Bamboo float

SUMMARY

The results of this study showed that:

- **The purification of wastewater from a pig farm by the culture of *C. zizanioides* was practical.**
  - **The removal rates of N was up to 60%, and P between 59–85%**
  - **The purifying effects of Vetiver to heavy metals is Zn > Cu > As > N > P > Pb > Hg.**
  - **With the highest Cu, and Zn > 92%, As up to 60%, Pb between 30–71%, and Hg between 13–58%.**

- **In addition, the Vetiver bamboo float technology can provide a workable method for a large-scaled purification. Therefore, the environmental pollution from pig farms can be further controlled.**

SELECTION OF SUITABLE PLANT SPECIES

Xindi Liao *et al*, at the College of Animal Science, South China Agricultural University, Guangzhou selected plants suitable for pig farm effluent treatment.

***Chrysopogon zizanioides* and *Cyperus alternifolius* were tested for their ability to decontaminate pig farm wastewater. The plants were evaluated comprehensively for their:**

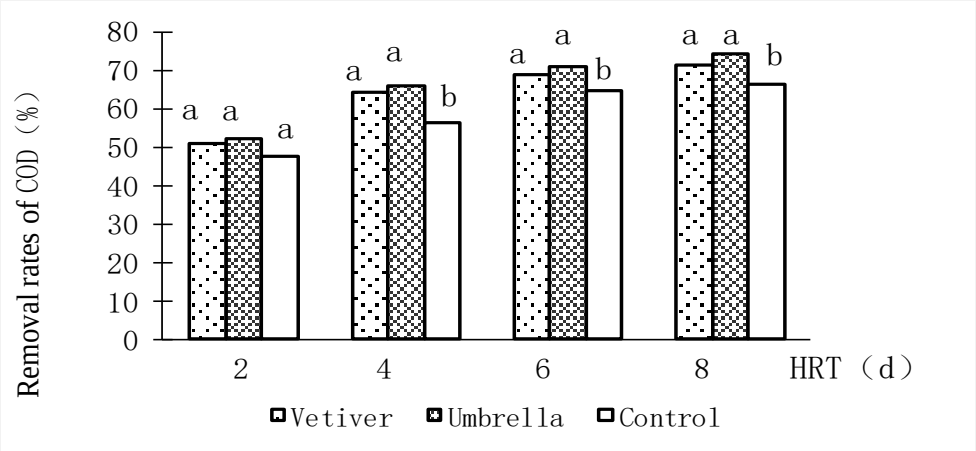
- ***Pollution resistance***
- ***Biomass accumulation***
- ***Root growth***
- ***Landscape beauty and***
- ***Management cost***

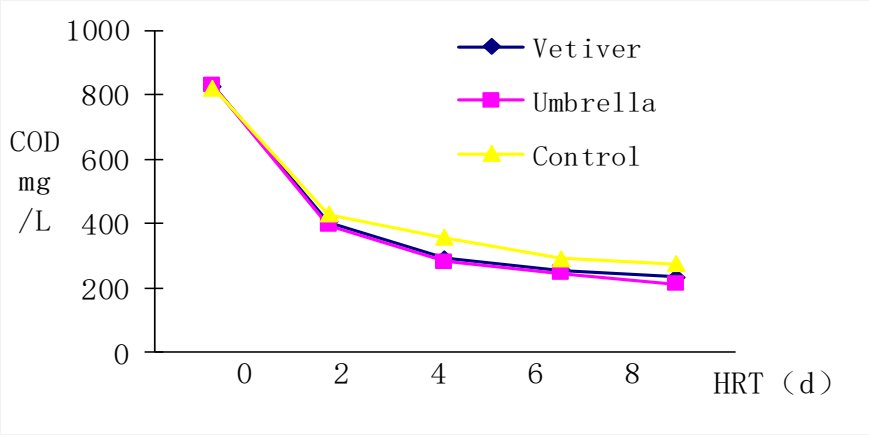
RESULTS AND RECOMMENDATION

- **Both *C. zizanioides* and *C. alternifolius (*Umbrella*)* significantly reduced the levels of COD, BOD and NH_3-N from pig farm wastewater at COD 825 mg/L, BOD 500 mg/L, NH_3-N 130 mg/L and Total P 23 at mg/L.**
- **These plants could cut down those index to 64%, 68%, 20% and 18% respectively by hydraulic retention time (HRT) of 4 days.**
- **Vetiver showed higher removal rate of Total P than umbrella.**
- **As P is very important in the treatment of wastewater in pig farm, it recommended that**

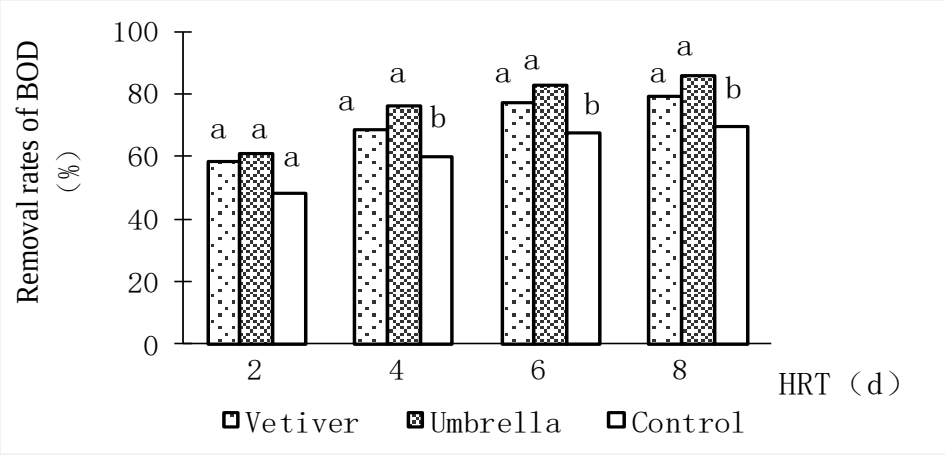
VETIVER SHOULD BE USED FOR TREATING WASTEWATER IN PIG FARM,

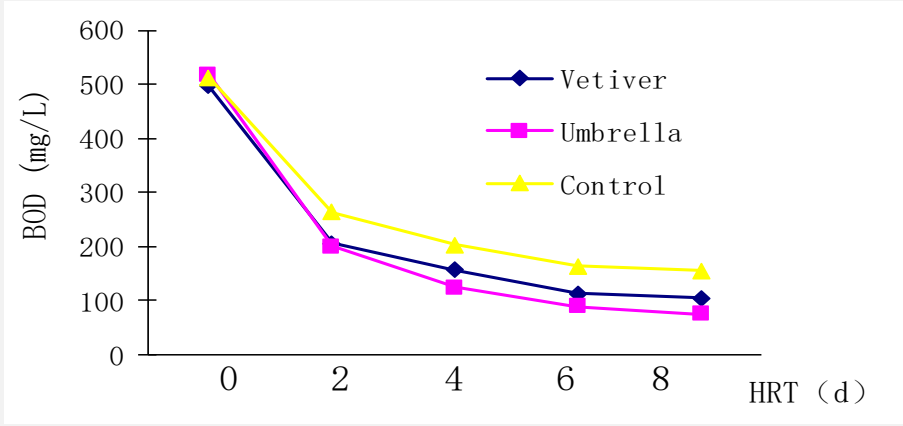
COD LEVELS IN WASTEWATER IN PIG FARM UNDER DIFFERENT TREATMENTS



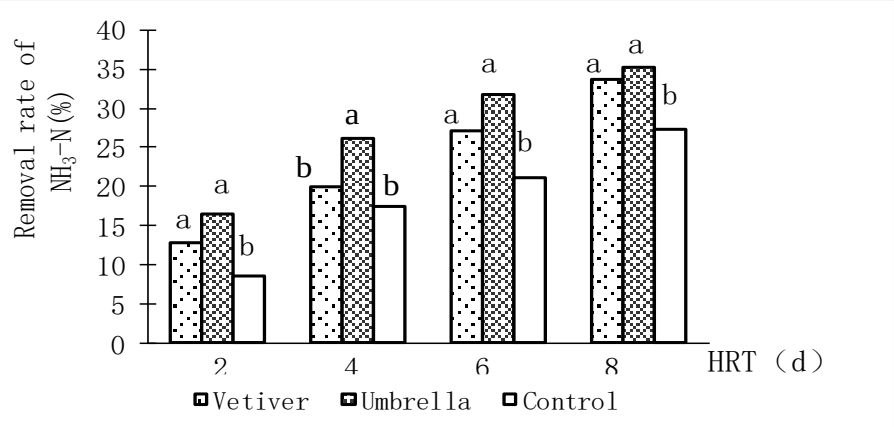


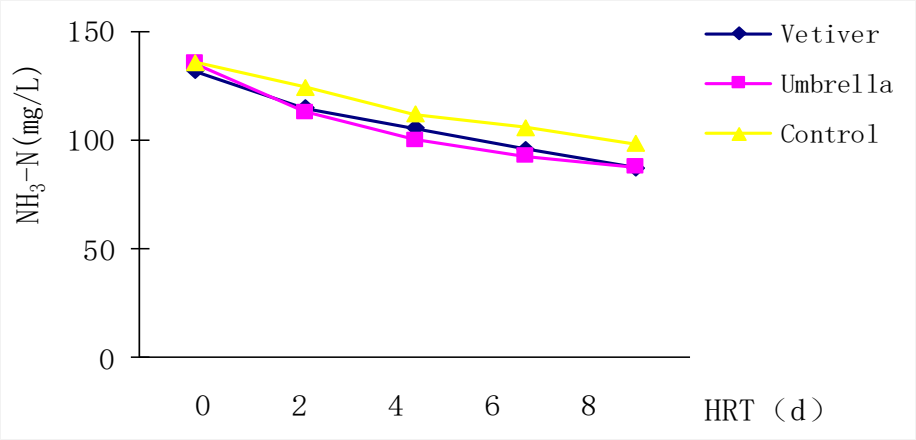
BOD LEVELS IN WASTEWATER IN PIG FARM UNDER DIFFERENT TREATMENTS



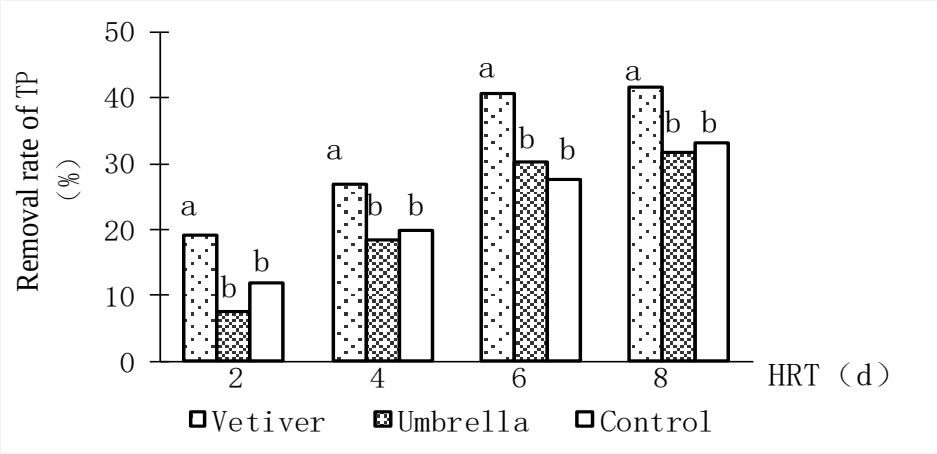


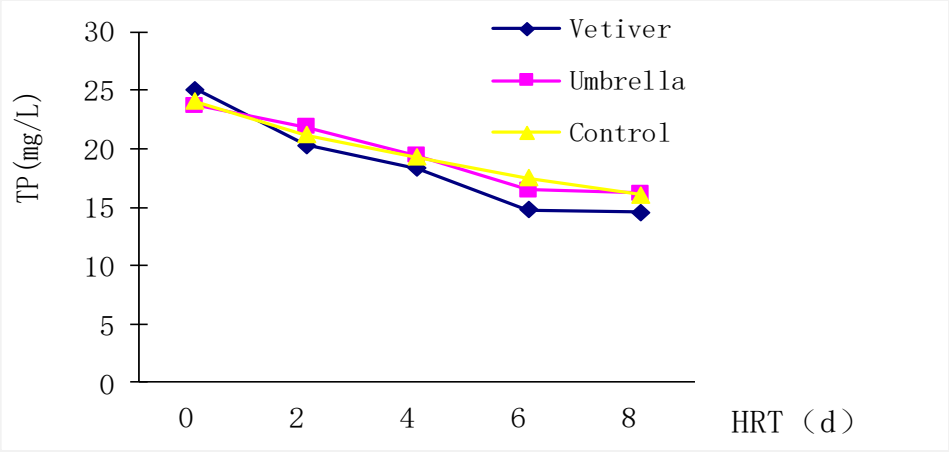
AMMONIA LEVELS IN WASTEWATER IN PIG FARM UNDER DIFFERENT TREATMENTS

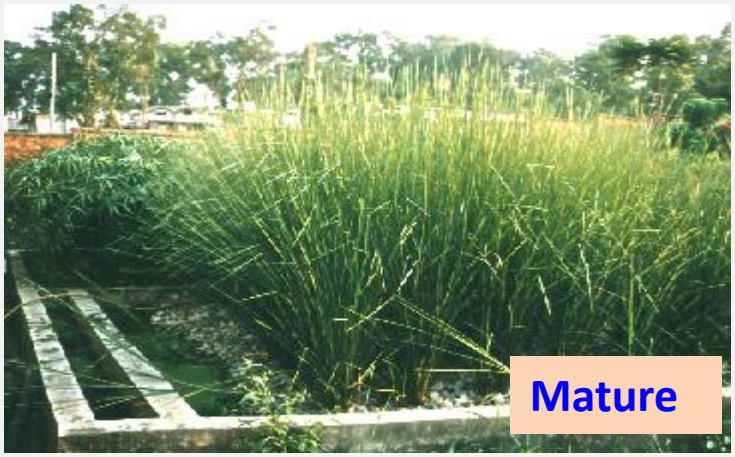




TOTAL P LEVELS IN WASTEWATER IN PIG FARM UNDER DIFFERENT TREATMENTS







Testing outdoor

FARM APPLICATION IN VIETNAM

The effluent of this 8000 pig farm was treated first on land around the pond and vetiver float in the pond.

Planting on land around the pond and irrigated with effluent

Two years after planting

Vetiver Floats in Effluent Pond.

Two years after planting