Trials of mangrove plantation at mudflats suffering from rough waves and strong winds

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ABSTRACT

In order to establish mangrove forests in newly developed mudflats in coastal zones, we developed a new method for planting mangroves and the effectiveness has been verified at mudflats suffering from rough waves and strong winds. Several mangrove species were also examined to determine appropriate species for plantation at mudflats. Some results of our previous experiments conducted in Thailand and newly started experiment in Vietnam are reported. In the interim result, *R. mucronata* and *S. alba* were appropriate species for planting on mudflats suffering from rough waves and strong winds. The planting method newly developed in this study would be suitable especially for *R. mucronata*.

KEYWORDS

coastal zones, mangroves, mudflats, plantation

INTRODUCTION

Tropical coastal zones have recently been damaged by increasing of population pressures, food production and industrial and urban development in many parts of the world. Especially in Vietnam, most of the mangroves were destroyed during the two Indochina wars. Recently, excess cutting of mangroves and conversion of mangrove forests to agricultural lands and aquaculture ponds for commercial production have caused environmental problems. The coastlines where the mangroves disappeared easily suffer erosion by rough waves of sea water. Afforestation of mangroves and restoration of coastal zones, therefore, has recently become an urgent issue.

The goal of this study is to establish mangrove forests in areas after cutting mangroves and in newly

developed mudflats in coastal zones. The areas easily suffer from rough waves and strong winds because of no wave-break and wind-break belts. Many trials of mangrove plantation have been made and failed in such areas. We developed a new method for planting mangroves and the effectiveness has been verified at mudflats suffering from rough waves and strong winds. Some results of our previous experiments conducted in Thailand and interim findings of newly started experiment in Vietnam are reported.

GROWTH OF MANGROVE SEEDLINGS UNDER DIFFERENT ELEVATIONS AT MUDFLATS

A research was conducted to determine the effect of elevation on survival and growth of mangrove seedlings during the establishment period (Kitaya *et al.*, 2002). Seven typical mangrove species namely *Rhizophora mucronata*, *Rhizophora apiculata*, *Bruguiera cylindrica*, *Ceriops tagal*, *Sonneratia alba*, *Avicennia officinalis* and *Xylocarpus granatum* were planted in respect to topographic difference in an intertidal zone in southern Thailand. The experimental areas included abandoned areas after tin mining and gap areas in natural habitats. The experimental sites were sloping and showed a maximum elevation difference of 1.8 m. The plots were naturally submerged with 2-3% saline water twice a day. Salinity, pH and concentrations of several ions in the soil water were similar in all the plots. Survival and growth performance of all seedlings were measured every six months.

The results showed that more seedlings of *B. cylindrica c*, *C. tagal* and *X. granatum* planted in lower elevations died with a year, while *Rm* and *Sa* survived even at the lowest elevations, but showed different growth rates in response to topography. It may be concluded that early growth of seven mangrove seedlings under different elevations differed and showed increasing tolerance to higher tidal levels in the order, *R. mucronata*, *S. alba*, *R. apiculata*, *A. officinalis*, *C. tagal*, *B. cylindrica* and *X granatum*, respectively. These findings provided guideline information for appropriate species selection in a mangrove restoration program.

A MANGROVE PLANTATION TRIAL AT MUDFLATS IN THAILAND

A research was conducted to assess feasibility of mangrove afforestation in new mudflats in central Thailand (Jintana et al., 2005). Seedlings of *R. mucronata, Sonneratia caseolaris, Avicennia alba* and *Avicennia marina*, were planted at five different distances to the existing mangrove forest edge. The seedlings were preliminarily established on slabs of rockwool medium for a half year before transplanting to the mudflats.

The results showed that survival rates of all species tended to decline with time. Six months after planting, *R. mucronata* showed the highest survival rate, followed by *S. caseolaris*, *A. alba* and *A.*

marina, respectively. Tree heights of all species except *R. mucronata* tended to decrease with the increase of the distance from the existing mangrove forest edge. It was found from an interview survey with local people that most of the respondents agreed to plant mangroves on the mudflats. However, they pointed out from their experiences that natural stresses brought about by the wave and wind may destroy the seedlings. Thus, the mangrove afforestation should be established within an appropriate distance from the coastal edge.

A MANGROVE PLANTATION TRIAL AT MUDFLATS SUFFERING FROM ROUGH WAVES AND STRONG WINDS IN VIETNAM

This study was initiated to establish mangrove forests in mudflats in Vietnam. Some of the areas examined in this study suffered from rough waves and strong winds. Some trials of mangrove plantation had been made and failed in such areas.

MATERIALS AND METHODS

The experimental site was set up in a bare intertidal area of the mudflat in Can Gio District located in 20 km southeast of Ho Chi Minh City. There exist mangrove forests that mainly consists of *R. apiculata*, *A. alba* and *A. Marina*. *R. apiculata* has been planted following massive wartime destruction in the most areas of the district and *A. alba* and *A. marina* are naturally regenerated near the coastline. The plant species used in the experiment were *A. alba, A. marina, R. apiculata, R. mucronata* and *S. alba.* These were planted in four bare areas including three experimental plots named A, B and C that located in a newly developed mudflat and one experimental plot named D that located along a canal (Fig. 1). The experimental plots suffered from rougher waves and stronger winds in the order of A>B>C>D. We planted seedlings at the plot A in December, 2005 and at the plots B, C and D in June, 2006.

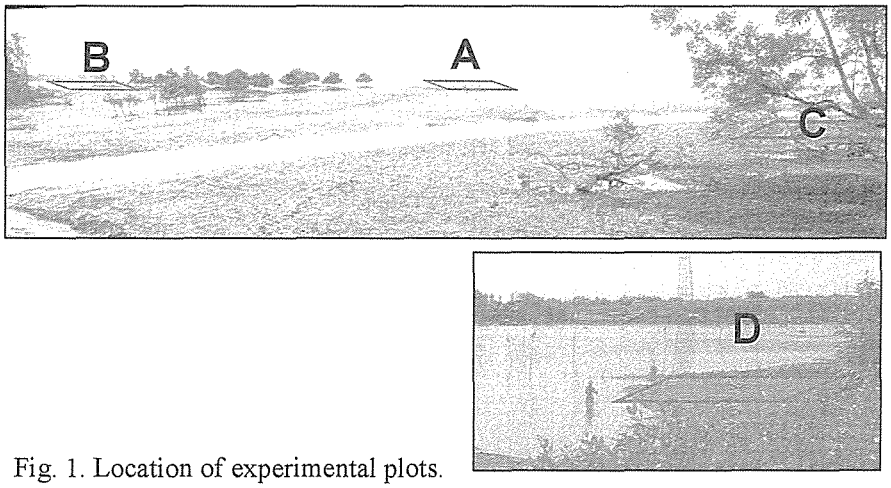

Fig. 1. Location of experimental plots.

Each plot was consisted of 24 seedlings of each species at a spacing of 1 m. Seedlings were preliminary established on soils contained in plastic bags. The plastic bags were removed before transplanting. The soil including the root system of the half of 24 seedlings were covered with rockwool slabs (Fig. 2) just before transplanting to the experimental plots. The rockwool material is made commercially from natural stones and totally inert. The rockwool material is fibrous and holds large amount of water and adequate air, and acts as support for the plants and their root systems in the plantation sites. The plots were submerged with 2% saline water twice a day. The highest tidal level was 2 m from the soil surface at the experimental areas. Survival and growth performance have been compared among two treatments with five species. Survival rates were checked every two months.

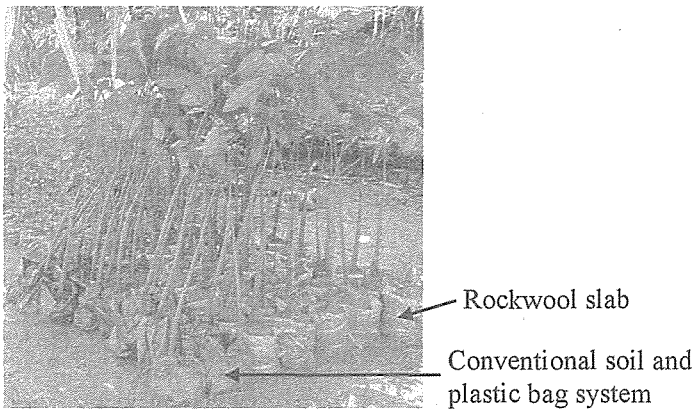

Fig. 2. Preparation of seedlings with and without rockwool slabs.

RESULTS AND DISCUSSION

The results of the first experiment that started on 5th December, 2005 in the plot A with roughest waves, strongest winds and deepest water in all the plots were shown in Fig 3. All the species except *S. alba* died two months after planting in the plot A. *S. albe* survived longer than other species and the survival rate declined with time. *S. alba* died six months after planting in the plot A. There was no significant difference between seedlings with and without rockwool. The site was not appropriate for planting mangroves because of rough waves, strong winds and deep water.

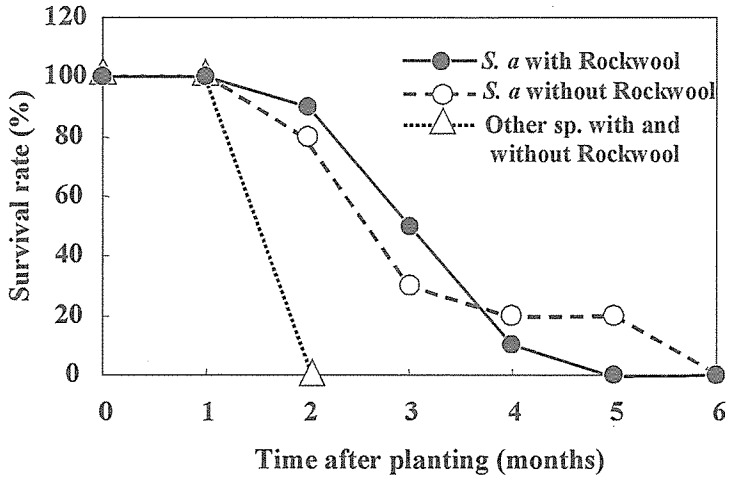

Fig. 3. Time courses of survival rates of five mangrove species after planting at plot A with or without rockwool.

The results of the second experiment that started on 7th June, 2006 in the plots B, C and D were shown in Fig. 4. All the species survived two months after planting in the plot D with less waves and winds. *R. mucronata* showed the highest survival rate followed by *S. alba* in the plots C and D with less waves and winds compared with the plot B. The survival rate of *R. mucronata* with rockwool slabs tended to be higher than that without rockwool slabs, while the survival rates of other species with rockwool slabs tended to be lower than those without rockwool slabs in the plots C and D. The survival rate of *S. alba* was higher than that of *R. mucronata* in the plot B where the wave was rougher and the wind was stronger than those in plots C and D. This was similar to the result of the first experiment in the plot A. *R. apiculata* and *A. marina* disappeared in the plots B and C two months after planting.

In the present experiment, we covered the root system with the rockwool slab just before transplanting. The root system of *R. mucronata* was seemed to develop more rapidly and to fix more tightly in the rockwool slab than those of other species, because the root system of the seedlings of *R. mucronata* was more vigorous than those of other species. Then seedlings of *R. mucronata* tightly fixed in the soft mud soil on the mudflat. On the other hand, seedlings of other species were easily damaged by rough waves and strong winds before the root systems developed in the rockwool substrate.

S. alba has thinner stems and softer leaves compared with those of *R. mucronata*. The shape of *S. alba* might moderate the wave and wind disturbance and thus improved the survival at the plots with rough waves and strong winds.

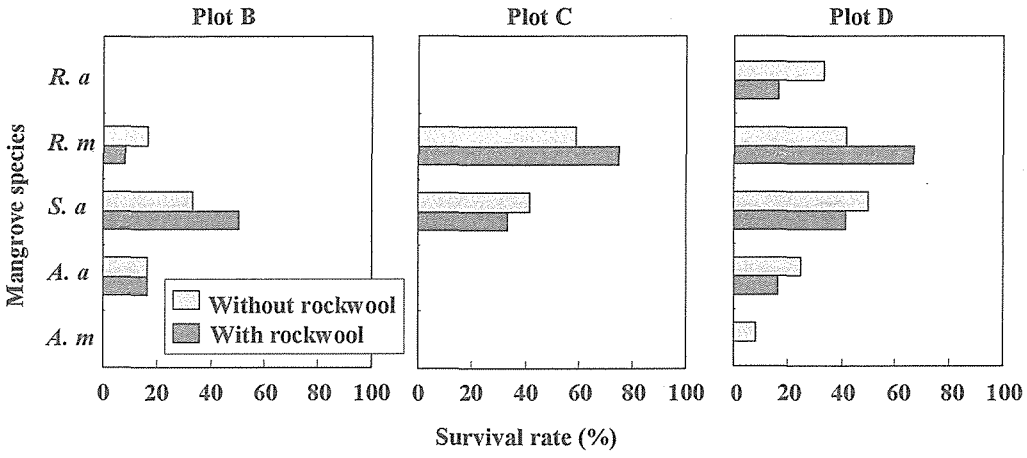

Fig. 4. Survival rates of five mangrove species two months after planting at plots B, C and D with or without rockwool

In the interim result, *R. mucronata* and *S. alba* have rooted and grown at the mudflat suffering from rough waves and strong winds. Especially for *R. mucronata,* survival after transplanting on mudflats would be improved by using the planting method newly developed in this study.

CONCLUDIUNG REMARKS

We have been assessing the mangrove plantation with the newly developed method. The experiment has been continuing. *R. mucronata* and *S. alba* were appropriate species for planting on mudflats suffering from rough waves and strong winds. The planting method newly developed in this study would be suitable especially for *R. mucronata*. We need a longer-term study to confirm the effectiveness of this method. We expect that our findings will provide guideline information for appropriate species selection in a mangrove reforestation program in mudflats.

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