

9. RATIONALE AND KEY RESEARCH QUESTIONS ADDRESSED BY FIELD TRIALS ESTABLISHED AS PART OF THE ACIAR SMALLHOLDER TREEFARMER PROJECT

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A series of field trials have been established as part of the ACIAR Smallholder Tree Farmer Project. These trials are designed to have both a research and demonstration function. A field trial was designed to investigate the potential interaction between four species providing a combination of native and exotic species and nitrogen-fixing vs non-nitrogen-fixing. Importantly, this design provides information about different mixture ratios using only one plot. This field trial will provide important information about the interactions of the four species when grown in varying mixture ratios. A clinal trial using the design of Vanclay (2006) was established in Leyte Leyte in December 2007 using four species. This trial will provide important information on ideal spacing at which trees should be established and how initial planting density affects site capture and early growth, especially in respect to indigenous species. Field trials have also been established to investigate the effect of fertiliser and shade on the establishment and early growth of mayapis and to demonstrate the positive impact that the use of high quality germplasm and good early age silviculture has on the growth of gmelina. The establishment of the field trials has been an important capacity building exercise within the project team. Filipino collaborators have been intimately involved in the design, establishment and monitoring of the field trials and are now capable of establishing similar rigorous field experiments.

INTRODUCTION

Analysis of the tree inventory database indicates that on average only about 30% of site potential in terms of timber yield is being captured by smallholder tree farmers in Leyte. This suggests that substantial improvements in timber yields, and hence financial returns, could be made with improved silviculture. However, there is a lack of locally-relevant evidence-based silviculture prescriptions for key species, including *Gmelina arborea* Roxb. and *Swietenia macrophylla* King., especially in relation to the likely impacts of the two key silvicultural practices of thinning and pruning of mature stands in Leyte. There is also a lack of rigorous field trial data for many other species of interest to smallholders. In particular, there is great interest in indigenous timber species but few evidence-based recommendations on what species offer the greatest potential and how these species should be grown. The field trials were designed to investigate ways to improve the performance of *existing plantations*, and design better performing tree farm systems for *new plantations*.

Field trials established as part of ACIAR project ASEM/2003/052 – Improving Financial Returns to Smallholder Tree Farmers were required to serve both research and demonstration functions. This requirement has a number of implications and constraints. First, the sites need to be highly visible and accessible, hence all sites have been located adjacent to roads. This requirement resulted in difficulty in obtaining suitable sites and some compromises had to be made in terms of total area available for planting. Second, the species studied had to be of high interest to smallholders. Third, for existing plantations, only two species have been planted widely (gmelina and mahogany) and hence research on

improving the performance of existing plantations had to be restricted to these two species. Fourth, while there was a broad range of species of interest to smallholders, planting materials were not available for some species of high interest, particularly dipterocarp species which fruit on an irregular basis.

FIELD TRIALS – EXISTING TREEFARMS

Existing tree farms on Leyte Island consist almost exclusively of gmelina and mahogany, most of which are in excess of 10 years in age. At this age, pruning is not a feasible option and thinning is the main silvicultural option available to improve yields. It is, however, uncertain whether thinning will have a marked effect on growth for stands of advanced age and whether such late-age thinning is economically viable. Field trials were established to address the following questions:

- Is there potential to improve yields of gmelina and mahogany, even if they are thinned at an advanced age? (Will the remaining trees grow any faster?)
- Is it financially viable to thin?
- Can demonstration sites be used to convince smallholders of the need to thin?

Thinning experiments were established at Bato (14 year old gmelina, 14 year old mahogany) and Maasin (8 year old mahogany). Trees at each site were mapped and dbh and height recorded. The thinning strategy employed was to remove all poorly-formed stems and then where several well-formed trees remained clumped together, removal of sufficient stems to reduce immediate competition from neighbours. At the same time, nutrient cycling studies were established in each of the plots (Figure 1).



Figure 1. 12 year old mahogany at Bato before and after thinning. Note leaf litter traps and stemflow collectors located in the site as part of nutrient cycling studies

FIELD TRIALS WITH SPECIES MIXTURES

There is much interest in the Philippines in growing indigenous species, particularly in mixtures. There is a large number of potential species that are of interest to smallholders and it was beyond the scope of the project to establish extensive field trials. Instead, trials were focused on several key species with a view to answering several specific research questions which have relevance both in the Philippines and elsewhere in the tropics. In particular, much has been suggested in the scientific literature about the possible benefits of mixtures over monocultures but there is still little evidence to support these propositions. There have been suggestions that benefits in overall productivity can be achieved by growing non-nitrogen-fixing species with nitrogen-fixing species.

A field trial was designed involving four species providing a combination of native and exotic species and nitrogen-fixing vs non-nitrogen-fixing. The species were falcata (*Paraserianthes falcataria* (L.) I. Nielsen, exotic, nitrogen fixing), mahogany (exotic, non-nitrogen fixing), narra (*Pterocarpus indicus* Willd., indigenous, nitrogen fixing), and mayapis (*Shorea palosapis* Merr. native, non-nitrogen fixing).

The planting design was based on the suggestions of Vanclay (2006, see Figure 4 in that article) for a planting design to investigate competition between four species (see Figures 2 and 3). Importantly, this design provides information about different mixture ratios using only one plot. This field trial will provide important information about the interactions of the four species when grown in varying mixture ratios.

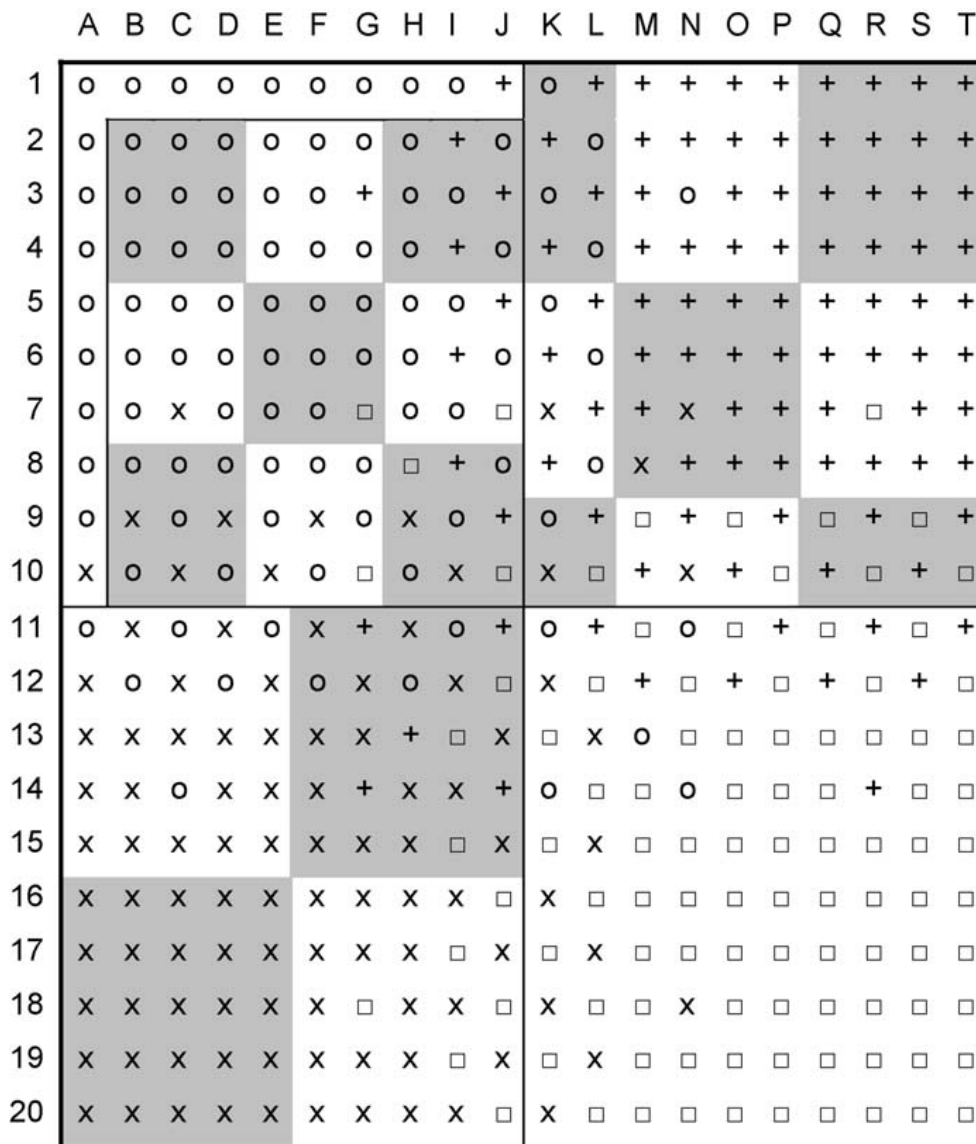


Figure 2. Planting layout for mixed species trial based on Vanclay (2006)
 X = Narra, O = Mayapis, □ = Mahogany, + = Falcata.



Figure 3. Mixed species trials in Leyte Leyte. Top – Mayapis (with shade), mahogany and falcata. Bottom – Nestor Gregorio taking photosynthesis readings for falcata with a portable infrared gas analyser

VARIABLE SPACING PLANTING TRIAL

There is little information about the ideal spacing at which trees should be established and how initial planting density affects site capture and early growth, especially in respect to indigenous species. Probably the most common planting density applied is either 3 m x 3 m or 3 m x 4 m, although a 1 m x 1 m planting configuration appears to have been used in many Leyte reforestation sites.

Spacing trials typically involve planting multiple plots at different spacing e.g. 2 m x 2 m, 3 m x 3 m, 4 m x 3 m, 4 m x 4 m etc. This experimental design requires large amounts of land and other resources, both of which were not available to the smallholder tree farmer project.

An alternative planning clinal planting design has been suggested by Vanclay (2006, see Figure 5 in that article) which requires only one plot and which allows investigation of spacing effects on four species simultaneously (illustrated in Figures 4 and 5).

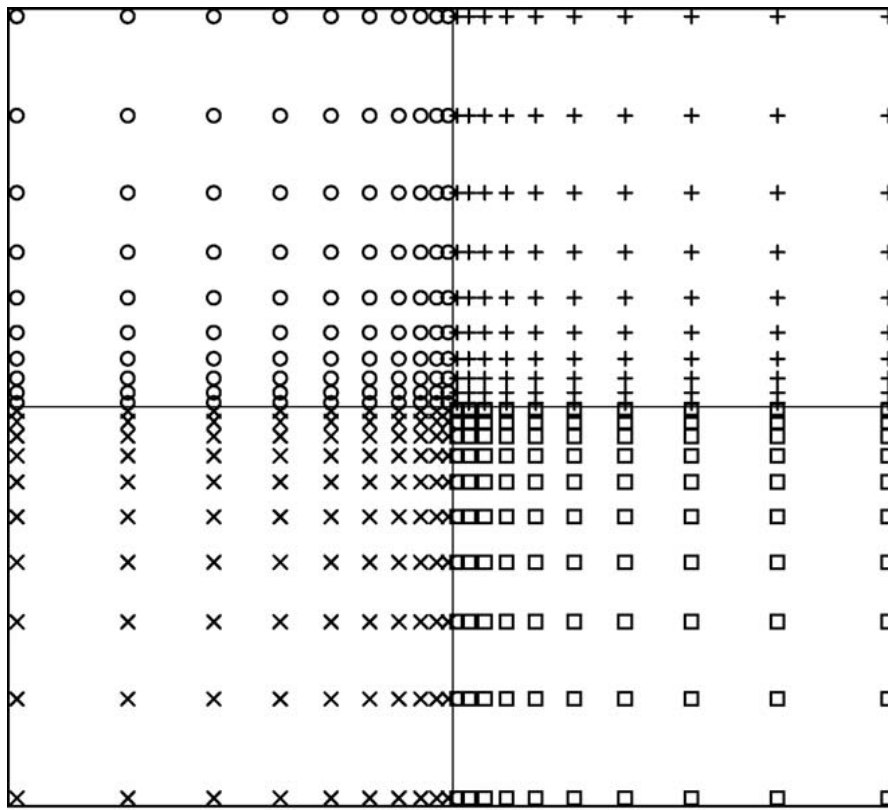


Figure 4. Planting layout for variable spacing (clinal) trial based on Vanclay (2006).
X = Narra, O = Mayapis, □ = Mahogany, + = Falcata.

A clinal trial using the design of Vanclay (2006) was established in Leyte Leyte in December 2007 using four species – mayapis, mahogany, falcata and narra. Measurements of DBH, crown radii and height have been made on height and DBH at three month intervals. In addition, photosynthesis measurements have been made at the site in December 2008 to February 2009. It is expected that useful (and publishable) results will be obtained on the analysis of the first year of growth data.



Figure 5. Variable spacing trial at approximately age 6 months. Mahogany in foreground, falcata tall trees in top right, narra middle left and mayapis under shade in middle background.

FIELD TRIALS ON THE IMPACT OF SHADE AND FERTILISER ON MAYAPIS

Anecdotal evidence suggests that shade is necessary when planting dipterocarp seedlings in open sites. From studies involving coffee trees (which also require shade) it was found that high soil fertility reduces the requirement for shade. A shade and fertiliser trial was established in Leyte Leyte to address the following questions:

- What are the impacts of shade and fertiliser on establishment and early growth of mayapis?
- Are thatch cages or shade trees the best way to provide shade to mayapis seedlings?
- Does fertiliser modify (i.e. reduce) the requirements for shade?

PLANTING TRIALS OF GMELINA GERmplasm SOURCE AND MANAGEMENT

There appears to be great scope to improve the growth of gmelina through sound early age silviculture. However, it is difficult to convince farmers of the benefits of using improved germplasm and undertaking basic weed control and management activities. A field trial has been established at Mahaplag (illustrated in Figure 6) which addresses a series of questions related to early establishment practices, namely:

- How do seedlings from different seed sources perform on outplanting, i.e. is there an advantage in using improved seed?
- What impact does early-age management practices (i.e. weed control) have on performance?
- What impact does early-age pruning have on the growth and net photosynthesis of young gmelina seedlings?

- How effective are demonstration trials (early-age management vs no management) in convincing smallholders of the benefits of management?

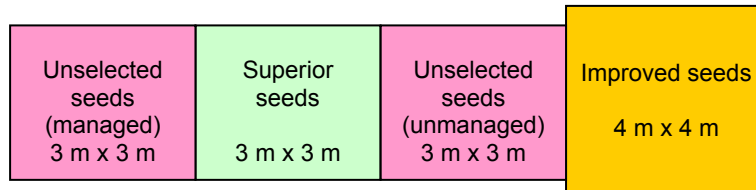


Figure 6. Planting layout for gmelina trial at Mahaplag

CONCLUDING COMMENTS

Field trials are long-term experiments, which typically take many years to produce publishable scientific results. In the case of the trials established under ASEM/2003/052 publishable results have already been achieved for the variable spacing trial in Leyte Leyte, the gmelina trial at Mahaplag trials and the thinning experiments at Bato and Maasin. These early results are largely due to the well-thought-out experimental designs aimed at producing results from an early age, and further enhanced by the high growth rates of the species planted. The field trials will be maintained as part of ACIAR project ASEM/2006/092 and regular data collection undertaken and further results will be presented as part of the end-of-project report.

The establishment of the field trials has been an important capacity building exercise within the project team. Filipino collaborators have been intimately involved in the design, establishment and monitoring of the field trials and are now capable of establishing similar rigorous field experiments. It is expected that the field trials will continue to be maintained and monitored by Filipino collaborators well beyond the end of ASEM/2006/092. The field trials have the potential to be some of the most significant of their type anywhere in the world.

REFERENCES

Vanclay JK (2006) Experiment designs to evaluate inter- and intra-specific interactions in mixed plantings of forest trees. *Forest Ecology and Management* 233(2-3):366–374