



Manual reclamation of land infested with *Imperata cylindrica* is hard work. Photo: M. van Noordwijk.

Rotational hedgerow intercropping + *Peltophorum pterocarpum* = New hope for weed-infested soils

Under conditions of shifting cultivation, farmers clear new land primarily because they expect a higher yield per unit of labour than they could obtain from their old plots. In these systems, the returns to labour tend to decrease when the same plot is used for several years. Two factors are usually involved: nutrient depletion and physical degradation of the soil cause lower crop yields, and increasing weed infestation leads to higher labour requirements.

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by
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The fallow phase has primary importance either for soil recovery or weed control, depending on soil, climate and vegetation type. Presumed 'stable alternatives' to shifting or slash-and-burn cultivation should deal with both sets of problems. However, weed control tends to receive less attention than soil fertility maintenance.

Weed control is especially important in the humid tropics of Southeast Asia, where *Imperata cylindrica* (spear grass, cogon or alang-alang) is particularly aggressive (Brook, 1989). Large tracts of land are dominated by this coarse grass,

which prevents the normal succession to a forest vegetation. In Indonesia alone, *Imperata* dominates about 10 million hectares. For continuous cropping, it is imperative to prevent the establishment of *Imperata* or to control it at an early stage (Suryatna and McIntosh, 1982).

Because of its rhizomes, it is difficult to eradicate the grass by manual weeding. It quickly germinates on open soil, but is not very tolerant of shade. Thus, the cropping system should provide a closed canopy most of the time, which is sufficiently dense during part of the season to suppress any *Imperata* plants that find a chance to germinate (Brook, 1989). An 80% reduction in light intensity can lead to a 50% reduction in the growth rate of *Imperata*'s shoots and rhizomes over a period of two to six months (Eussen, 1978). Prevention of infestation and reclamation of infested

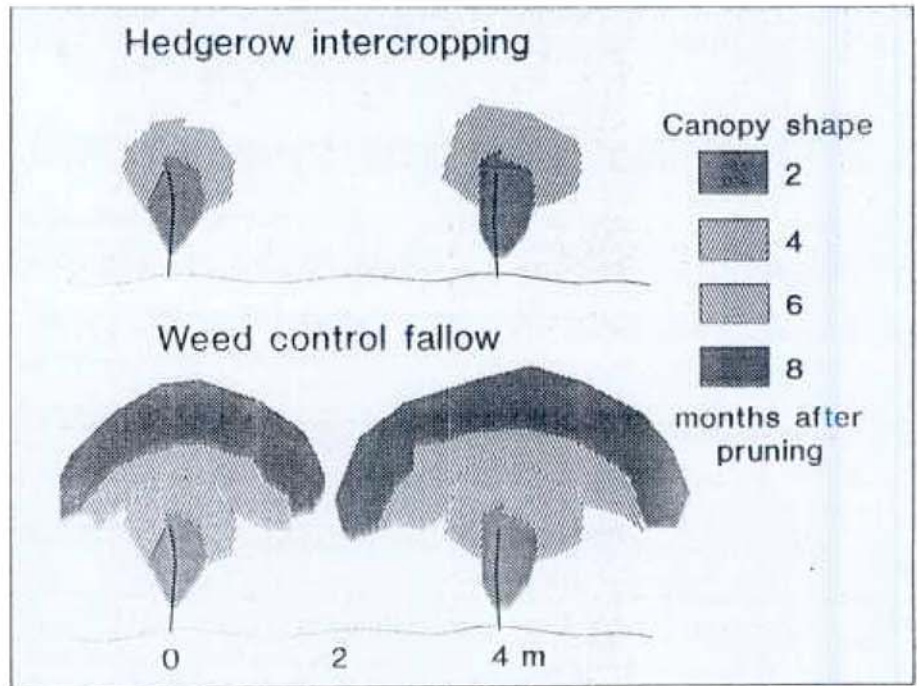
land could help to stabilize land use and reduce further deforestation.

Controlling weeds

Hedgerow intercropping, or alley cropping, has attracted considerable interest as a 'stable alternative to shifting cultivation', primarily because it provides sufficient quantities of mulch to maintain soil fertility, to reduce nutrient losses by leaching and to add biologically fixed nitrogen. Yet the labour requirements for hedgerow pruning are often perceived as a constraint on farmers' acceptance. If trees could help control weeds, then agroforestry could actually help reduce the overall demand for labour.

Rotational agroforestry systems can be based on alternating periods of hedgerow intercropping with fallow phases in which the hedgerow trees are left unpruned. However, the species most widely recommended for hedgerow intercropping—*Leucaena leucocephala* and *Gliricidia sepium*—do not provide a dense enough shade to control *Imperata*, even if they are left to grow during fallow periods of six months or a year. Areas where weed control is an important consideration call for different tree species, trees that form a dense canopy when left unpruned but can still be managed in hedgerows without too much shading of crops.

Results from trials in Lampung, South Sumatra, Indonesia, suggest that *Peltophorum pterocarpum* is a suitable model for such a tree. As shown in the diagram,



Canopy of *Peltophorum pterocarpum* during the first four months after pruning (top) and during the next four months (bottom) if trees are left unpruned.

Peltophorum has a dense canopy that provides a high biomass of prunings but causes little shade to crops in the first two to three months after the trees are cut. With hedgerows spaced at 4-metre intervals and cut two to four times a year, the annual yield of prunings during the three-year period of the experiment averaged 8 tonnes per hectare, containing 200 kilograms of nitrogen.

During the fallow phase, the trees form dense umbrella-shaped canopies, which allow very little light to reach the soil surface. The leaflets decompose slowly—15 weeks are required for 50% loss of dry weight. We have observed that few *Imperata* seeds germinate in soil covered by a layer of partly decomposed *Peltophorum* litter, although we have not yet identified a specific mechanism inhibiting germination of the weed.

Peltophorum pterocarpum is one of the few trees that establishes spontaneously in fields infested with *Imperata cylindrica*. The tree survives frequent fires in the dry season and resprouts rapidly.

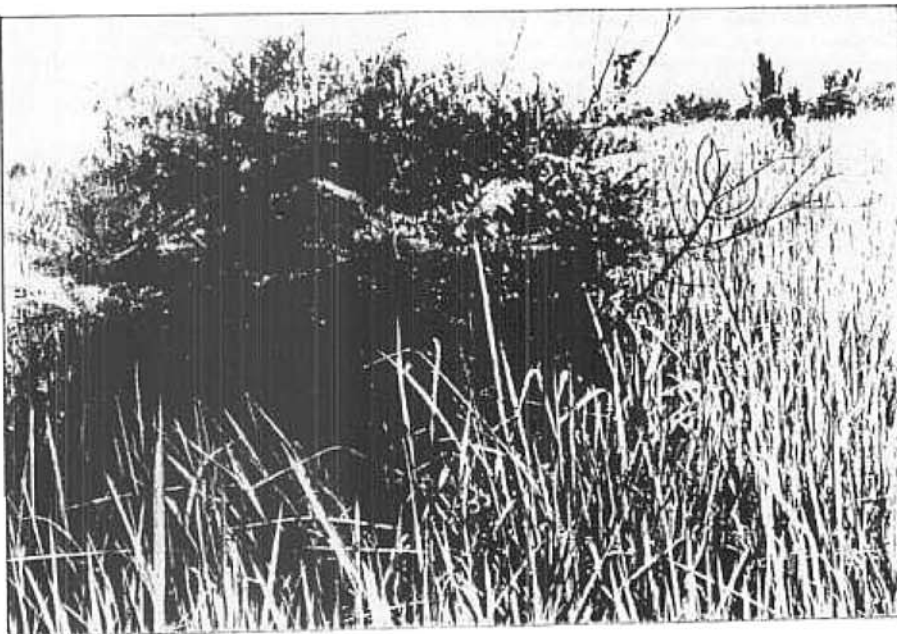
Reclaiming weed-infested land

It may be possible to establish lines of *Peltophorum* in fields already infested with *Imperata*. The trees could be given some time—say, two years—to develop and shade out the grass, and then a pruning regime could be introduced and food crops planted in the alleys.

In general, *Imperata* grasslands are an unfavourable environment for establishing trees because of strong competition for water and nutrients, allelopathic effects, shade at ground level and frequent fires in the dry season. Trees that tolerate all these types of stress are rare. *Peltophorum* is one of the few trees that establishes naturally under such circumstances.

To test the use of trees to reclaim weed-infested land, we planted *P. pterocarpum*, *G. sepium* and *Calliandra calothyrsus* on plots covered with dense *Imperata*. We

Photo: M. van Noordwijk





A hedgerow of *Peltophorum pterocarpum* after five years of pruning and intercropping: a small but dense tree canopy and a thick layer of mulch on the ground

cleared only narrow lines of vegetation in which the tree seedlings were planted. As planting stock, we collected *Peltophorum* seedlings from secondary vegetation in the area, transferred them to polythene tubes and maintained them until planting time.

If this low-labour system for reclaiming *Imperata*-infested land appears to work, the specific techniques for tree establishment could probably be improved. The system might also be combined with a leguminous cover crop, such as *Mucuna* species, to attack remaining patches of

Experiment to establish *Peltophorum pterocarpum* seedlings in a narrow strip cleared of *Imperata cylindrica*.



Imperata in the months before the trees are pruned. We hope to know soon.

Further reading

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About Peltophorum

Peltophorum pterocarpum (DC.) K. Heyne (copperpod, yellow flame, false elder, sogu, batai laut, petaian; synonyms: *P. inerme* (Roxb.) Llanos, *P. ferrugineum* (Decne) Bth., *Inga pterocarpum* DC.) is a common tree in the secondary forest of Lampung, Indonesia. It is almost the only local tree that grows naturally in fields infested with *Imperata cylindrica* and stays green in the dry season.

According to Bakker and Bakhuizen van den Brink (1963), *Peltophorum* is most common in forests up to 100 metres above sea level, especially behind the beach and along the inner margin of mangrove swamps. It also occurs in fields infested with *Imperata* and in teak forests. According to Spaan (1909), branches 1 metre long and 5 centimetres in diameter can be planted on *Imperata*-infested wastelands. Corner (1988) only mentions *Peltophorum* on rocky or sandy coasts (hence its name 'batai laut').

Cattle will eat the leaves of *Peltophorum*, and in the past the bark had some commercial value as a source of tannin for the leather industry and as a dye. Because of its dense foliage and yellow flowers, it is recommended for use as a shade and ornamental tree. The US National Academy of Sciences recommends the species for reclaiming wastelands covered with *Imperata* and recommends the wood for fuelwood and furniture making (NAS, 1979).

Peltophorum pterocarpum is closely related to the flamboyant tree, *Delonix regia*. Neither species is thought to produce root nodules for nitrogen fixation. Yet in mixed hedgerows of *Peltophorum* and *Glicicidia*, the *Peltophorum* may benefit from nodulation of the other species (Van Noordwijk and Dommergues, 1990).

Peltophorum resists wind damage, which suggests that it has a deep root system. It is not attacked by boring beetles. Observations of root distribution and pruning tolerance (Van Noordwijk et al., 1991) suggest that it is a good candidate for hedgerow systems.

Experiments in Lampung have yielded data on biomass production under intensive pruning (Hairiah et al., 1992), on maize and soybean yields under intercropping with *Peltophorum* hedgerows (Sitompul et al., 1992), and on the decomposition rate of prunings (Handayanto et al., 1992).