Inga species and alley-cropping alternative to slash-and-burn agriculture

TECHNICAL ADVICE

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System variables within the control of the farmer

Based on experiences in the La Conquista (La-C), San Juan and other experimental sites, the first outlines of a decision-making structure can be sketched :

The following variables are within the farmer's control; they represent a wide spectrum of choices which will obviously depend upon the farmer's personal and local circumstances :

1) **Choice of species :**

As argued above, more-durable mulch species are desirable; but mixtures are feasible and might include a proportion of readily-decomposable foliage species such as *Gliricidia sepium* , which is very well-known throughout Central and South America . The research project reported here has trials of pepper (*Piper nigrum*) grown on living supports of this species, between hedgerows of *Inga* . The pepper receives no agro-chemical inputs whatsoever and, in a weed-free environment, appears to be thriving.

The first-choice *Inga* is likely to be the commonest local provenance; and, commonly, the *Inga* species grown for shade over coffee or cacao. However, *I. edulis* is not endemic to Central America , yet appears to have undergone a widespread and spontaneous local adoption as an easily-established shade species.

There exists a wide spectrum of choice within which to choose, and alley-cropping systems with *Inga* appear to be rather forgiving, provided they are pruned with care.

2) **Within-row density**

Although more detailed work is needed, the indications are that, above a certain planting density, foliage production in an alley hedgerow tends to stabilise at a certain level per metre of hedgerow, while decreasing per tree

stem. A useful spacing in the La C and San Juan sites appeared to be about 0.5m, which allows for some sporadic mortality without compromising mulch production; however, this was a somewhat intuitive choice.

3) **Alley width**

A balance needs to be struck between a wider spacing to minimise competition between the trees and crops and a narrower spacing to maximise weed-control; the working assumption being that the latter is the dominant factor. A general rule-of-thumb would then be : "As wide as is compatible with sufficient mulch production for permanent cover". Any over-dominance by the tree component can be controlled by varying other management practices, such as pruning height or frequency.

The 4.0m alley width for the *Inga* at the san Juan site was also an intuitive choice based upon experiences at La C. The most productive species of the San Juan trials (*I. edulis; I. oerstediana*) should be able to achieve permanent mulch cover at 5m. alley width

4) **Alley alignment**

4. i) It can be argued that, in equatorial regions, an ideal alley alignment would be East-West, because this is likely to impose more competition for sunlight within tree rows than between the trees and the crops which will be in sunlight for most of the day. This could be important for maize, but beans at both the La C and San Juan sites appeared little affected by a degree of shading, as the sun, in the Northern winter, swung to the Southward of the hedgerows.

4. ii) However, the need for a contouring alignment to counter the risk of erosion on slopes may override this ideal; and this factor, in turn, implies that greater care needs to be taken to reduce shading. It seems, therefore that decisions of this nature need to be integrated with other management variables; such as : "If there is a risk of shading from contoured tree lines, then reduce stem-height or increase pruning frequency".

5) **Hedgerow height:**

The higher the stem, the greater and more-rapid will be the recovery of foliage; and, probably, the more resilient the tree; whereas, the lower the stem is pruned, the fewer the available nodes for regrowth. *Inga* appears to require a moderate-to-high stem. Pruning-height and frequency are probably the easiest ways of altering the dominance or "presence" of the tree component in an alley system. The height options thus fall within the range :

5. i) To favour the trees and mulch production : As high as is feasible (say up to 1.75m.)

5. ii) To disfavour the trees : Coppiced low to the ground (but the suggested minimum with *Inga* would be about 1m.).

6) **Pruning regime**

In practice, the timing-and-frequency of pruning are likely to reflect cropping needs, rather than any agenda set by the trees themselves; but there are some exceptions. For example, if experience shows that an alley system may only sustain one crop per annum, then tree growth in the period between crops may, in the case of some *Inga* species, be very vigorous, leaving few branches and little foliage on the lower stem. This, in turn, may leave the stem bereft of foliage when pruned back to the working height. (*I. edulis* at the La C site grew to over 4m. in 9 months from transplanting). In this instance, it is advisable to carry out the pruning in two phases. It may be preferable to cut out the leading central stem, reducing shading and allowing the lower stem to resprout before pruning back the side branches. However, this may not permit enough light to strike low enough on the stem for this to happen. Alternatively, it may be better to cut out all the side branches over the final pruning height, thus leaving the central leader to maintain the tree whilst the lower stem resprouts. When this is clearly under way, the leader (called a "chimenea" in Costa Rican cafetales) can be taken out. The aim would be to time the second pruning for a week or two before the planned crop-sowing; this, in turn, implies a first-phase pruning some month-to-six-weeks earlier. All this would have to harmonise with local perceptions as to what are, or are not, good pruning and sowing times. In any case, a light pruning will be needed to reduce competition perhaps some 4-6 weeks into crop growth.

Frequency of pruning

Low		**High**
Greater dominance of the system by the tree component...		...Lesser role of the tree component
Greater shading of weeds...		...Lesser shading of weeds
Less smothering of weeds by mulch...		....More smothering of weeds by mulch
The greater overall production of pruned biomass...		...Less overall production of pruned biomass

Greater proportion of woody biomass in the prunings...		...Greater proportion of leaf biomass in the prunings
Greater likelihood that 2-phase pruning will be necessary...		...Little likelihood that a 2-phase pruning will be needed
The possibility that the system will produce firewood...		...The probability that the system will not produce firewood

Table: Pruning frequency in alley-cropping; a spectrum of effects.

As outlined above, manner-of-pruning is very important to the survival of the trees and any attempt at a 100% foliage removal will involve the risk of killing the tree. Similarly, the damage and ripping associated with pruning too close to the main stem must be avoided. Clean cuts with sharp tools, together with the leaving of short spurs, with some foliage, minimises this risk; also, the branches of some *Inga* species (e.g. *I. marginata; I. samanensis*) are characteristically more-slender and appear to suffer much less setback as a result of pruning. It is hoped that more-detailed knowledge of the pruning-tolerance of the species groups may be gained in the future; our knowledge at present is rudimentary.

7) **Soil supplements**

Rock-Phosphate

As argued above and elsewhere (Palm et al 1991 ; Hands et al, 1995), the minimum condition for any low-input, sustainable agricultural system, as a stable, alternative subsistence strategy to shifting cultivation, will be that maintenance supplies of phosphorus will have to be made cheaply available. For a number of reasons, the obvious source of this phosphorus input is rock-phosphate; and it is suggested that this is more-efficiently applied to the mulch in an alley system, rather than to the soil itself. At a national or regional scale, the logistical difficulties of this are clearly very great and involve social, political and economic issues which go far beyond the scope of this text; the condition itself is, however, ecological in nature (i.e. pertaining to plant ecology) and non-negociable.

Lime

In addition to rock phosphate, one further long-term ecological condition which may have to be fulfilled on an acid soil relates to slash-and-burn agriculture itself.

One aspect of the short-term success of a slash-and-burn operation in a rain-forest swidden lies in the effect of the ash upon the accumulated organic reserves of the soil (SOM). In short, SOM that may be turning over very slowly may undergo an accelerated decomposition due to a temporary change in the pH of the immediate surface soil (Hands, 1988; Hands et al ,1995). It is the release of nitrogen and phosphorus associated with these reserves that may be the key process in swidden agriculture. In a green mulch system such as a-c with *Inga* , it is likely that, over time, the soil will accumulate a wide range of SOM types with many differing decomposition characteristics. It could prove to be necessary for well-sustained maize yields, for example, that this pH-effect of the ash will have to be simulated, not by burning, but by lime or dolomitic lime (for the magnesium); and, possibly, by some source of potassium. The expectation is that a-c will retain and recycle these supplements better than any bare-soil alternative.

There is wide scope for experiment with all these options and experiences with *Inga* in alley-cropping indicate that these systems are rather flexible, resilient and forgiving. Supplements, as described above, are, of course necessary for long-term sustainability; but the system does not appear to collapse if they are witheld for a while. In the experiments carried out the only supplement that made a difference and was required was an initial application of phosphorus, which was applied as rock phosphate, and after that one initial application the plots have remained fertile without further input, so far for six years.

References

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