Alley Cropping to Sustain Yields

Dan Sonke

Alley cropping is an agroforestry technique which has been widely promoted in agriculture development programs throughout the tropics. Many studies report increased harvests in alley crops versus control plots without trees. A recent report from the International Centre for Research in Agroforestry (ICRAF) in Nairobi, Kenya, however, suggests that alley cropping has been too widely promoted in areas where it is not suited. This prompted us to look more closely at the practice.

The report from ICRAF states that alley cropping should not be practiced in dry climates with acidic soils or in areas of low fertility. In some instances the competition between crop and tree roots negates the expected benefits of alley cropping. In others, yield increases were overestimated because of procedural mistakes.

We contacted Dr. P.K. Nair at the University of Florida Department of Forestry for his perspective on the controversy. Dr. Nair is a founding scientist of the International Centre for Research in Agroforestry, ICRAF, where he worked as a principal scientist for about 10 years. That interview is found later in this article, but first we will review the basics of alley cropping.

A BRIEF OVERVIEW OF ALLEY CROPPING. Alley cropping (AC) is the practice of growing food crops in alleys between hedgerows of trees or shrubs which are regularly "coppiced," or severely pruned. Sometimes the prunings of these trees are placed on the soil as a mulch around the food crops. As this mulch decomposes, its nutrients become available to the crops. Trees with roots which grow deeper than those of typical crops are used to bring nutrients up from the subsoil. Nitrogenfixing trees are often used to maintain an input of nitrogen into the cropping system. In this way, soil fertility is maintained or improved despite the removal of nutrients in the crop harvest.

Typically an AC system consists of trees planted 2050 cm apart in straight rows which are 4 to 6 m apart (rows may follow the contour if on a slope). The specific width of alleys depends on many factors, including average rainfall and the crops grown.

A version of alley cropping called the SALT technique (Sloping Agricultural Land Technology) was designed to control erosion (EDN 141). In SALT, trees are planted only a few cm apart in double rows (rows 50 cm apart). The double rows, which follow the contour, reduce the chance of an opening through which water could

pour. As water passes through the double hedgerow, it is slowed down and much of the suspended soil is dropped, eventually forming a terrace of sorts. Crops are grown in alleys between the double rows.

The hedgerows in alleycropped systems provide other benefits, including animal fodder and wood for fires, though some uses compete with their use as mulch and green manure. One report from an African region with limited trees states that farmers highly prized AC because they could grow more stakes for their yam gardens. ECHO used moringa for its demonstration alley because leaves can be used for human food or pig feed.

Periodically the hedgerows must be pruned. For use as forage or mulch, a general rule of thumb is to cut the trees by the time they reach 3 m in height or the stem diameter is more than 1 cm. The trees should be cut to 1 m or less. For some crops research has been done to determine whether timing of pruning is important for optimum nutrient availability. Delays in pruning may result in a "woody" mulch which does not decompose adequately. Obviously, AC is a laborintensive venture not suited to farms with a labor shortage.

Some commonly recommended tree species are Leucaena sp. (susceptible to psyllids in Asia and Africa), Calliandra calothysrus, Gliricidia sepium, Senna siamea, Sesbania sesban, Grevillea robusta, Acacia sp. Sometimes one may find that a native species is better adapted to local conditions and pests.

Some general characteristics of a useful species are:

- can be easily established
- is fast growing therefore produces much biomass
- is deep rooted, without many shallow, lateral roots
- sends out new growth rapidly after repeated severe prunings
- provides useful byproducts (firewood, fodder, stakes)
- has high protein (nitrogen) content in the foliage
- has a compact canopy to prevent crop shading.

Interview with Dr. Nair

Q. What do you think of the ICRAF report on AC?

A. The report has been blown out of proportion in some journals. The limitations cited are not new revelations. We have been saying from the beginning that AC is not suited to areas with limited water supply. In more humid zones it works beautifully well. In Kenya, for example, AC works very well in the humid regions, but very poorly in the drier regions. Unfortunately, too much eagerness by some people has caused it to be established without regard to its limitations.

Q. For what environments do you recommend AC?

A. Areas with poor soils and plenty of available moisture, where fertilizer is limited, and/or subsistence level agriculture is used. AC is effective on gentle slopes for preventing soil erosion; Haiti has working examples of this. I should caution that a plentiful lowcost labor supply is very necessary as well.

Q. What about the ICRAF recommendation against AC on acidic soils?

A. I have seen successful examples on acidic soils in high rainfall areas (which is where acidic soils often occur) when appropriate tree species are used.

Q. What characteristics would you look for in a useful tree species?

A. High biomass production and nitrogenfixation are desirable. The tree shape must not produce excessive shade to the crop. Generally species with small leaves or leaflets rather than broad leaves are used because of more rapid decomposition. Decomposition rate can be important; in some situations very rapid decomposition may result in the nutrients becoming unavailable to the crop. Where organic matter is lacking in the soil, slower decomposition may be desirable to improve soil. Leaves with high lignin or tannin may decompose too slowly. Each situation is different. The trees chosen should not harbor pests of the crops, including birds for some crops and regions. Nor should the trees themselves be susceptible to pests. In Asia psyllids have destroyed many agroforestry projects using leucaena. Diversifying the species used in a region lowers the risk of losses to insects or diseases. Deep-rooting species are important; shallow-rooting species compete with the crop.

Q. Can the severe pruning of a tree alter its rooting pattern, causing a deep-rooting tree species to produce shallow roots which might compete with crops?

A. This is an area in which we are presently conducting research. I do not want to make a claim without concluding the research. [Ed.: We hope to report on this when research is available.]

Q. Can you make a general recommendation on how wide the alleys should be?

A. Alley width depends on the crop needs, available moisture, and the amount of mulch desired. Much research has been done using different alley widths. I encourage people to consult the research applicable to their situation. Keep in mind that more narrow alleys means more tree area and less crop area. The increased tree growth produces more mulch which should increase harvests. Finding the optimum balance between mulch production and crop area is the goal.

Q. Is AC self-sustaining in the long term?

A. As in any system, occasional inputs of nutrients result in longer term sustainability. AC is designed for areas where fertilizers are limited, but over time even limited inputs will be beneficial. It is also important to realize that removing biomass from the system in the form of firewood or animal fodder makes it less sustainable over time. Although this produces benefits to the farmer, it requires more inputs to compensate. In Haiti the theft of firewood from hedgerows frustrates farmers efforts to be sustainable. [End of interview].

The ICRAF report criticized that some alley crop research stations have produced faulty crop yield data due to improper procedure. At two sites mulch was imported into the system to produce better mulch than the hedgerows actually produced. At another semiarid site tree roots spread 15 m and actually grew into the plot which was supposed to be a no tree control plot, which suffered reduced yields from root interference without the shade and mulch benefits of AC. One method suggested to correct this was to dig a trench around the AC system to prevent roots from influencing crops around it. Senna species are also being used in experiments, since their black roots can be easily distinguished from others. If you wish to do

your own experiments on AC in your area, we encourage you to use similar methods to obtain good data. If you do have experience or data on AC successes or failures, ECHO would like to hear from you.

© 1995 ECHO Inc.