Cultivation of Medicinal Plants in Alley Cropping System with *Moringa oleifera* in the Virgin Islands

by

Manuel C. Palada, Brian N. Becker and Jeanmarie Mitchell

University of the Virgin Islands' Agricultural Experiment Station

Medicinal plants have been closely associated with the traditional, social and cultural events of the people in the Caribbean in general and the Virgin Islands in particular. Medicinal plants are commonly referred to as folk medicine or bush medicine in the Caribbean. Folk medicine is defined as "the substance of all the traditional viewpoints on sickness and healing methods applied against disease which exists among the people" (Erich and Beitel, 1955). Folk medicine in St. Croix developed out of the interactions between European and African healing systems as they were combined in the New World (Kuby, 1979).

Today, medicinal plants are important horticultural crops in the Virgin Islands. About half of the farmers are involved in growing and producing herbs and medicinal plants. There are species and varieties that are indigenous to the Virgin Islands as well as introduced species that have been naturalized in the islands. The economic importance of these plants indicates that more research and development efforts must be undertaken to maintain and conserve germplasm materials. Research is also needed to provide herb growers with necessary technical information to help them improve production, processing, marketing and utilization. Small-scale growers in the Virgin Islands grow medicinal plants in small garden plots using less efficient planting methods. There has been no research work addressing improved crop management practices of medicinal plants. The few published materials with descriptions and culture of common and local medicinal plants focus on their growth habit and herbal uses. Some of the indigenous as well as introduced species of medicinal plants are heavily exploited and threatened by extinction. Collection, conservation and production of medicinal plants are approaches that will maintain genetic resources and enhance diversity. Studies on cultural practices from planting to harvesting are essential for the common and important species of medicinal plants.

In the Virgin Islands, herbs and medicinal plants are grown either in the wild or cultivated in a variety of cropping systems and cultural management practices. The plants are grown at elevations ranging from flat lands to sloping hills and rolling topography. For example, in St. Thomas medicinal and culinary herbs are cultivated in small farms located in sloping lands. Some are grown in terraces as well as in bottom level lands. Cropping systems with herbs and medicinal plants are normally in mixtures or integrated into fruits and vegetables on small farms. Wild types and indigenous species are usually seen under a forest canopy.
Interest in medicinal plants has been growing among local farmers. Medicinal trees like Neem (*Azadirachta indica*), Moringa (*Moringa oleifera*) and Noni (*Morinda citrifolia*) are becoming popular in home gardens on St. Croix and St. Thomas (Thomas and Palada, 1994; Thomas, 1997; Palada and Davis, 2000; Palada et al., 2002). Some of these trees have been grown with vegetable crops in agroforestry systems (Palada et al., 1994; O’Donnell et al., 1995).

Cultivation of medicinal plants may offer a potential alternative to conventional fruit and vegetable production in the Virgin Islands. Although it can be a viable option for small-scale farmers, little research information is available on the merits and benefits. Farmers need information on improved species and cultivars along with recommended crop management practices for increasing yield and economic returns. This study is being conducted with the following objectives: 1) to determine the influence of tree hedgerows on growth and productivity of traditional medicinal plants and culinary herbs grown in an agroforestry systems; and 2) to evaluate the economic benefits of growing medicinal plants in an agroforestry system.

**Materials and Methods**

This study was conducted at the Agricultural Experiment Station, University of the Virgin Islands, St. Croix, U.S. Virgin Islands, Eastern Caribbean (lat 17°45′N, long 64°45′W). Annual rainfall ranges from 500 to 750 mm. Moringa (*Moringa sp.*) tree hedgerows were established in May 2002 by direct seeding two to three seeds per hole spaced at 1.5 m. Seedlings were thinned to one plant per hole two weeks after germination. Moringa tree hedgerows were spaced at 5 m forming 5-m alleys between hedgerows.

Four species of medicinal plants and six species of culinary herbs were used in the study. The medicinal plants were “Japana” (*Eupatorium triplinerve*), “Blue Verbena” or “Worrywine” (*Stachytarpheta jamaicensis*), “Inflammation Bush” (*Verbersina alata*), and “Lemongrass” (*Cymbopogon citratus*). Culinary herbs grown were Basil (*Ocimum basilicum*), Sweet Marjoram (*Origanum majorana syn Majorana hortensis*), Thyme (*Thymus vulgaris*), Cilantro (*Coriandrum sativum*), Chive (*Allium schoenoprasum*) and Mint (*Mentha piperita*).

**Japana** (*Eupatorium triplinerve* L. Vahl) is commonly grown in home gardens. This perennial medicinal plant is native to the Atlantic coast of South America and naturalized in the Virgin Islands. It is utilized in bush tea as a “cooling” beverage and for a treatment of coughs and colds (Thomas, 1997).

**Blue Verbena** (*Stachytarpheta jamaicensis* L. Vahl) is native throughout the Caribbean and can be found growing along roadsides and on disturbed sites. Locally known as “Worrywine,” the fresh leaves are consumed in bush tea as a “cooling” tonic and blood cleanser, to treat “asthma” and “ulcerated stomachs” (Kuby, 1979; Thomas, 1977).

**Inflammation Bush** (*Verbersina alata* L.) is native to parts of the Eastern and Southern Caribbean. This plant can be found growing wild on disturbed sites. Commonly cultivated in home gardens, it is known as “Inflammation Bush” in the Virgin Islands. It is consumed in bush tea as a cleansing tonic, or a treatment for coughs, colds, and bruises (Kuby, 1979; Thomas, 1997).

**Lemongrass** (*Cymbopogon citratus* DC Stapf) is native to South Asia and has been introduced throughout the tropics. A perennial grass with a distinctive lemon odor, Lemongrass is used in bush teas both for flavor and medicinally to treat fevers (Kuby, 1979). Lemongrass is used internationally in food flavorings, aromatherapy, and the perfume industry.
Basil (*Ocimum basilicum*) is an aromatic annual or short-lived perennial herbaceous plant native to tropical Asia. A popular culinary and medicinal herb, it has been distributed worldwide. Numerous varieties have developed with varying combinations of volatile oils, ornamental foliage and adaptation to local conditions. In the Virgin Islands basil, known locally as “mint,” “garden balsam,” or “mosquito balsam,” is cultivated for use as a cooking herb and in beverage and medicinal bush teas. A bush tea made from the leaves is used to treat stomachaches (Kuby, 1979).

Sweet Marjoram (*Origanum majorana syn Majorana hortensis*) is a perennial sub-shrub native to the Eastern Mediterranean, often grown as an annual. It is a popular culinary herb and is used commercially in body care products and flavorings.

Thyme (*Thymus vulgaris*) is a perennial, aromatic herb native to Eurasia. Thyme species are ideally suited for the Virgin Islands, preferring stony and rocky neutral to alkaline soils. Thyme is a popular culinary herb for meat, soups and stuffings. Dried thyme leaves are used in potpourris and thyme oil is used in toothpastes and mouthwashes. Thyme also makes excellent honeybee forage.

Chive (*Allium schoenoprasum*) is a hardy perennial herb that grows in clusters of many small, onion-like bulbs. Chive is grown in home gardens and small vegetable farms in the Virgin Islands. It is one of the popular culinary herbs and its fresh green leaves are used to flavor almost all foods in which a mild onion flavor is desired.

Mint (*Mentha piperita*) is a hardy perennial native to Mediterranean countries. Although it is adapted to temperate climate, mint can be best grown in the Virgin Islands during the cool months of December to February. Fresh mint is mainly used in salads and food flavoring.

Cilantro (*Coriandrum sativum*) also known as coriander, is a hardy annual of the parsley family. It thrives best in weedless, fertile and deep soil. The plant has many branches and the leaves are serrated. In the Virgin Islands, the fresh stem, leaves and seeds are all used in many culinary preparations and have a specific aromatic odor. The young leaves are also used to flavor soups and salads.

The trial was established in a randomized block design with four replications. Treatments consisted of alley cropped plots (hedgerow) and control plots (no hedgerow). All medicinal plants and culinary herbs were sown in the greenhouse and grown until seedlings reached optimum transplant size. Lemongrass, japana, basil, blue verbena and inflammation bush were planted at 61 cm in-row plant spacing. Chive, cilantro, mint, sweet marjoram and thyme were planted on randomly assigned positions in each block at 20 cm in-row plant spacings. All plants were planted at row spacings of 61 cm between rows. Plot size for each species was 6 rows with 7 plants per row for the 20 cm in-row spacing (3.7 m x 1.4 m or 5.12 m²).
and 6 rows with 3 plants per row for the 61 cm in-row spacing (3.7 m x 0.6 m or 2.22 m²). A starter soluble fertilizer (20-20-20) was applied per tree of Moringa hedgerows. Medicinal plants and culinary herbs were fertigated with 20-20-20 soluble fertilizer at weekly intervals. Drip irrigation was installed along hedgerows for early tree establishment. Medicinal plants and culinary herbs were drip irrigated based on soil moisture tension maintained at -30 kPa.

For Moringa tree hedgerows data were collected on initial germination and establishment, plant height at monthly intervals, number of side branches and biomass production at pruning. Tree hedgerows were pruned at 1 m above ground when the trees reached a height of 2 m. Regrowth was evaluated in terms of number of newly developed side shoots/branches. Medicinal plants and culinary herbs were sampled for fresh and dry weights at each harvest. Plant height was measured at first harvest. Sample size consisted of two plants in each row for perennials and 4 to 5 plants in each row for annuals. In this paper, only data from basil and lemongrass are reported for discussion purposes.

Tree-crop interaction was measured in terms of light competition. Photosynthetic active radiation (PAR) was measured across rows of herbs and medicinal plants using a hand-held Quantum Meter (Apogee Instruments, Inc., Logan, Utah, USA). Percent shading (light reduction) due to hedgerows was determined from PAR readings.

Results and Discussion

Germination and establishment of Moringa were excellent. The trees reached a height of 1.76 m six months after planting. The length of the longest side branch was 1.6 m ten months after planting. Total dry biomass production from prunings taken seven and ten months after planting averaged 2.06 kg/plant. Moringa oleifera is a fast growing tree that attains a height of 2-3 m within one year of growth. This result is consistent with those observed in on-farm trial where Moringa attained a height of 4 m six months after planting (Palada, et al., 2003).

Growth and yield of basil and lemongrass are presented in Table 1. Basil was harvested two times while lemongrass was sampled four times for yield. As shown in Table 1, the effect of hedgerow (alley) on plant height and plant fresh weight of basil was not significant. However, plant fresh weight in alley was slightly lower than that in no alley plot (control) indicating that the Moringa hedgerow might have a competitive effect and basil is sensitive to this effect. It was observed that plant fresh weight was almost similar between the treatments during the first harvest, but in the second harvest, plant fresh weight in alley plot was significantly lower than no alley plot. This suggests that competition by Moringa hedgerows becomes apparent in subsequent harvests.

With lemongrass, the competition effect was not significant in the first harvest which is similar to that of basil (Table 1). The yield-reducing effect by Moringa hedgerows became apparent in subsequent harvests (harvests 2 to 4). Plant fresh weight was significantly reduced in hedgerow intercropping (Table 1). This resulted in lower total plant fresh weight in the alley plot compared to no alley plot.

One of the major factors that influence crop yield in hedgerow intercropping is competition for light. Tree-crop interaction may be positive or negative depending on tree and crop species. During the early stage of tree hedgerow establishment, tree-crop interaction is minimal since the hedgerows do not exhibit a dominant role. In this trial, photosynthetic active radiation (PAR) was measured above and below the canopy of medicinal plants grown in alleys within hedgerows of Moringa. PAR was reduced greatly in

V.I. Agriculture: An Open Door in 2004
rows adjacent to hedgerows in both measurement dates (19 Dec and 17 Mar). PAR was also lower in hedgerow than no hedgerow treatment for both basil and lemongrass. Palada et al., 2003 reported a 21-33% reduction in PAR reaching basil and lemongrass canopy under Moringa hedgerows in on-farm trial. Despite light reduction, yields of these two species were not drastically reduced, indicating that the light compensation point for these species is lower than other species. Because of time limitation, PAR was not determined for other species, however, PAR measurement for basil and lemongrass is representative for all hedgerow plots with intercrops.

Cost and returns analysis for basil and lemongrass indicated that in general, economic returns were lower for hedgerow intercropping than monoculture. Pre-tax returns from intercropping (alley plot) were lower than monoculture (no alley) for basil and lemongrass. The lower returns from intercropping are mainly due to decreased total yield of herbs in subsequent harvests resulting from competitive effect of Moringa hedgerows.

Summary and Conclusion

This initial study indicates that integration of medicinal plants and culinary herbs into agroforestry systems involving medicinal trees is feasible in water-limited environment such as the Caribbean. Traditional medicinal plants including lemongrass, blue verbena, inflammation bush, and japa as well as some culinary herbs such as basil, thyme, sweet marjoram, cilantro, chive and mint can be grown in alleys formed by hedgerows of medicinal tree Moringa with minimal negative effect on growth and yield during the early stage. Competition for light was not critical at the early establishment period of hedgerows. Additional studies are needed to determine the long-term effect of tree-crop interaction on total productivity of this system in the tropics.

Acknowledgment

This study was funded by the Center for Subtropical Agroforestry (CSTAF), University of Florida, Gainesville, Florida.

References


V.I. Agrifest 2004


Table 1. Growth and yield of basil and lemongrass planted in alleys between Moringa hedgerows. UVI/AIDS, St. Croix, USVI.

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Basil</th>
<th></th>
<th></th>
<th>Lemongrass</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Plant height</td>
<td>Fresh wt (g/plant)</td>
<td>Plant height</td>
<td>Fresh wt (g/plant)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Alley</td>
<td>55</td>
<td>742</td>
<td></td>
<td>138</td>
<td>1106</td>
<td></td>
</tr>
<tr>
<td>No Alley</td>
<td>50</td>
<td>809</td>
<td></td>
<td>136</td>
<td>1469</td>
<td></td>
</tr>
<tr>
<td>Pr&gt;F</td>
<td>NS</td>
<td>NS</td>
<td></td>
<td>NS</td>
<td>**</td>
<td></td>
</tr>
</tbody>
</table>

NS = not significant; **Significant at P<0.01. 
Plant height measured at first harvest
Basil = total of 2 harvests; Lemongrass = total of 4 harvests.

V.I. Agriculture: An Open Door in 2004