



Green Manure/Cover Crops

Most Information from Roland Bunch

“I give you every seed bearing plant on the face of the whole earth and every tree that has fruit with seed in it. They will be yours for food.”

Genesis 1:29

Introduction

- Problem:
 - Soil fertility
 - Fallow periods
 - Cost of fertilizer
 - Weed problems
- Solutions:
 - Low cost
 - Low tech
 - Sustainable



Solutions

- Agroforestry and Green/Manure cover crops
 - Low cost
 - Low tech
 - Fights weeds
 - Products are multi-purpose
 - Sustainable and ecologically sound

Green Manure/Cover Crops

- Definition:
 - “A species of plant, often but not always leguminous, whether a tree, bush, vine or crawling plant, which is used by a farmer for one or several purposes, at least one of which is that of maintaining or improving soil fertility or controlling weeds.” Roland Bunch

What it is and is not

- Not traditional green manure that is mono cropped and then incorporated into the soil at the flowering stage (why is this less desirable?)
- 9% of the systems used are not legumes
- Most are intercropped (crops or trees)
- Applied only to soil surface
- Applied only at maturation after seeds are harvested (food, animal feed, future plantings)

Some Systems

- Bunch mentions 140 different gm/cc systems
- Developed by farmers
- Varied purposes
 - Improve soil and control weeds
 - Human food
 - Feed (seeds and foliage)
 - Increase income
 - Restore wastelands
 - Increase organic matter
 - Provide shade
 - Increase soil moisture
 - Prevent plant diseases (sun scorch on citrus)
 - Control pests
 - Barrier species
 - Firewood

Advantages

- Increase om and nutrient cycling
- Nitrogen fixation
- Sustainable (save own seeds or self seeding)
- No transportation costs to increase soil fertility
- Low cost to farmer (needs seeds)
- Weed control
- 25-40% decrease in chemical use
- Constant soil cover
- Soil moisture
- Zero tillage
- Competitiveness with mechanized farmers
- Income generating

Disadvantages

- Unless gm/cc also produces food or income, not accepted
- Slow results
- Dry season problems
- Difficult growing conditions
- Synchronization
- Destruction by animals

Keys to Success

- Land for non food producing gm/cc's must have no opportunity cost
 - Pick ones that are edible
 - Intercrop with coffee or maize
 - Rejuvenate wasteland
 - Grow with fruit trees
- Must occasion virtually no cash cost
 - Produce own seeds
 - Avoid using inoculants
- Must have low labor cost
 - Less labor in weed control
- Must fit into existing farming systems
- Must have one major benefit besides improving soil
- Choose one sure success for niche
- Be sure not to introduce pests/invasives

Rancho Ebenezer





SALT and GM/CC

SALT in Honduras



Some plant species

- Pigeon peas
- Velvet beans
- Mung beans
- Cowpeas
- Rice bean
- Jack bean
- Red lablab bean





Cajanus cajan Pigeon Pea



Sesbania rostrata



Mucuna pruriens Velvet bean

Velvet Bean





**No Weeds!!! Lots of
organic matter!!**





Indigofera hirsuta

Hairy indigo



Gliricidia sepium

Madre de Cacao



Lablab purpureus



Clitoria ternatea
Butterfly pea



Canavalia ensiformis Jack Bean



*Vigna
umbellata*

Rice bean



Phaseolus lunatus 7 year lima

ECHO's gm/cc

■ **Mucuna pruriens* Velvet Bean

Bush Velvet Bean and Tropical

- Climate: Hot, moist. Up to 2100m in altitude in a range of soils receiving up 650-2500mm of rainfall.
- Uses: gm,cc,f
- Facts: “The main attribute of velvet beans is their long growing season in frost-free environments, which enables them to protect the soil throughout the wet monsoonal season.”

■ *Leucaena diversifolia*

K784 Leucaena

- Climate: 760+mm
- Uses: cc, f
- “Similar in use and habit to *Leucaena leucocephala*, but more tolerant of acid soils and cooler temperatures. Suitable for elevations up to 2500m. More resistant to psyllid attack than *L. leucocephala*, but about 10% lower in fodder digestibility. K156 and K784 are highly productive selections by the University of Hawaii.”

■ *Gliricidia sepium*

Madre de Cacao

- Climate: Evergreen in moist areas, drops leaves in cold and/or dry seasons. Tolerant of many soils.
- Uses: cc, f
- “Gliricidia is one of the few forage trees capable of leaf yields comparable to those of leucaena and will grow on a wider range of soils, tolerating low pH provided that this is not associated with high aluminium saturation. After *Leucaena leucocephala*, gliricidia is believed to be the most widely cultivated multipurpose tree.”

■ *Sesbania rostrata*

- Climate: deep clayey alluvial soils, periodically flooded or water-logged
- Uses: cc
- Facts: Not too palatable for animals, but good as an N-fixer.
- “The amount of nitrogen added by a good crop of *Sesbania rostrata* is evaluated at 60-240 kg / ha / yr ; that is : the increase in rice yield resulting from the utilization of *Sesbania* as green manure corresponds to a dressing of this amount of pure nitrogen.” It accomplishes this production on N, in part, by the ariel nodules on its stem. This is a better fixer than soy bean.

- ***Crotalaria juncea*** Sunn Hemp
 - Climate: Short day annual. Hot, dry adapted and can withstand drought. Doesn't handle water logging or salt well.
 - Uses: gm, cc, f
 - Facts: Sunn hemp is fast growing. "Seedlings emerge 3 days after sowing, and rapidly produce a thick ground cover that smothers weeds."
- ***Stylosanthes hamata*** Caribbean Stylo
 - Climate: 500-1300mm rain. Requires pronounced dry season. Not very cold tolerant.
 - Uses: gm, cc, f
 - Facts: Suitable for acidic, sandy soils—perfect for ECHO!
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- ***Neonotonia wightii*** Glycine (Cooper and Malawi)
 - Climate: Summer rains of 750-1500mm. Summer perennial. Needs good drainage.
 - Uses: gm, cc, f
 - Facts: Has a rather long, persistent taproot.

- ***Cajanus cajan*** Pigeon Pea
 - Climate: Very versatile, 300-2000mm rain. Adaptable to many soils. Prefers hot, moist conditions.
 - Uses: gm,cc,f “Due to its deep rooting system pigeon pea offers little competition to associated crops and is therefore much used in intercropping systems with cereals such as millet, sorghum and even maize, it also provides a good means to improve fertility in fallows.”
 - Facts: One of the most drought tolerant of the legume crops.
- ***Desmodium heterocarpon***
 - Climate: 1200-4500mm rain. Hot, humid tropics. Low nutrient requirements and can handle poor, acid soils.
 - Uses: gm, cc, f
- ***Leucaena* Hybrid (KX2)**
 - Climate: 760+mm rain
 - Uses: gm, cc, limited f
 - “It has excellent psyllid resistance and was selected for forage production in tropical low to mid-elevation (0-1000m) environments. Field trials in Hawaii indicate superior psyllid resistance and improved cold tolerance over *L. leucocephala* K636.”

- ***Macroptilium atropurpureum*** Siratro
 - Climate: 650-1800mm rain. Wide range of soils expect poorly drained ones.
 - Uses:
 - Facts: “Extremely drought-tolerant by reason of its deep-rooting habit.” But not flood tolerant.
- ***Erythrina berteroana***
 - Uses: living fence, cc, f
 - Thorny versions in Ethiopia were excellent living fences and simple to propagate through vegetative cuttings.
- ***Sesbania bispinosa***
- ***Chamaecrista rotundifolia*** Wynn Cassia
 - Climate: disturbed land, roadsides
- ***Aeschynomene americana*** American Joint Vetch
 - Climate: Wetland plant requiring at least 1000mm of rain. Summer growing.
 - Uses: gm, cc, f
 - Facts: Great for ditches, can be heavily grazed with no problem.

- ***Lablab purpureus*** Lab-lab, Dolichos
 - Climate: 400-2500mm rain, though not tolerant flooding, does best in rainy summer seasons.
 - Uses: gm, cc, f
 - Facts: Quite drought tolerant. Does not spread naturally so shouldn't become a pest.
- ***Desmodium intortum*** Greenleaf Desmodium
 - Climate: "Favours a well-distributed rainfall in excess of 875 mm a year." Summer growing.
 - Uses: gm, cc, f
 - Facts: Strong N-fixer ("D. intortum fixed over 300 kg. N/ha/year in Hawaii")
- ***Indigofera hirsuta*** Hairy Indigo
 - Climate: Needs 900-1700mm of Rain. Summer growing
 - Uses: gm, cc, f
 - Facts: "Tolerates soils of low pH and fertility, and thus can be useful for soil improvement." Nematode resistant.

■ *Arachis pinto*

Forage Peanut

- Climate: 1100mm/yr is best. Shade, drought and flood tolerant.
- Uses: gm, cc, f
- Facts: freezes kill the leaves and stolons but rhizomes produce new shoots in spring. A very good grazing legume.

■ *Acacia angustissima*

- Climate: Does better at higher altitudes.
- Uses: cc
- Facts: In Zaire, one of our contacts was trying it in alley cropping saying it had good coppicing ability.

■ *Clitoria ternatea*

Butterfly Pea

- Climate: 400mm min. but does best at 1500mm. Is intolerant of water logging and flooding however.
- Uses: cc, f
- Facts: Drought resistant, good fodder.

- ***Calliandra calothyrsus***

- Climate: warm climates with 700-4000mm/yr with a dry season
- Uses: gm, cc, f
- Facts: Can tolerant very poor, acid soils. Good for alley cropping as it can tolerant shade and is a good erosion control.

- ***Centrosema pascuorum***

Centurion

- Climate: Requires high temps for growing. A strongly alternating wet/dry climate.
- Uses: gm, cc, f
- Facts: Extremely drought resistant and very adaptable to many kinds of soils and pH.

- ***Sesbania sesban***

Sesban

- Climate: “When flooded, it initiates floating adventitious roots and protects its stems, roots and nodules with spongy, aerenchyma tissue. Evans and Macklin (1990) report the rainfall range of *S. sesban* as 500-2,000 mm. Another outstanding feature is its tolerance of both saline and alkaline soil conditions (Hansen and Munns 1985). However, its tolerance of highly acid, aluminium saturated soils is not known.”
- Uses: cc, f
- Facts: Frequent coppicing is very beneficial to the plant.

- ***Canavalia ensiformis*** Jack Bean, Sword Bean
 - Climate: Tropics
 - Uses: gm,cc,f
 - Facts: Hardy, drought resistant, soil rejuvenator
- ***Desmodium rensonii***
- ***Stylosanthes scabra*** Shrubby Stylo
 - Climate: 500+mm but very drought resistant. Fairly versatile in soils and does best in infertile, sandy soil.
 - Uses: gm,cc,f
 - Facts: Extremely hardy and versatile
- ***Leucaena leucocephala***
 - Climate: 650-3000mm, but 800-1500mm is best.
 - Uses: cc, f (limited)
 - Facts: alley cropping, fuel, living trellice. Frost will make it drop leaves.

■ ***Pueraria phaseoloides***

Tropical Kudzu

- Climate: Best at 2500+mm. Can handle down to 800mm in swampy areas
- Uses: gm, cc, f
- Facts: An excellent feed in wet tropics. A solid N-fixer.

■ ***Crotalaria ochroleuca***

Sunhemp

- Climate: drought resistant but responds well to hot, wet conditions.
- Uses: gm, cc, f
- Facts: One of the few *Crotalaria*'s free of toxins (in it's leaves anyway). A network member reported a butterfly weed effect when this was intercropped with maize (JEFF!). When the *Crot.* was cut, the insects returned to the crops; when it grew back the insects went to the sunnhemp again.

■ ***Erythrina poeppigiana***

- (See above)

- ***Sesbania grandiflora***
 - Climate: 2000-4000mm ideally
 - Uses: gm ,cc, f
 - Facts: Can handle flooding and waterlogging. Supposedly pest free.
- ***Neonotonia wightii*** (see *Neonotonia wightii* above)
- ***Albizia lebbbeck*** Woman's Tongue Tree
 - Climate: tolerant to light frost (so sub-trop to trop)
 - Uses: cc, f
 - Facts: good N-fixer, good coppicer, often used as shade tree for coffee and tea crops.



“God, give me one good idea”

Calliandra calothyrsus