

A Look at Five Green Manures for Tropical Farm Systems
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Background

Green manuring “involves the soil incorporation of any field or forage crop while green or soon after flowering for the purpose of soil improvement.” (Sullivan, 2003) Green manures are effective alternatives to chemical fertilizers in the management and preservation of soil fertility and productivity, adding organic matter and nutrients to the soil as well as protecting surface soil from damage due to wind, rain and sun. Characteristics of green manures include a crop that is fast growing with rapid decomposition and quick nutrient release. Green manures may be applied directly, leaving it on the soil as mulch, or composted before application and can serve a dual purpose as a source of green manure and as a source of food. Some green manures can be used as animal feed with the resulting animal manure used as fertilizer. A new focus is the production of fibers or forage allowing for greater and varied uses of green manure and an increase in its benefits.

Cowpea (*Vigna unguiculata*)

Cowpea, also known as black-eyed peas or southern peas, is a quick-growing, herbaceous tropical legume crop. Some varieties grow erect while others grow trailing and there is usually no seed preparation needed to break dormancy.

- *Growth season*
Cowpea is a summer-growing annual crop. If stored properly, seeds are viable for up to three years, however seed from the last harvest should be used for the next planting.
- *Soil and nutrient requirements for growth and soil benefits*
Cowpea is tolerant of a wide range of soil textures ranging from sands to heavy, well-drained clays. The heavy clays encourage vegetative growth but at the expense of seed production. It is also tolerant of a wide range of soil pH but prefers slightly acidic to slightly alkaline soils. Where pH is low calcium has shown good results. Its erosion control is considered excellent as well as its ability to increase organic matter and improve soil structure. In better soils it grows well without fertilizer, while in soils of low fertility cowpea has shown to respond to phosphorus, potash and nitrogen.
- *Climatic tolerances*
Tolerant features include good shade tolerance and tolerance to drought. It is not as tolerant of cool temperatures as Lablab and is susceptible to frost. The preferred conditions are warm and moist with a hotter climate than there is for maize or soybeans. It is usually a low altitude plant but may grow up to 1500 meters. The preferred rainfall is 750-1100 mm but it will tolerate lower rainfall. In areas of higher rainfall the incident of disease and insect attack increases.
- *Relationship to other crops and weeds*
Cowpea does not compete with perennial grasses and may be mixed with maize, sorghum or millet. It competes fairly well with low-growing weeds and has been shown to be successful in weed suppression. Cowpea can also be used as a companion crop in orchards, vineyards or with corn.

- *Pests and diseases*
Cowpea is considered significantly poor in the area of suppressing nematodes or diseases including bacterial diseases and viruses. To help in the control of disease and nematodes cowpea should be rotated with 4-5 years of crops that are not hosts. The diseases reported most often are stem and root rots as well as some pod infections. The pests most often reported are weevils, leaf-hoppers, thrips, mites, aphids and pod borers. Its susceptibility to insects is applicable to when it is in the field as well as when it is being stored after harvest. At the same time, cowpea can be very good for attracting beneficial insects.
- *Land preparation and continued management*
The crop will grow best if it is sown on well-prepared seed beds, or at least roughly prepared seed beds from initial plowing. It usually does not spread in unprepared land. Heavy grazing should be avoided, grazing only to the stage of leaf removal and not before flowering. It is not fire tolerant and is considered too green to burn. As with all legumes, for optimal nitrogen fixing and growth the soil should have adequate phosphorus and balance of micronutrients as well as good aeration. There are a few different sowing methods and early sowings give higher yields.
- *Other uses*
While cowpea is used for hay and silage, its thick stems can make haymaking difficult. Cowpea can also be used as a cheap source of protein for human consumption and is an excellent source of grazing for dairy cattle and other livestock.
- *Resources and further information*
Food and Agriculture Organization of the United Nations
www.fao.org
www.fao.org/waicent/portal/statistics_en.asp
www.fao.org/ag/agp/agpc/doc/gbase/data/pf000090.htm
University of Hawaii at Manoa College of Tropical Agriculture and Human Resources
www2.ctahr.hawaii.edu/sustainag/GreenManures/cowpea.aspm

Jack bean (*Canavalia ensiformis*)

The jack bean is an herbaceous climbing or woody shrub. This crop grows slowly at first but is considered hardy and is native to Central America.

- *Growth season*
Jack bean is an annual crop. Early planting gives higher yields. It is initially a slow growing plant but after flowering (4-5 months) seedpods will be produced continuously for at least the next year.
- *Soil and nutrient requirements for growth and soil benefits*
Given its drought resistance it grows well in poor, droughty soils and less so in fairly fertile soils or soils with excess water.
- *Climatic tolerances*
Jack bean is considered extremely drought resistant and may be used in cornfields that are considered too dry for velvet beans.

- Relationship to other crops and weeds
Jack bean is not as vigorous as velvet bean but may be used in grain fields and under orchard trees.
- Pests and diseases
With virtually no natural pests or diseases its leaves are actually used on leaf-cutter anthills to eliminate them.
- Land preparation and management
Planting should be done in soil that has been cultivated within 3 years and recently weeded.
- Other uses
While it is generally cultivated for forage or green manuring purposes, its young pods and immature seeds may be used as a food (vegetable) source for humans. In terms of forage, toxicity in livestock has been reported in cattle grazing and the consumption of too much seed meal resulting in a need to be moderate in its use. While jack bean will be eaten by animals it is not as well-liked and therefore can be used where there is a fear of damage to crops by animals.
- Resources and further information
Food and Agriculture Organization of the United Nations
www.fao.org
www.fao.org/waicent/portal/statistics_en.asp
www.fao.org/ag/agp/agpc/doc/gbase/data/pf000012.htm

Lablab (*Lablab purpureus*)

Lablab, also known as hyacinth bean, is a short-lived legume. The climbing varieties tend to be invasive.

- Growth season
Lablab is a summer-growing, perennial crop that can be grown as an annual. If sown in early summer it will yield more grazings than in later summer. Germination may occur within 5 days and seeds can remain viable for 2-3 years. The actual growth period is a range of 75-300 days.
- Soil and nutrient requirements for growth and soil benefits
It is adapted to a wide range of soils and tolerant of acidic or low fertility soils. While it is tolerant of a range of soils and soil textures, they should be well-drained with sandy or recently cultivated soils working best. In fertile soils generally no fertilizer is necessary, however potash may be used if needed. It is similar in appearance to velvet bean but can be faster growing where soils are fairly fertile. Lablab also provides excellent soil erosion control. As a green manure it can provide a quick improvement to the topsoil and its root system allows the soil to become more friable, improving water filtration.
- Climatic tolerances
Once established lablab shows good drought tolerance and is intolerant of flooded conditions, unable to grow in wet soils. Lablab is shade tolerant and is normally adapted to the same areas as cowpeas. While it is more tolerant of cold than velvet bean, it does have a low frost tolerance and is intolerant to fire.

- Relationship to other crops and weeds
During the early period of establishment it may be slow to grow and subject to weeds. However, once established this crop competes well with weeds and is shown to be excellent for suppressing weeds. It can be used as a cover crop in rotation with sorghum and cotton, an organic mulch in orchards and may be intercropped with maize. Lablab has been intercropped with corn in Honduras resulting in slightly increased corn yields in the second year.
- Pests and diseases
The pest and disease problems include a susceptibility to root-knot, nematodes, leaf-eating insects and pod borers.
- Land preparation and management
Lablab grows best in well-prepared seed beds and will not spread naturally. Unless a natural pasture is cultivated, lablab does not establish well. In contrast to jack bean and velvet bean, lablab is able to be mowed nearly at ground level but still re-grow, however at a slower rate.
- Other uses
Lablab is among the most palatable legumes for animals with a preference for it being shown over jack bean or velvet bean. However a sole diet of lablab may cause bloating.
- Resources and further information
Food and Agriculture Organization of the United Nations
www.fao.org
www.fao.org/waicent/portal/statistics_en.asp
www.fao.org/ag/agp/agpc/doc/gbase/data/pf000047.htm
University of Hawaii at Manoa College of Tropical Agriculture and Human Resources
www2.ctahr.hawaii.edu/sustainag/GreenManures/lablab.asp

Pigeon pea (*Cajanus cajan*)

Pigeon pea is another hardy, short-lived legume crop. No treatment is needed to break dormancy.

- Growth season
Pigeon pea is a perennial, but sometimes annual, shrub. The growing period varies depending on cultivar and latitude.
- Soil and nutrient requirements for growth and soil benefits
Pigeon pea is adapted to grow on fertile or infertile soils and has a low response to fertilizers. While it will grow in soil that ranges from coarse to fine it does not do well in waterlogged clays. Its tolerance range of pH is also wide-ranging. As with lablab it has an extensive root system that results in a more friable soil facilitating water filtration. Soil quality is improved through its role as a nitrogen fixer and is considered a good plant for restoration of fertility. When needed pigeon pea does respond to phosphorus and does require an appropriate amount of calcium, potash and magnesium.
- Climatic tolerances

Pigeon pea does show tolerance to drought conditions (as one of the most drought tolerant legumes) as well as heat, preferring hot, humid conditions. It does not tolerate flooded conditions or frost and is subject to frost damage. Pigeon pea's rainfall tolerance is wide-ranging.

- Relationship to other crops and weeds

Weed control may be needed during its establishment but once past the seedling stage can quickly shade out weeds. It can be intercropped with cereals, cotton or groundnut and used as a shade crop for young coffee trees, cover crop, support for vanilla or wind-break for young coffee or forest seedlings. Crop rotations can occur with maize and tobacco and in Hawaii a five-year rotation with pineapple has been successful. Because of its deep root system, there is less competition with associated crops.

- Pests and diseases

If managed solely as a green manure pigeon pea has few pest, however it become more susceptible to attacks if allowed to form pods. Attacking insects and diseases include leaf eating caterpillars, stem borers, termites, pod borers, gall flies, scale insects, wilt and leaf spot. Nematodes have been shown to attack the roots. It has been shown to be fairly tolerant of herbicides.

- Land preparation and management

Pigeon pea does best in seed beds prepared by deep plowing and cultivations to reduce weeds. It is not tolerant of frequent or severe cutting or heavy defoliation caused by continuous grazing, needing to be well developed before grazing.

- Other uses

Other uses of pigeon pea include as a food source for humans, and forage or hay (not grazed however) with branches and stems used for baskets and fuel. In terms of livestock feed, however, while the value of the fodder is excellent it is not always readily accepted by livestock that do not have an acquired taste for it. There are some traditional medicinal uses as well.

- Resources and further information

Food and Agriculture Organization of the United Nations

www.fao.org

www.fao.org/waicent/portal/statistics_en.asp

www.fao.org/ag/agp/agpc/doc/gbase/data/pf000150.htm

University of Hawaii at Manoa College of Tropical Agriculture and Human Resources

www2.ctahr.hawaii.edu/sustainag/GreenManures/pigeonpea.asp

Velvet bean (*Mucuna pruriens*)

Velvet bean can be herbaceous or climbing. Velvet bean has been among the more promising green manures used in Central America where it is native.

- Growth season

Velvet bean is an annual or perennial crop ready for harvest 180-270 days after planting (sooner when grown for forage).

- Soil and nutrient requirements for growth and soil benefits

The crop is adapted to a wide range of soil types including heavy (well-drained) clays with a tolerance for fairly acidic soils. The preferred soil for optimum yield

is a light sandy loam with a pH of 5.0-6.5. It can grow successfully on soils not suitable for cowpeas and can be valuable as an anti-erosion crop.

- *Climatic tolerances*
Cultivars have been developed that are more tolerant of temperate conditions while other are tolerant of humid regions with others suitable for drylands. However, they are still susceptible to frost and do require a frost-free period, though they do tolerate a bit cooler climate than jack bean. Velvet bean is very intolerant of waterlogged conditions and not as drought resistant as jack bean.
- *Relationship to other crops and weeds*
Velvet beans are grown with other crops, in particular maize, cereals or sugarcane.
- *Pests and diseases*
Crops are affected by wilt and slug damage, as well as rabbits, leaf-cutter ants, and iguanas.
- *Land preparation and management*
A well prepared seed bed is required that is completely free from weeds. It may grow in roughly prepared land, provided the seed is covered or rain falls soon after seeding. Velvet beans are grown with other vigorous crops such as sugarcane or maize but care should be taken so that the velvet bean does not outgrow the maize.
- *Other uses*
In recent years research has been done on the medicinal property of velvet bean in regards to it being a commercial source of L-dopa. There has also been research on its use as an industrial starch to be used as a thickening agent for foods and adhesive in paper and textile. The dry beans been used in conjunction in a 50-50 mix with coffee as a stretcher and in some cases as a complete substitute for coffee. Unlike the other legumes, the seed is not valued for human or animal feed due to its extensive required preparation for safe consumption. The leaves and vines, however, are used as an excellent source of high protein fodder.
- *Resources and further information*
Food and Agriculture Organization of the United Nations
www.fao.org
www.fao.org/waicent/portal/statistics_en.asp
www.fao.org/ag/agp/agpc/doc/gbase/data/pf000054.htm

Sources

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FAO Grasses and Legumes Index.
<http://www.fao.org/ag/agp/agpc/doc/gbase/Default.htm>

Sullivan, Preston. 2003. Overview of Cover Crops and Green Manures: Fundamentals of Sustainable Agriculture. Appropriate Technology Transfer for Rural Areas.
<http://attra.ncat.org/attra-pub/covercrop.html>

Cooperative Extension Service (University of Hawaii). 2002. Sustainable Agriculture Green Manure Crops.