



# Pigeonpea

Hector Valenzuela<sup>1</sup> and Jody Smith<sup>2</sup>

Departments of <sup>1</sup>Tropical Plant and Soil Sciences and <sup>2</sup>Natural Resources and Environmental Management

At the turn of the 19<sup>th</sup> century, long before the advent of the agricultural chemical industry, agriculturists in Hawaii were growing a hardy, drought-tolerant legume from India known as the pigeonpea (*Cajanus cajan*). First used as a windbreak and for livestock feed, the plant became very popular and eventually was grown on over 10,000 acres, interplanted with pineapple as a “soil builder.” Pigeonpea still offers the same excellent array of features, now valued by contemporary farmers who are trying to practice sustainable agriculture. Today, in terms of global production of legume crops, pigeonpea is sixth after *Phaseolus* species (common beans), peas, chickpeas, broad beans, and lentils.

## Characteristics

Pigeonpea is an erect perennial legume shrub often grown as an annual, reaching 3–12 ft (1–4 meters) in height. The leaves have three leaflets that are green and pubescent above and silvery grayish-green with longer hairs on the underside. The flowers are yellow with red to reddish-brown lines or a red outside. Pigeonpea seedlings emerge 2–3 weeks after sowing. Vegetative growth begins slowly but accelerates at 2–3 months. Pigeonpea roots are thin with a deep-rooting taproot reaching up to 6 ft (2 m) in depth. This deep rooting system helps to improve water infiltration into the soil. Research in India showed greater water infiltration in a sorghum-pigeonpea rotation than in sorghum monocultures.

## Environmental requirements

Pigeonpea can be grown in a wide range of soil textures, from sandy soils to heavy clays. It grows best at a soil pH of 5.0–7.0 but tolerates a wider range (4.5–8.4). It does well in low fertility soils, making it a favorite among subsistence farmers. As with most legumes, it

## Benefits provided by pigeonpea

**EXCELLENT** source of organic nitrogen, to increase soil organic matter and improve soil structure and quality

**TOLERATES** low fertility soils, drought conditions

**GOOD** forage for animal production systems (production, nutritional quality, and palatability)

**USE IN** annual production systems (vegetables, herbs, cut flowers and ornamentals, dryland taro); for intercropping and agroforestry to shade young coffee trees and forest seedling nurseries; as a windbreak (taller types)



does not tolerate waterlogged or flooded conditions for very long. Pigeonpea is very heat-tolerant and grows well in hot, humid climates; it thrives under annual rainfall between 24 and 40 inches (600–1000 mm). It is generally grown where the temperatures are in the range of 64–85°F (18–30°C), but under moist soil conditions it can withstand temperatures of 95°F (35°C) or more. Once established, it is one of the most drought tolerant of the legumes, and it can be grown in rainfed conditions or with minimal irrigation. In Hawaii, pigeonpeas grow year-round at elevations ranging from sea level to 3000 ft, according to the USDA Natural Resources Con-

ervation Service (NRCS). Because many varieties have been developed with different growth and flowering responses to daylength, numerous types are available to meet growers' situations of location, elevation, and season when it is to be grown. Pigeonpea is generally a short-day plant. The so called "early" or "short duration" varieties may flower at 90–320 days after planting, while the "late" varieties flower at 175–430 days after planting. The crop often does not require additions of fertilizer, but it responds to sulfur in soils low in this nutrient.

### Cultivars

The pigeonpea cultivars commonly recommended for use as green manure by the Hawaii NRCS are 'Norman' and 'FL81d'. These cultivars are shorter and shrubbier and resistant to root-knot nematodes (*Meloidogyne incognita*).

### Establishment

Inoculate seeds with a cowpea-type rhizobium inoculant. Broadcast 40–60 lb/acre pure live seed. Use the higher rate if severe weed competition is expected or if the crop is to be incorporated as a green manure after a short period of growth; a denser stand produces finer stemmed, more succulent material that is easier to work into the soil. Broadcast and cover or drill to a depth of 1–4 inches (2.5–10 cm).

### Uses

#### Soil improvement

When used as a green manure, pigeonpea produces about 2½ tons/acre dry matter and about 50 lb of nitrogen per ton of dry matter, according to NRCS. Fresh weight yields of the top growth can reach up to 35 tons/acre, including about 700 lb/acre of seed, making it one of the highest yielding food legumes. Total N available from a summer pigeonpea planting in Florida was estimated at 250 lb/acre, although only a fraction of this amount became available for the following crop, indicating that the N is released over a long period of time.

When planted at a CTAHR's low elevation Waimanalo Research Station on Oahu in mid-September, foliage fresh weight was about 15,000 lb/acre after about 14 weeks of growth. A summer planting (mid-June) at the same site resulted in foliage fresh weight ranging from 43,000–80,000 lb/acre when flail-mowed 23 weeks after planting. Plants in the 14-week fall planting grew to about 5 ft tall, and in the summer planting they grew

to 8–10 ft. The tissue nitrogen content of pigeonpea foliage is about 2½%.

Farmers profit from the natural ability of legumes to fix nitrogen. As for all legumes, to optimize nitrogen fixation be sure the soil has a sufficiency of micronutrients (iron, sulfur, molybdenum), suitable pH, and good aeration (no compaction or waterlogging). When used as a green manure, pigeonpea should produce quick improvements in the topsoil. Its extensive root system makes soil more friable, improves its tilth, and facilitates water infiltration. Pigeonpea is also known for its ability to access insoluble phosphates in soils low in P, increasing the availability of soluble P for the following cash crops in the rotation. Research in India showed that the roots of pigeonpeas release piscidic acid, which reacts with iron-bound phosphate in the soil to release P.

#### Agroforestry

Taller pigeonpea varieties can be used as a semi-permanent, perennial component of alley cropping systems. This multi-functional plant can serve as a windbreak and living fence that also produces food and fodder. The leaf litter contributes a mulch that decomposes to add to the soil organic matter, possibly contributing as much as 35 lb/ac (40 kg/ha) of nitrogen to the soil. Pigeonpea cannot tolerate the frequent, severe cutting or heavy defoliation pressure typical of continuous grazing operations.

#### Intercropping

Due to its deep root system, pigeonpea offers less competition to associated crops than some other legumes, and it is often used in intercropping systems with cereals such as millet, sorghum, and maize or with short-duration legumes such as cowpea. Its initial growth is slow, and thus as an intercrop it is initially less competitive for light, water, and soil nutrients when grown as a companion with short-season cash crops. Animals allowed to graze intercropped fields after the main crops are removed eagerly browse on pigeonpea.

#### Food

Pigeonpea is widely known for its use as food. Immature pods, immature seeds, and the mature seeds can be consumed. The seeds are used whole, dehulled, or ground to a flour. In the Caribbean, people often eat the seed as the green (immature) pea, but it is mostly processed into a dried split-pea ("dahl").

### Feed

Pigeonpea foliage is an excellent fodder with high nutritional value. The plants can be grazed, but this should be carefully managed as the plant stems are brittle and easily broken. Pigeonpea should be allowed to develop well before being grazed, and the plants cannot tolerate continuous grazing.

### Wood

Pigeonpea is an important source of household fuelwood for subsistence farmers. Its productivity makes up for the relatively poor fuel characteristics of the wood. The woody stems are also used as thatch and for temporary fencing.

### Pest management

Once the crop is well established, pigeonpea can smother weed growth in the field and help maintain the field weed-free for the following crop in the rotation. Some pigeonpea varieties are reportedly resistant to the root-knot nematode. Also, studies have shown that pigeonpea roots inoculated with beneficial mycorrhizal fungi not only improve the availability of nutrients to the plant but also the plant's tolerance of nematodes and diseases; these fungi are often naturally available in the soil.

### Management cautions

The seedling is fairly slow to establish, and weed control for the first two months of growth considerably improves its development. Once established, it grows vigorously. Cut pigeonpea at flowering or mid-flowering to obtain maximum legume N when using it as a green manure. Select cultivars that are resistant to nematodes. Root growth varies depending on variety, a consideration when growing a cover crop to break hard pans or to improve water infiltration. The roots of "early," short-duration types will grow only about 1½ ft (50 cm) deep into the soil, while the roots of long-duration types may grow up to 6 ft (2 m) deep.

### Pest problems

When managed as a green manure crop, pigeonpea generally has few insect pests. However, if allowed to form pods, pigeonpea may attract pod borers and agromyza

fruitflies. In Hawaii, reports indicate that pigeonpea is attacked by the scale insect *Coccus elongatus*, a stem borer, a pod borer (*Lycaena boetica*) and leaf-eating caterpillars. Pigeonpea can be a host to root-knot and reniform nematodes, but this varies among cultivars.

### For assistance:

Contact your nearest Cooperative Extension Service office for additional assistance in selecting appropriate cover crops and green manures for your farm and cropping situation. Help can also be obtained from the USDA Natural Resources Conservation Service field offices located on each island.

Visit CTAHR's Sustainable Agriculture for Hawaii Program Website at <<http://www.ctahr.hawaii.edu/sustainag>> to find additional information about green manure and cover crops. The site also includes references and links to other useful on-line resources.



### Sustainable Agriculture in Hawaii . . .

. . . integrates three main goals—environmental health, economic profitability, and social and economic equity. Sustainable farms differ from conventional ones in that they rely more on management practices such as crop diversification and crop rotation, agroforestry, integrated pest management, rotational grazing, and innovative marketing strategies. For further information on Sustainable Agriculture in Hawaii, contact:

Dr. Richard Bowen,  
Hawaii SARE Program Coordinator  
phone (808) 956-8708  
e-mail: <[rbowen@hawaii.edu](mailto:rbowen@hawaii.edu)>  
<<http://www.ctahr.hawaii.edu/sustainag/>>

This material is based on work supported by the Cooperative State Research, Education, and Extension Service, U.S. Department of Agriculture, and the Agricultural Experiment Station, Utah State University, under Cooperative Agreement 98-ESAG-1-0340. Portions of this text were adapted from the USDA Natural Resources Conservation Service Hawaii Field Office Technical Guide, Section IV, Code 340, "Cover and Green Manure Crop" May 1992. Plant drawing by P. Verheij-Hayes, in L.J.G. van der Maesen and Sadikin Somaatmadja (eds.), 1989. Plant Resources of South-East Asia No 1. Pulses. Pudoc Scientific Publishers, Wageningen, the Netherlands. Logo drawing courtesy of Deitrich Varez.

