

# JACK BEAN

## *Canavalia ensiformis* (L.) DC

Plant Symbol = CAEN4



Jack bean (*Canavalia ensiformis*). Photo by Christopher Sheahan, USDA-NRCS, Cape May Plant Materials Center

### Alternate Names

#### Common Names:

jack-bean  
 sword-bean  
 coffee bean  
 wonder-bean  
 giant stock-bean  
 horse-bean  
 horse gram

#### Scientific Names:

*Canavalia ensiformis* var. *truncata* Ricker  
*Dolichos ensiformis* L.

### Uses

**Commercial crop:** Outside of the United States both young pods and green seeds are eaten as a vegetable. Seeds are also used as a coffee substitute. The mature bean contains potentially harmful saponins, cyanogenic glycosides, terpenoids, alkaloids, and tannic acid (Udedibie and Carlini, 1998) and must be cooked before eating. There is also pharmaceutical interest in the use of *C. ensiformis* as a source for the anti-cancer agents trigonelline and canavanine (Morris, 1999). Jack bean seed has been promoted in developing nations as a potential source of affordable and abundant protein. It has 29.0% protein content (Adebowale and Lawal, 2004).

**Livestock feed:** In the United States, jack bean is grown mainly as animal feed. Grazing animals do not prefer jack bean to other green manures (Bunch et al., 1985) and although nutritious, it is coarse and unpalatable (Allen and Allen, 1981). Forage yields have reached roughly 8–

10 tons/ac (FAO, 2012) and 15 tons/ac in Hawaii (Allen and Allen, 1981).

The plant has also been used as silage and the seeds are ground for livestock. Adding molasses to jack bean seed meal may help increase its palatability (FAO, 2012). Seed meal may be toxic if too much is consumed and should either be heat-treated to destroy potentially lethal enzymes or limited to 30% of the ration (FAO, 2012). Moist heat is more effective at destroying trypsin inhibitors in *C. ensiformis* than dry heat (Udedibie and Carlini, 1998). Caution should be used when using the seed as human food or animal feed. The most harmful antinutritional protein, concanavalin A, is somewhat protected from heat treatment (Udedibie and Carlini, 1998). Even minute amounts of this protein may be harmful to animals.

**Cover crop/green manure:** As a cover crop jack bean produces phytochemicals that act as a pesticide, bactericide, and a fungicide (Morris, 1999). The canopy of jack bean can establish 85% cover 60 days after emergence and produces roughly 4,915-6,250 lb/ac of dry matter (Bayorbor et al., 2006; Florentin et al., 2004). It has been used successfully to fix nitrogen and control weeds under fruit trees (Bunch et al., 1985). Jack bean can fix between 167–205 lb N/ac (Bayorbor et al., 2006; Benjawan et al., 2007). It works well suppressing vigorous weeds, such as *Pennisetum* spp., and can provide rapid ground cover in agricultural plantations (Kobayashi et al., 2003). Because jack bean has been shown to produce large amounts of biomass in both sun and shade, it has potential for use in silvopastoral systems (Bazill, 1987).

**Soil biofumigant:** Incorporating jack bean dry matter into the soil has reduced root galling in tomatoes and increased tomato plant height and weight (Morris and Walker, 2002). Jack bean has been successfully used to increase yield and to suppress nematode (*Pratylenchus zae*) populations and root necrosis when intercropped with maize (Arim et al., 2006). Farmer Participatory Research (FPR) in Uganda showed that jack bean intercropped with banana, coffee, sweet potatoes, or cassava is a preferred green manure among farmers (Fischler and Wortmann, 1999). However, research by McIntyre et al. (2001) has shown that intercropping banana with jack bean had no beneficial effect on nematode populations.

**Aquaculture:** Detoxified jack bean seed has been used successfully as a high protein fish meal substitute in tilapia aquaculture (Martinez-Palacios et al., 1987).

**Phytoremediation:** Jack bean can be grown in soils with high lead concentration and has potential to be used for restoration of lead-contaminated soils (Faria Pereira et al., 2010).

**Wildlife:** It is pollinated by solitary bees and carpenter bees.

### **Ethnobotany**

Leaves are spread on leafcutter anthills to eliminate ants (Bunch et al., 1985). In Nigeria, jack bean seed is used as an antibiotic and antiseptic (Olowokudejo et al., 2008). Historically, it was used by native tribes for food and forage in droughty regions of Arizona and Mexico.

### **Status**

Jack bean is an introduced species in the United States. Please consult the PLANTS Web site and your State Department of Natural Resources for this plant's current status (e.g., threatened or endangered species, state noxious status, and wetland indicator values).

### **Description**

**General:** Jack bean is an annual or weak perennial legume with climbing or bushy growth forms. It is woody with a long tap root. The 8 in (20 cm) long and 4 in (10 cm) wide leaves have three egg-shaped leaflets, are wedge-shaped at the base, and taper towards the tip. The 1 in (2.5 cm) long flowers are rose-colored, purplish, or white with a red base. It has a 12 in (30 cm) long, 1.5 in (3.8 cm) wide, sword-shaped seedpod. Seeds are white and smooth with a brown seed scar that is about one-third the length of the seed. Its roots have nodules which fix nitrogen.



Jack bean (*Canavalia ensiformis*) in flower. Photo by Christopher Sheahan, USDA-NRCS, Cape May Plant Materials Center.

**Distribution:** Found in the tropics, subtropics, West Africa, Asia, Latin America, South America, India, and South Pacific—mainly in cultivation. It is also grown in the southwestern United States and Hawaii. *Canavalia* is a pantropical genus that is believed to have originated in the New World based on the large genetic diversity of species in the fossil record (Saur and Kaplan, 1969).

For current distribution, please consult the Plant Profile page for this species on the PLANTS Web site.

**Habitat:** Jack bean will become established in disturbed upland areas where average rainfall is 28–165 in (NAS/NRC, 1979). It is shade-tolerant (Bunch, 2003), grows best in a temperature range of 57–81°F, and is found at elevations up to 5,900 ft. (NAS/NRC, 1979).

### **Adaptation**

A distinguishing characteristic of this plant is its ability to continuously grow under severe environmental conditions (Udedibie and Carlini, 1998), even in nutrient-depleted, highly leached, acidic soils (NAS/NRC, 1979). Jack bean is drought-resistant and immune to pests (FAO, 2012; Bunch et al, 1985). It can grow in poor droughty soils, and does not grow well in excessively wet soil. It will drop its leaves under extremely high temperatures, and may tolerate light frosts (Florentin et al., 2004).

### **Establishment**

Jack bean should be planted in full sun to light shade in seed beds roughly 1.5–3 ft apart, in late spring/early summer, at 50–60 lb/ac. For weed suppression, researchers have planted 4–5 seeds per square meter (80 lbs/acre) (Bunch, 1985). Its initial growth may be slower in more northern latitudes, and it flowers after 4–5 months (Bunch et al., 1985). If interseeding jack bean with corn or sorghum, seed should be drilled 15–30 days after sowing the main crop, and after being soaked in water for 24 hours (Bunch et al., 1985). Sowing the intercrop at least 15 days after the main cash crop will limit the potential negative effects of plant competition (Caamal-Maldonado et al., 2001). It does not require staking.

### **Management**

When used as a cover crop or green manure the plant should be terminated mechanically with a roller-crimper or chemically when it first begins to flower. Because jack bean is an annual or very short-lived perennial, it may have to be reestablished each year if used as a weed smothering plant.

### **Pests and Potential Problems**

Jack bean has no significant pests or diseases (NAS/NRC, 1979). The toxicity of the seeds makes them unpalatable to insects and protects them from insect attack (Oliveira et al., 1999).

### **Environmental Concerns**

The plant can become naturalized beyond its native range. It is not an environmental weed or parasitic.

### **Seeds and Plant Production**

Green pods are produced in 80–120 days and mature seeds produced after 180–300 days (FAO, 2012). Jack bean can produce up to 4,105 lb/ac dry seed (NAS/NRC,

1979), but amounts around 892 lb/ac are more common. There are approximately 658 seed/lb (Acosta, 2009).

### **Cultivars, Improved, and Selected Materials (and area of origin)**

There has been limited cultivar development of this species. Most plant development has been performed by agricultural experiment stations and has focused on selecting cultivars with low toxicity (NAS/NRC, 1979). Both viny and bushy varieties exist.

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