

Vegetable Crops–PLSC 451/551

Lesson 21, Legumes

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Legume
flower
morphology



Legumes

General Information

Belong to the family Fabaceae (Leguminosae)
Family with 450 genera, 12,000 species
Provide many useful products, including food
Share 20,000 years of history with humans
Cultivated for at least 9000 years
Historically critical to sustainable agriculture



Legumes

Nitrogen Fixation

Most species of legumes fix atmospheric nitrogen

Form symbiotic relationships – *Rhizobium* bacteria

Nitrogen available for subsequent crops

Legume crops differ in fixation potential

lateral root

nodule

Legumes

Average N Fixation per Season

Snap bean	40 lb/A
Peanut	40
Pea	70
Vetch	80
Lentil	100
Alfalfa	190

Erdman, USDA/ARS, 1967

Legumes

Examples of Useful Legumes

- ❏ *Acacia farnesiana*
(cassie, huisache)
- ❏ Form: Woody (Tree)
- ❏ Uses: Perfume, tannin, wood, fodder
- ❏ Grown: Australia, India, Java, West Indies
- ❏ Origin: North America
- ❏ Other: Flowers are source of perfume

(Derived from a Univ. Hawaii lecture module)

Legumes

Examples of Useful Legumes

- ✦ *Crotalaria juncea*
(sun hemp, Indian hemp)
- ✦ Herb
- ✦ Fiber, green manure
- ✦ India, Pakistan, Bangladesh, Brazil
- ✦ Origin: India
- ✦ Other: Seeds are poisonous to humans, horses



Legumes

Examples of Useful Legumes

- ✦ *Cajanus cajan*
(pigeon pea)
- ✦ Form: Shrub
- ✦ Uses: Food, green manure, fuelwood
- ✦ Grown: India, Africa, Southeast Asia
- ✦ Origin: Africa or India
- ✦ Other: short maturity, often succession cropped



Legumes

Examples of Useful Legumes

- ✦ *Cyamopsis tetragonoloba*
(guar, cluster bean)
- ✦ Form: Herb
- ✦ Uses: Gum, green manure, cover crop, forage
- ✦ Grown: India, Pakistan, USA, Africa
- ✦ Origin: Probably Africa
- ✦ Other: Major source of vegetable gum for food, paper, textiles



Legumes

Examples of Useful Legumes

- ✦ *Canavalia ensiformis*
(jack bean)
- ✦ Form: Herb
- ✦ Uses: Erosion control, green manure, food
- ✦ Grown: Indonesia, Mexico, Tropical Africa
- ✦ Origin: Central America
- ✦ Other: Requires boiling for detoxification



Legumes

Examples of Useful Legumes

- ✦ *Cicer arietinum*
(chickpea, gram, garbanzo)
- ✦ Form: Herb
- ✦ Use: Food
- ✦ Grown: Middle East, India, Mexico, Chile, Peru
- ✦ Origin: Turkey
- ✦ Other: 2nd most important pulse crop, used to make dhal



Legumes

Examples of Useful Legumes

- ✦ *Phaseolus coccineus*
(scarlet runner bean)
- ✦ Form: Herb, perennial
- ✦ Uses: Food, ornamental
- ✦ Grown: Europe, Central America
- ✦ Origin: Mexico
- ✦ Other: Used like snap beans, pretty red flowers



Legumes

Examples of Useful Legumes

- ✦ *Pachyrhizus erosus*
- ✦ (yam bean, jicama, sen kuang)
- ✦ Form: Herb
- ✦ Use: Food
- ✦ Grown: Mexico, Southeast Asia, China
- ✦ Origin: Tropical America
- ✦ Other: Grown for roots rather than pods



Legumes

Examples of Useful Legumes

- ✦ *Lens culinaris*
- ✦ (lentil, masur dhal)
- ✦ Form: Herb
- ✦ Uses: Food
- ✦ Grown: Middle East, India, warm temperate regions worldwide
- ✦ Origin: Mediterranean area
- ✦ Other: Used exclusively as a pulse crop



Legumes

Examples of Useful Legumes

- ✦ *Vicia faba*
- ✦ (broadbean, faba bean)
- ✦ Form: Herb
- ✦ Uses: Food, forage, green manure
- ✦ Grown: USA, Canada, Middle East, South America
- ✦ Origin: Possibly Mediterranean region
- ✦ Other: Immature seed consumed



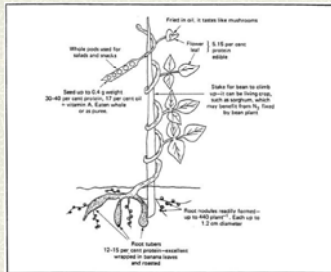
☞ *Psophocarpus tetragonolobus*
(winged bean)

 Use: Food

📦 Origin: East Africa

☞ Other: Entire plant is edible

Multiple Food Uses of Winged Bean



- ✚ beans + corn (South & Central America)
- ✚ chickpeas + wheat/sesame (Middle East)
- ✚ peanuts + millet (much of Africa)
- ✚ peas + oats (western Canada)
- ✚ dahl + rice/wheat/barley (India)

Bob LeRoy, Vegetarian Voice

Legumes



Pulse vs Vegetable Uses

Pulse crops are technically agronomic

Mature, dried seed handled as a grain crop

Vegetable legumes (vegetables, duh!!)

Immature seeds, green pods, leaves, stems, roots

Very difficult to separate uses with respect to world production statistics, management principles, etc.

Legumes



Most Widely Grown Food Legumes

Bean	<i>Phaseolus vulgaris</i>	pulse/vegetable
Peas	<i>Pisum sativum</i>	pulse, vegetable
Chickpea	<i>Cicer arietinum</i>	pulse, vegetable
Faba bean	<i>Vicia faba</i>	vegetable
Pigeon pea	<i>Cajanus cajan</i>	pulse, vegetable
Cowpea	<i>Vigna unguiculata</i>	pulse, vegetable
Lentil	<i>Lens culinaris</i>	pulse

Bean



Taxonomy

Dicotyledon

Family: Fabaceae (Leguminosae)

Genus and species: *Phaseolus vulgaris*

Related species: peas, locoweed, clover, alfalfa, lupines, many others

Bean

Origin and Domestication

Center of origin – Mexico and Central America

Secondary centers of diversity in South America

Cultivated in Mexico for >7000 years

Taken to Europe by early explorers

Also known as: common, kidney, navy, pinto, wax, haricot, marrow, frijole, snap, string, China, black, and white bean



Bean

Consumer use

Consumed in several ways:

Immature pods – boiled, fried, canned, frozen

Mature green seed – boiled, soups, canned

Dry seed – soups, stews, refried

In Mexico and Africa, shoots and stems are also consumed as cooked vegetables



Bean

Fertilization

Weak N fixer (inadequate)

Treat seed with appropriate *Rhizobium* strain

Apply early season N, 20-50 lb/A (too much suppresses nodulation)

Excess nitrogen decreases pod yield



Bean

Growth Habit – Production System

Bush beans (determinate)

Utilized in modern-intensive production

Suitable for once-over machine harvest

Pole beans (indeterminate)

Utilized in market garden and subsistence

Long harvest period, hand picked

Often intercropped with corn, okra

Bean

Harvest Equipment

Tine strippers for processed and some fresh beans

Picker/shellers for green seed beans

Specially equipped grain combines for dry beans

Hand harvesting for pole beans and most fresh beans

Bean

Handling and Storage

Quality declines quickly

Immediately hydrocooled to 40 degrees

Chilling injury at <36 degrees

Storage life

Snap pods – 1-2 weeks at 40 degrees, 95% RH

Shelled green – 1-2 days at 40 degrees, 98% RH

Dry seed – several years in ambient dry air

Dry beans – handle gently to prevent cracking



Pea

Origin and Domestication

Wild progenitors unknown
Assumed center of origin is central Asia and/or the
Mediterranean region
Among the oldest cultivated plants
Utilized 7000-9000 years ago
Remnants found in the city of Troy
Imported into Europe around 1600



Pea

Use and importance

Over 50 countries maintain production records
Considered a major contributor to human nutrition
Rich source of protein, vitamin C, vitamin A,
calcium, potassium, phosphorus, iron, and
carbohydrates

Pea

Consumer use

Shelled green
Boiled, stewed, stir-fried
Processed by freezing, canning
Shelled dry
Used in soups and stews
Processed into soups and stews
Whole green pods
Eaten fresh, boiled, stir-fried



Pea



Heat units and planting

For processing, planting scheduled by heat units

Base temperature - 40 degrees

Upper limit adjustment - 85 degrees

Early varieties require about 1000 degree-days

Late varieties require over 1600 degree-days

Planting date determined by prediction of harvest date using historical temperature averages

Pea

Fertilization

Considered a weak to moderate N fixer

May require seed treatment w/ Rhizobium

Requires starter N 20-30 lb/A, all preplant

Pea



Harvest Indices

Green - pods smooth but filled, seed immature

Dry- moisture content <40%

Edible pod

Non-snap types - full-size pod, no seed

Snap types - pod smooth, seed 1/2 to 3/4 size

Canning peas tested with tenderometer, starch content, brine solutions, alcohol soluble solids

Pea

Production - Harvest

Optimum quality stage lasts only 2-3 days
Hand-picking common for fresh use (mostly gardens)
Machine picking common for processing
Operation – pick, strip, shell
Efficiency – 67-97%
Dry peas harvested with a grain harvester



Pea

Handling and Storage

Rapid post-harvest conversion of sugar to starch
Temperature critical – shelled peas held 3 hr at ambient results in quality loss
Immediate hydrocooling to 32 degrees
Shelf life depends on product
Shelled peas – several hours
Podded peas – 1-2 week at 32 degrees, 90% RH
Dry peas – several years if dried to <15% moisture



Lima Bean

Origin and domestication

Species: *Phaseolus lanatus*
Wild types found in Mexico, Central America, and throughout the Andes
Remnants of large-seed types – 7000 years old
Taken to Europe by early explorers
Both annual and perennial forms are cultured



Lima Bean

Use and production

Subsistence crop in South America, Africa, Asia

Used as a major pulse crop in 3rd world countries

In the United States

Grown as mature green seed for processing
(canned, frozen)

Grown as dry seed for soups or other uses



Soybean

Origin and domestication

Species: *Glycine max*

Originated in southeast Asia, probably China

Evidence of culture since 2800 BC

Domestication and movement resulted in widely
adapted land races

Now produced throughout the world



Soybean

Use and production

Used mostly for oil and pulse in Europe and
the U.S.

Considered a vegetable due to green seed and
sprout consumption in Asia



Peanut (Goober Pea)

Origin and domestication



Possible center of origin in Northern South America

Domesticated east of Andes in Brazil, Bolivia

Cultivated for more than 5000 years

Grown throughout the tropics, temperate regions up to 40 degree latitude
