

Field Beans

adapted from

<http://teach1.cses.vt.edu/cses3444/3444lec17.html>

I. Topic

- Field beans originated in Mexico and Central America.
- They have a great variety of species with a very broad distribution.

II. Learning Objectives

- To become aware of the diversity of the bean species and their importance to human nutrition.
- To understand the climatic and edaphic conditions necessary for successful field bean production.
- To know several important bean types, where they are grown and their use.
- To understand the basic management of beans in a cropping system.

III. Overview

The common bean was probably domesticated from a wild form found in Mexico and Central America. There is a record of bean cultivation before 3000 BC. These plants combined with corn provided the basic diet for the Native American Indian populations of Meso Americans. Beans and corn remain the basic diet in that region today. Beans are warm-season plants that can be either short-day, or day-neutral. Most require a frost-free period of 120-130 days and are usually grown in humid regions. Beans are also produced with irrigation and can be used in the summer after a wheat crop in semi-arid regions. This gives the field bean a very wide distribution (unlike cowpeas and peanuts). Beans need longer rotations because of disease buildup in the soil. Both fungus and viral diseases are important pests of beans. Also, continuous planting of beans lead to high levels of soil erosion because of the small amount of crop residue left after bean culture.

IV. Economic Importance

- World:
 - 23 millions of hectares. 11.5 millions of metric tons.
 - Leading producing countries: Brazil, India, Mexico, U. S.
- U. S.: 778,000 metric tons and 555,000 ha.
 - Leading states:
 - MI, CA, ID, CO, NE

V. History

- Common bean (*Phaseolus vulgaris*) was probably domesticated from a wild form found in Mexico and Central America.
- Kidney beans and tepary beans were cultivated in that area before 3,000
- Lima bean seed was brought to U.S. from Peru in 1824

VI. Adaptation

- Many are short-day plants, some are day-neutral.
- Warm-season plant.
- Optimum temperature: 65 - 75^oF.
- Most successfully produced where rainfall is higher during the latter part of the season.
- Requires a frost-free season of 120-130 days in order to mature seeds.
- Mostly grown in humid region and north, but also in east.



VII. Botanical Description

- Genus - Phaseolus.
- Four species commonly grown in the U. S.:
 - *Phaseolus lunatus (limensis)* (lima beans)
 - *P. actifolius ver. Latifolius* (teparty bean)
 - *P. multiflorus* (runner bean)
 - *L. vulgaris* (common bean)

VIII. Structural and Growth Characteristics:

- Plant: bushy or viney
- Leaves: pinnately trifoliolate. Both leaves and stems are pubescent
- Flowers: white, yellow, or bush purple
- Pods: straight or distinctly curved, 4-8 inches long, and end in a distinct spur
- Seeds: white, buff, brown, pink, red, blue-black, or speckled in color
- Pollination: self-pollinated with less than 1% natural

IX. Bean Types

1. Field beans:
 - White pea: Small semi-trailing plant with white flowers and small white seeds. Mature in 110-120 days. Resistant to common mosaic or anthracnose. Grown mostly in Michigan.
 - Red Kidney Beans: Bush type. Flowers are lilac in color. Seeds are large, flattened, pink at harvest, and dark red when old. Susceptible to bacterial blight and anthracnose. Grown in CA and ID.
 - Great Northern: NB, ID, WY. Short and trailing flowers white, seeds white, large and flattened. Medium-late in maturity. Resistance to common bean mosaic or curly-top virus.
 - Pinto varieties: Grown in irrigated or dry areas in CO, ID and other western and north central states. Semi-trailing. Flowers white. Seeds medium to large, somewhat flattened, buff colored and speckled with tan to brown spots and splashes.
 - Red Mexican and small red varieties: Adapted to irrigated and higher rainfall areas of the Columbian and Snake River basins in Washington and Idaho. Seeds are bright red.
 - Pink bean: Semi-trailing. Flower white. Seeds are pink and medium size. Heat resistant.
2. Tepary bean. (*Phaseolus acutifolius var. Latifolius*): Small leaflets, white seeds. Resistant to drought. Grown in New Mexico, OK and other southwestern areas. Beans considered harder to cook and less palatable than the common beans. Grown also as hay.
3. Mung bean (*Phaseolus aureus*): Suitable for feed, silage, and hay. Leaves glabrous and similar to those of cowpea except for being smaller and bushier. Flowers are yellow. Pods ripe black or brownish. Seeds green, yellow, golden-brown, or marbled.
4. Lima Bean: The large lima bean (*P. limensis* or *P. lunatus var. macrocarpus*) is a perennial grown as an annual. Consumed as green limas, either frozen, canned, or fresh. Mostly grown in CA.
5. Broadbean: Also called horse bean or Windsor bean. Mostly cross-pollinated. Well adapted to the coastal section of CA. Eaten either green or dry.



6. Chick peas (*Cicer arietinum*):
Mostly grown in CA. Adapted to warm semi-arid regions. Flowers are white, or reddish, small and borne singly at the tip axillary branches. Seeds roughly globular, flattened on the sides and somewhat wrinkled.
7. Lentils (*Leutilla lens*):
The lentil plant is a branched weakly upright or semi-viney annual 18-22 inches (45-55cm) tall, with pinnately compound leaves. Flowers are white, lilac, or pale blue. Highly self-pollinated. Susceptible to many viruses that attack peas, clover, or alfalfa. The field should be isolated from other legumes.

X. Crop Rotations

- In humid and irrigated regions: It is advisable to grow beans in long rotations with other crops. An interval of 3 to 4 years between bean crops reduces the risk from soil-borne disease infection. Beans succeed well after green manure crops, legume/grass hay crops, small grains, corn, or potatoes.
- In semi-arid regions: Beans may replace summer fallow in the alternate wheat-fallow cropping system. Continuous culture of beans may result in severe soil erosion.

XI. Culture

- Fertilizers:
 - N: 20-60 lb/acre are helpful in the humid region when beans do not follow a legume crop that has been turned over. In irrigated areas, 120 lb/acre may be profitable on new land or on soils of low residual fertility.
 - P_2O_5 and K_2O : 40-160 lb/acre of each may increase bean yields on soils that are deficient in available quantities.
 - Zn-deficiency on bean plants is avoided by applying 10 lb/acre of $ZnSO_4$ every four years.
- Planting practices.
 - Should be planted in warm soil, preferably above 65°F. After all danger of frost is past. In the northwest, time varies about May 20 to June 10. In CO, from May 20 to June 15. In NM from May 15 to July 1, and in CA from April 10 to July 10. Generally planted in drilled rows 20 to 42 inches apart. Seeds are planted at a depth of 2-1/2 to 4 inches in semi-arid areas
- Weed control.
 - May be cultivated with a rotary hoe before the germinating seedlings emerge or after the plants are 2 to 4 inches tall. Most weeds in some areas can be controlled with herbicides applied as a spray before planting or placed 3 to 5 inches underground with a special subsurface applicator.
- Irrigation.
 - At planting time, soil should be wet nearly up to its field carrying capacity to the depth of the root/feeding zone of 3 feet or more. Should not be irrigated after planting until the seedlings have emerged. Usually 3 or 4 irrigations are necessary after planting until the seedlings have emerged. Usually 3 or 4 more irrigations are necessary after the beans have emerged. Irrigation for the season should cease when 1/4 of the bean pods have turned yellow.
- Harvesting.
 - Generally harvested when most of the pods have turned yellow but before they are dry enough to shatter from the pods. When threshed, beans are being dried with heated air, the temperature should not exceed 100°F, and not more than 3% of moisture should be removed in one drying stage.



XII. Diseases

- Bacterial blights.
 - Among the most serious diseases. Symptoms: Spots that may enlarge rapidly and produce dead areas on the leaf. Causal agent: *Xanthomonas phaseoli* and *Pseudomonas phaseolicola*. Control measure: Plant blight-free seed. Some resistant varieties are available.
- Anthraxose.
 - Caused by *Colletotrichum lindemuthianum*. Symptoms: Dark-colored areas appear on leaves. Most serious in wet seasons. Measures of control:
 - use of disease-free seed grown in the semi-arid region,
 - resistant varieties,
 - crop rotations,
 - keep workers out of the field when the plants are wet,
 - fungicides.
- Common bean mosaic.
 - Seed-borne virus disease also spread by several species of aphids. Symptoms: Mottling of leaves may form various patterns of dark green and light green areas. Leaves of insect infected plants may be curled downward. Control measure: Resistant varieties.
- Others:
 - Bean must (*Uromyces phaseoli typica*), curly top

XIII. Insect Pests

- Bean weevil (*Acanthascelides obtectus*) damage in storage and in the field.
 - Control measure:
 - planting weevil-free seed,
 - fumigation of infected seeds,
 - field sanitation.
- Mexican bean beetle (*Ephialachna varivestris*).
 - Control:
 - With insecticides.
- Others: Potato leafhoppers, seed corn maggot, Pacific Coast wireworm, white-fringed beetle, lygus bugs, and cutworms.

XIV. Summary

- There are many varieties of field beans and together they have a very broad distribution. Beans are important in the diet of most every culture.
- They are usually associated with a basic cereal and together make up the basic human diet.
 - Examples are: Mexico, corn and kidney/pinto bean; Southeast Asia, rice and mung bean; Mediterranean pasta (wheat product) and lentil; India, sorghum and pigeon pea.
 - In all cases the bean uses the legumes' ability to fix nitrogen and thus provides needed protein for the basic human diet.

