The SOYBEAN Plant

Description

Soybean (*Glycine max* (L.) *Merrill)* or soya bean is a legume crop belonging to the family Leguminosae or Fabaceae and sub-family Papilionaceae. The plant grows up to 1.5 meters tall, depending on variety. Erect stems are covered with thick brown hair. Leaves are compound, with 3 leaflets. They are alternate, trifoliate with ovate leaflets and short peduncle. The inconspicuous, stalkless white to purple flowers are borne singly or in small clusters in the axils (where leaf meets stem). The fruit is a broad, hairy, flattened legume or pod, around 10 cm (3 in) long, yellow to brown when fully mature and dried. The fruits are called pods measuring up to 7 centimeters long, containing 1 to 4 seeds which are colored yellow, black or green.

Soybeans occur in various sizes, and in many hull or seed coat colors, including black, brown, blue, yellow, green and mottled. The hull of the mature bean is hard, water-resistant, and protects the cotyledon and hypocotyl (or "germ") from damage. If the seed coat is cracked, the seed will not germinate. The scar, visible on the seed coat, is called the hilum (colors include black, brown, buff, gray and yellow) and at one end of the hilum is the micropyle, or small opening in the seed coat which can allow the absorption of water for sprouting.

In the Philippines, it is known as “Utaw” while in other Asian countries, it is known as “Wonder bean,” “Great treasure,” “gift from God” and the “source of liquid gold.”

Origin and Major Types

Soybeans were a crucial crop in East Asia long before written records began. It originated in southeastern Asia (including China, Japan, and Korea) that was domesticated more than 3,000 years ago for its edible seeds and young pods. Prior to fermented products such as soy sauce, tempeh, natto, and miso, soy was considered sacred for its beneficial effects in crop rotation. Soy was first introduced to Europe in the early 18th century and to British colonies in North America in 1765, where it was first grown for hay.

Soybeans did not become an important crop outside of Asia until about 1910. In America, soy was considered an industrial product only, and was not used as food prior to the 1920s. Soy was introduced to Africa from China in the late 19th century, and is now widespread across the continent.

In Asia, the wild ancestor of the soybean is *Glycine soja*(previously called *G. ussuriensis*), a legume native to central China. According to the ancient Chinese myth, in 2853 BCE, soybean was one of the five most sacred plants aside from rice, wheat, barley, and millet. Cultivation of soybeans was long confined chiefly to East Asia, but gradually spread to other countries during the 20th century.

The oldest preserved soybeans resembling modern varieties in size and shape were found in archaeological sites in Korea dated about 1000 BCE. Soy bean from the Jomon period in Japan from 3000 BCE are also significantly larger than wild varieties. Soy bean was unknown in South China before the Han period, using varieties with small wild size beans. Only when new soy bean cultivars became introduced into Zhou China from the "north-east"

around 510 BCE an agricultural revolution was triggered eventually making soy beans part the staple diet.

Production Trends

Soybean is now the world's most important legume crop, and the sixth of all cultivated crops in terms of total harvest, and the most widely produced oilseed, grown in diverse climates worldwide. The Food and Agriculture Organization (FAO) classified it as an oil seed rather than pulse.

The U.S., Argentina, Brazil, China and India are the world's largest soybean producers and represent more than 90% of global soybean production. The U.S. produced 75 million tons of soybeans in 2000, of which more than one-third was exported. In the 2010–2011 production year, this figure is expected to be over 90 million tons.

The average worldwide yield for soybean crops, in 2010, was 2.5 tons per hectare. The three largest producers had an average nationwide soybean crop yield of about 3 tons per hectare. The most productive soybean farms in the world in 2010 were in Turkey, with a nationwide average farm yield of 3.7 tons per hectare. The world record for soybean yield is 10.8 tons per hectare, demonstrated in 2010 by Kip Cullers, a farmer in Purdy, Missouri.

Top Soybean Producersin *2010*	
(million metric tons)	
United States	90.6
Brazil	68.5
Argentina	52.6
People's Republic of China	15.0
India	9.8
Paraguay	7.4
Canada	4.3
Uruguay	1.8
Ukraine	1.68
Bolivia	1.63
World Total	**249.0**

Source: UN Food & Agriculture Organisation (FAO)

Total commercial production of soybeans in 2010 was 261.6 million metric tons (mmt) worldwide, harvested from 102.4 million hectares (which comprises around 2% of the planet's agricultural land). The U.S. was the leading producer of soybeans, producing just over one third of the world total. Other leading producers include Brazil, Argentina, and China.

In the Philippines the area planted with soybean is just about 1,000 hectares. Currently, our country is highly dependent on importation for our domestic needs which reach as much as 300,000 metric tons annually. The main sources are USA, Brazil, and Argentina. The volume of soybean for the direct usage, whether for feed or for food is probably less than 100,000 tons per year. The food soybeans are sourced mostly from Canada and China.

Hence, in order to minimize import dependence, the government through the auspices of the Department of Agriculture initiated the development of the soybean industry. Alongside this effort, the Bureau of Plant Industry particularly its National Crop Research and Development Centers at La Granja, La Carlota, Bacolod; and at Los Baños, Laguna; together with other breeding institutions like the Institute of Plant Breeding of the University of the Philippines Los Baños are working on the varietal improvement of soybean to produce high yielding varieties. Moreover, a national program onorganic soybean production is presently implemented as demand for organic soybean is becoming a big niche among health conscious consumers.

Properties/Uses

Soybean seeds contain high protein ranging from 35 to 40%, comparable to that of milk and eggs. It is also rich in oil (20%), vitamins and minerals.

Nutrient content of soybeans:

Component (per 100g portion)	Amount	Component (per 100g portion)	Amount
Water (g)	68	Selenium (µg)	1.5
Energy (kJ)	615	Vitamin C (mg)	**29**
Protein (g)	**13.0**	Thiamin (mg)	**0.44**
Fat (g)	**6.8**	Riboflavin (mg)	0.18
Carbohydrates (g)	11	Niacin (mg)	1.65
Fiber (g)	4.2	Pantothenic acid (mg)	0.15
Sugar (g)	0	Vitamin B6 (mg)	0.07
Calcium (mg)	**197**	Folate Total (µg)	**165**
Iron (mg)	3.55	Vitamin A (IU)	180
Magnesium (mg)	65	Vitamin E, alpha-tocopherol (mg)	0
Phosphorus (mg)	194	Vitamin K1 (µg)	0
Potassium (mg)	620	Beta-carotene (µg)	0
Sodium (mg)	15	Lutein+zeaxanthin (µg)	0
Zinc (mg)	0.99	Saturated fatty acids (g)	**0.79**
Copper (mg)	0.13	Monounsaturated fatty acids (g)	**1.28**
Manganese (mg)	0.55	Polyunsaturated fatty acids (g)	**3.20**

Because of its high nutritional quality, soybean is used as a major protein ingredient in the formulation of livestock and poultry feeds. It is also used as raw material for the manufacture of processed foods and food additives like soy sauce, tofu, soymilk, tokwa. It is also processed into soy paste (miso), and soy milk (which is frequently used as a dairy substitute). Hydrolyzed vegetable protein is a meat substitute made from processed soybeans. Flour made from soy beans is used in numerous processed foods, as a stabilizer and to increase protein content. Soy oil is widely used in cooking (including in food products such as margarine, shortening, salad oil) as well as in cosmetic and industrial products (paints, printing inks, soaps, disinfectants, andlinoleum). Soy oil is also increasingly used as a biofuel. The soy meal that remains after oil is extracted is used to make fiber, textiles, and adhesives,

or as livestock feed. Soybeans and whole plants are also widely used for animal fodder and pasture, hay, and silage, as well as grown as a cover crop (green manure).

Moreover, it is an ideal intercrop and rotation or relay crop to cereal-based farming systems.

Some Recommended Soybean Varieties

A number of National Seed Industry Council (NSIC) approved soybean varieties are available for commercial planting as shown in the table below:

Variety	Potential Yield/Ha/Season		Maturity (days after sowing /Season		Reaction to insect pests and diseases and other characteristics
	Wet	Dry	Wet	Dry	
PSB Sy 1	2.85	1.94	95	89	Resistant to soybean rust and bacterial pustule
PSB Sy3	2.42	2.04	98	85	Resistant to soybean rust and bacterial pustule
PSB Sy 8	2.68	1.97	91	83	Resistant to soybean rust and bacterial pustule
PSB Sy 6 (Tiwala)	2.19	2.08	100	92	Resistant to soybean rust and bacterial pustule
NSIC Sy 8	2.44	2.18	95	90	
PSB Sy 7 (Tiwala 10)	2.06	2.29	99	89	Yellow seedcoat; has good seed storability; recommended for wet season cropping in So. Mindanao
NSIC Sy 01	2.28	1.70	88	80	Resistant to soybean rust and bacterial pustule
NSIC Sy 02	2.03	2.00	93	84	Resistant to soybean rust and bacterial pustule
NSIC Sy 03	2.29	2.79	98	91	
NSIC Sy 04	2.29	2.06	99	89	
NSIC Sy 05	8.82	7.10	85	70	Resistant to soybean rust and bacterial pustule
NSIC Sy 06	14.76	8.55	87	70	Resistant to soybean rust and bacterial pustule
NSIC Sy 07	9.57	7.38	88	70	Resistant to soybean rust and bacterial pustule
NSIC Sy 09	2.44	2.18	95	90	Resistant to soybean rust and bacterial pustule

Soil and Climatic Requirements

Typically, soybeans planted during early May have the best yield performance. However, yield also depends on other factors. Growing conditions at planting time will influence the success of seed germination and seed vigor. Soybeans need a minimum soil temperature of 55 to 60^0F to germinate. Germination rate increases at warmer temperatures. A seed that is in the soil but cannot rapidly germinate and emerge above the soil surface will have a higher chance of exposure to diseases such as damping off.

Soybean thrives in well-drained, fertile, loam to clay loam soil with pH of 5.8 to 6.5. It can be grown in any part of the Philippines except in areas where rainfall is very heavy (Type 2 climate).

Cultural Management Practices

Land Preparation

Thoroughly plow and harrow the field twice at weekly interval to achieve good tilth.

Furrowing

Set furrows at 60 centimeters apart and about 4 to 5 centimeters deep.

Seed Inoculation

If inoculant is available, prepare inoculated seeds one hour before planting at the rate of 500 gm *Rhizobium* per 50 kilograms seeds. Place soybean seeds in a container, sprinkle with water, add the inoculant and thoroughly mix until all seeds are coated with inoculant. Keep the inoculated seeds in a shaded place until planted.

Fertilizer Application

When seeds are inoculated, apply three (3) bags of Superphosphate and one (1) bag Muriate of Potash per hectare. However, when no inoculant is used, apply four (4) bags of Triple 14. Before planting, drill fertilizer uniformly in furrows and cover thinly with fine soil. Organic fertilizer for better crop establishment can also be applied. Moreover, if you want to grow soybean organically apply 2-5 tons of organic fertilizer instead of the synthetic fertilizer.

Planting

Sow 18 to 20 inoculated soybean seeds per linear meter and cover thinly with soil. Forty (40) to 60 kg of soybean seeds are needed per hectare. Use seeds with high germination (80% or higher). Unlike palay, soybean seeds lose their viability in a short span of time. After 3 to 4 months in ordinary storage condition, germination will be less than 50 percent. Before planting, sun dry soybean seeds for about 2 hours.

Irrigation(optional)

If irrigation system is available and the soil has insufficient moisture, irrigate the field after planting and at blooming and pod setting stages.

Weeding and Cultivation

Two weeks after planting, pass a carabao-drawn cultivator between soybean rows to control weeds. Handweed remaining weeds especially those near the base of the soybean plant. Hilling-up is needed after handweeding.

Crop Protection

A. Insect pests of Soybean

At Seedling stage:

1. **Bean Fly/Stem Fly** (*Melanagromyzasojae*Zehntner)

Nature of damage

The maggot punctures and mines on the lower part of the leaves, feeding as miner on the leaf working down the petiole and into the stem. In serious infestation, the plants may assume a rusty appearance and in some cases many plants die.

Control Measures

a) Biological control such as weekly application of *Trichogrammachilonis* at the rate of 25-30 strips per hectare per application starting 20 days after planting up to reproductive stage; and spraying of vermi tea or naturally fermented solutions (NFS) can be employed.
b) For chemical control, spray contact insecticide following the recommended dosage.

2. **Soybean Aphids** (*Aphis glycines* Matsumura)

Nature of damage

Both adults and nymphs cause injury by sucking the plant sap. Heavily infested plants appear stunted and leaves curl down at the edges. Affected plant parts turn yellow, dry up and eventually fall. The occurrence of this pest is always associated with red ants due to their symbiotic relationship. Like other sucking insects, aphids also transmit virus.

Control Measures

a) For biological control, spray naturally fermented solutions (NFS) and EM5. Spraying of vermi tea is also recommended. During spraying, position spray nozzle upright to target the insect pest under the leaves.
b) Contact insecticide can also be used. Be sure to follow the recommended rate indicated on the label.

At Vegetative stage:

1. **Green Stink Bug or Green Soldier Bug** (*Nezaraviridula* L.)

Nature of damage

It is a polyphagous insect feeding on wide range of plants especially legumes. Both nymphs and adults of this bug pierce their mouthparts by sucking the juice from the stems, developing pods and seeds. As a result, the harvestable pods are reduced and eventually affecting both yield and quality of the crop.

Control Measures

a) For biological preventive measure, spray EM5, vermi tea and naturally fermented solutions at weekly interval.
b) Spray appropriate insecticides following the instruction on the label, at 14 days interval until infestation stops or controlled.

2. **Common Cutworm** (*Spodopteralitura*L.)

Nature of damage

The newly-emerged caterpillar feeds immediately on the oviposition site and completely skeletonizes the leaflet. The advanced instar later migrate to other parts of the plant and continue feeding including the pod resulting to non-marketability during harvest. It inflicts damage throughout tropical Asia and also attacks cabbage, eggplant, mungbean, corn and tomato.

Control Measures:

a) Alternate weekly spraying of vermi tea and naturally fermented solutions (NFS) at 60 ml and one liter, respectively, per knapsack sprayer as preventive measures.
b) Use *Trichogramma chilonis* at the rate of 200 strips per hectare divided into six weekly application starting 20 days after planting.
c) For chemical control, spray insecticide at 14 days interval following the recommended rate.

3. **Soybean Leaf Folder** (*Omiodesindicata*F.)

Nature of damage

The damage done by this pest often results in the serious defoliation of the host plant, hence, affecting its photosynthetic activity. The larva glues together the edges of a leaf on which it feeds inside. Its attack is evident in the large number of dried folded leaves.

Control Measures

a) Weekly spraying of vermi tea alternated with naturally fermented solutions (NFS) at the rate of 60 ml and one liter, respectively, per knapsack sprayer is recommended as preventive measure.
b) Apply *Trichogramma chilonis* at the rate of 200 strips per hectare divided into six weekly application starting 20 days after planting.
c) For chemical control, spray appropriate insecticide at 14 days interval following the recommended rate.

4. **Green Looper** (*Chrysodeixischalcites*Esper)

Nature of damage

The pale greenish larvae feed immediately on tender green foliage. In severe infestation, the plant can be completely defoliated.

Control Measures:

a) For preventive measure, alternate spraying of vermi tea and naturally fermented solutions (NFS) at the rate of 60 ml and one liter, respectively, per knapsack sprayer is recommended.
b) Apply *Trichogramma chilonis* at the rate of 200 strips per hectare divided into six weekly application starting 20 days after planting.
c) For chemical control, spray appropriate insecticide following the recommended rate.

At Reproductive stage

1. **Soybean Pod Borer** (*Etiellazinckenella*Treitschke)

Nature of damage

Eggs are laid singly on the nether surface of calyx and sepals of well-grown pods. Upon hatching, the larvae cause damage by boring on young pods. Seeds are partially eaten which can cause significant yield loss.

Control Measures

a) Alternate spraying of vermi tea and naturally fermented solutions (NFS) at the rate of 60 ml and one liter, respectively, per knapsack sprayer is a recommended preventive measure.
b) Application of *Trichogramma chilonis* at the rate of 200 strips per hectare divided into six weekly application starting 20 days after planting is also a recommended crop protection practice.
c) For chemical control, spray appropriate insecticide following the recommended rate at two weeks interval until pest infestation is controlled.

2. **Corn Earworm** (*Helicoverpaarmigera*Hubner)

Nature of damage

It is primarily a pest of corn, however, tomatoes especially during the fruiting stage are severely attacked by the pest. The larvae bore into the fruit, feeding voraciously on the tissues. This causes the fruits to dry up later and subsequently to fall. Similar damage is done by the pest on soybean wherein the larval stages of the pest affect the developing pods and seeds by boring and ultimately feeding on them.

Control Measures

a) Apply *Trichogramma chilonis* at the rate of 200 strips per hectare divided into six weekly application starting 20 days after planting.
b) Alternate spraying of vermi tea and naturally fermented solutions (NFS) at the rate of 60 ml and one liter, respectively, per knapsack sprayer is recommended as preventive measure.
c) If available, application of 1,000 assassin bugs per hectare at the onset of flowering is also recommended.
d) For chemical control, spray appropriate insecticide following the recommended rate.

General Suggested Pest Control Strategies

1. **Insect Pest Identification** – know what particular pest to control, its life cycle and nature of damage to determine what control measure is going to be employed.
2. **Cultural Control** - this includes the different field operations that promote favorable growth of the crops; and effectively control insect pests by directly destroying them, interfere with the normal biological processes and make the environment unpleasant for the insect pests. Example: clean culture and crop rotation.
3. **Mechanical Control** - involves the use of special equipment or operations. Generally, this gives immediate and tangible results. Example: handpicking and light trapping.
4. **Biological Control** - use of beneficial parasites, predators and pathogens to minimize or control the pest. Every pest species has one or more natural enemies which prevent their population from increasing to a disastrous level.

   Example: Application of *Trichogrammachilonis* at the rate of 200 strips per hectare at weekly interval starting 20 days after germination up to flowering stage and Assassin bug (1,000 nymphs or adult/hectare) at the onset of flowering up to pod development.

5. **Chemical Control** – also known as pesticide, most commonly used to control or kill pests. Effective against large pest populations, act within a short period of time, and are readily available for use. However, despite their advantages in pest control, the frequent use of pesticides often results in problems such as resistance, adverse effects to non-target organisms, hazards to users and environmental contamination. Hence,
   pesticides should be used only when necessary and should be integrated with other forms of pest control.

B. Diseases

1. **Bacterial Pustule** (*Xanthomonascampestris*pv. phaseoli (Smith) Dye)

Symptoms/Disease Development

It is characterized by small, yellow-green spots with reddish-brown centers. Later in the center of the spots a small, raised pustule develops which is most noticeable on the lower leaf surface. Pustule formation and the absence of a water soaked appearance in the early stages of lesion development distinguish bacterial pustule from bacterial blight. Diseased leaves develop a tattered appearance as dead tissue is torn away because of weathering. Severe infection often causes some defoliation of young leaves which are more susceptible than older leaves.

Control Measures

a) Plant resistant varieties.
b) Use high quality soybean seeds.
c) Spray recommended fungicide. Proper timing of application is strongly recommended.
d) Practice crop rotation.
e) Observe field sanitation.

2. **Soybean Rust** (*PhakopsorapachyrhiziSyd.)*

Symptoms/Disease Development

Tan, dark brown or reddish brown lesions occur on leaves. Severe infection causes leaf yellowing, defoliation and early maturity. Temperatures below 28^{0}C and prolonged leaf wetness favor the disease.

Control Measures

a) Plant resistant and early maturing soybean varieties.
b) Spray recommended fungicide only if need arises. Proper timing of application is strongly recommended.
c) Practice crop rotation and field sanitation.

3. **Purple Seed Stain** (Cercosporakikuchii)

Symptoms/Disease Development

It produces discoloration of pink or light to dark purple on soybean seed coat. Size of the discoloration may vary from a small spot to the entire seed surface. Affected seeds may be cracked, rough and dull. It is present as leaf blight in many soybean fields every year. It causes seed infection only in years when there is delayed harvesting due to wet weather. Furthermore, infection may increase under warm and moist environment. As a result, infected seeds are of poor quality and if used as planting materials can result in delayed seedling emergence, reduced plant stand, and poor seedling vigor. Planting infected seeds may result in further build-up of the disease on new crops.

Control Measures

a) Plant resistant and early maturing soybean varieties.
b) Spray recommended fungicide only if need arises. Employ proper timing of application.

c) Observe crop rotation and field sanitation.

4. **Damping-Off** (*Rhizoctoniasolani, Pythium spp. &Fusarium spp.)*

Symptoms/Disease Development

At pre-emergence damping off, seedlings rot before they could emerge. During post emergence, infected seedlings rot at the stem near the soil surface.

Control Measures

a) Plant resistant soybean varieties.
b) Treat the seeds with fungicide.
c) Practice crop rotation and field sanitation.

5. **Soybean Mosaic**

Symptoms/disease development

It is caused by soybean mosaic virus (SMV) and is the most widely distributed virus diseases of soybeans. It is spread by planting diseased seed and through aphids.

Symptoms of SMV vary depending on the soybean cultivar, the age of the soybeans, the virus strain, and the temperature. Symptoms are most noticeable under cool temperatures of 18 to 24^0 *C*. When temperatures rise above 30^0 *C.*, leaf symptoms may be masked. The youngest and most rapidly growing leaves show the most severe symptoms.

The leaves of SMV infected plants are distorted and narrower than normal, and develop dark green swellings along the veins. Infected leaflets are puckered and curl down at the margin. Plants infected early in the season are stunted, with shortened petioles and internodes.

Diseased seed pods are often smaller, flattened, less pubescence, and curved more acutely than pods of healthy plants. Infected seed are mottled brown or black, usually smaller than seeds from healthy plants, and germination may be reduced.

Control Measures

a) Plant resistant and early maturing soybean varieties.
b) Spray recommended insecticide to control aphids which is the insect vector of soybean mosaic.
c) Employ crop rotation and field sanitation.

General Guidelines in Disease Management

1. **Plant high quality, preferably certified seeds**. High quality, certified seeds reduce the possibility of introducing pathogens into the field, and also produce vigorous seedlings that minimizes possible incidence of seed decay and seedling disease.
2. **Fungicide seed treatment (for fungal diseases).** Thispractice protects seeds and seedlings from seed-borne and soil-borne pathogens. Seed treatment is inexpensive and effective.
3. **Practicethe recommended seedbed preparation, planting depth, and seeding rate.** This will promote uniform seedling emergence, vigorous seedling growth, and prevent incidence of seedling diseases.

4. **Practice crop rotation with non-legume crops.**Many pathogens survive between cropping seasons on crop debris. Continuous monoculture allows the pathogens to perpetuate and multiply. Crop rotation will reduce the survival and increase of pathogens within the field.
5. **Employ deep plowing to bury plant debris.** Pathogens survive between planting seasons on plant debris. Deep plowing will physically remove plant debris and hasten decomposition. As the debris decays, the pathogens will die out.
6. **Plant disease resistant crop varieties**. Plant resistance is the most efficient and least expensive disease management practice. However, resistance to all known diseases is not available, and may not last forever. Pathogens sometimes develop new strains which overcome plant resistance.
7. **Use foliar fungicides only when necessary.** When disease pressure is high, fungicides are effective and profitable. Benefits include increased yield and improved seed quality. Apply at proper time and rate following label instructions.
8. **Observe appropriate cultural management practices.** This includes good drainage, fertilization, irrigation, weed control, and insect management. This encourages healthy, vigorous growth that enables the plant to escape disease and be more tolerant to pathogens.
9. **Disease management is best accomplished using an integrated approach.** This requires incorporating as many of the principles listed above.

Harvesting, Drying and Threshing

Soybean is ready for harvest when 95% of its leaves have turned yellow or fallen. Cut plants at the base, then sundry. Thresh using flails or a modified rice or sorghum thresher. Clean and sundry grains for 2 to 3 days until moisture content is reduced to 12-13%.

Seed Selection

Discard infected and damaged soybean seeds including other seeds and varieties.

Storing and Marketing

For planting purposes, place seeds in airtight containers and store in a dry, cool place or in an air-conditioned room. For commercial use, soybean grains can be placed in ordinary sacks and stored in dry place until they are sold or disposed. Tie up with wellness market and feed millers are possible avenues for marketing soybeans.

Utilization of Soybean

The high regard for soya is due to its being a rich source of highly valuable nutritional elements. Soya contains 40% protein, 21% fat, 34% carbohydrates and 5% ash, and a significant amount of vitamins A and E as well as minerals. One kilo of cooked soya has as much protein as 10 boiled eggs or ½ kilo of cooked beef. It contains about twice the protein and 10 times the fat of common beans. Moreover, it contains essential amino acids necessary for growth and tissue repair.

Soybean can be processed into milk, soy sauce, bean curd, desserts, snacks, and food extender.

Nutritionists estimate that 1 hectare of land planted to soybean can provide the annual protein requirements of 58 persons.

Soybean is delicious when prepared properly. Both green and grain soybean can be used in vegetable dishes but green soybeans are better than the grains (dry) in flavor, texture and color.

Green soybeans may be boiled in pods in plain water and served like boiled peanuts. It is cooked in the same way as patani, peas and garbanzos.

Recipes

Soymilk

Ingredients: 2 cups Soybeans
9 cups Water
Sugar

Procedure:

1. Soak 2 cups soybean in water for 5 to 10 hours or overnight. Wash thoroughly and thendrain the water.
2. Remove the bean coat or hull by rubbing between the palms.
3. Grind the beans with 1-cup water as fine as possible. A corn mill, blender or stone mill can be used for the purpose.
4. Boil 9 cups of water and add the ground soybean and boil for 15 minutes. Stir constantly to prevent scorching.
5. Filter the liquid through cheesecloth to remove insoluble residues.
6. Boil the filtered liquid (soybean milk) for another 10 minutes and add calamansi rind.
7. Sweeten the soybean milk by adding sugar. Vanilla can also be added to improve the flavor.

Tokwa (Soybean Curd)

Ingredients: 3 cups soybean
6 cups water for grinding
7 to 8 cups water for boiling grounded soybean
1/3 cup vinegar (Del Monte)

Procedure:

1. Soak soybean overnight.
2. Wash the bean and remove the bean coat.
3. Grind soybean using corn mill grinder or blender.
4. Add 6 cups of water little by little while grindingor blending.
5. In a separate casserole, boil 7 cups of water and add the grounded soybean and boil 10 minutes with low flame and stir constantly to prevent scorching.
6. Strain through a cheesecloth bag to get the soymilk from the residue.
7. Set aside the milk until its lukewarm (70^0C).
8. Add vinegar and mix thoroughly. Let it stand for a few minutes while the curd forms. Filter the curd through cheesecloth.
9. Press the curd in the cloth using a wooden frame with holes in the bottom to allow excess whey/water to drain. Six cups of soybean milk will yield about 600 grams of tokwa.
10. Soak and wash the soybean curd in cold water for several times to remove the excess acid.
11. Drain for about an hour and press out the remaining liquid.
12. Season with salt and pack tightly in a moisten mold.
13. Cover and store in a cool place until firm enough to cut. Use tokwa as you would in cooking.

Soybean Burger Patties

Ingredients: ¼ kg ground beef
½ kg soybean akara (sepal from soymilk making)
1 medium onion (chopped)
2 teaspoon salt

2 cloves garlic
2 pcs bell pepper

Procedure:

1. Mix all ingredients and shape into small patties
2. Preheat oil in a pan (maintain in low fire)
3. Cook patties for 8 minutes on each side
4. Best served while hot.

Soybean Seed Production Cost Per Hectare

ITEM	QUANTITY	UNIT COST (Php)	TOTAL ESTIMATED COST (Php)	
			Conventional	Organic
A. Farm Inputs				
1. Seeds	50 kg	90.00	4,500.00	4,500.00
2. Fertilizers				
a. Triple 14	4 bags	1200.00	4,800.00	
c. Muriate of Potash (0-0-60)	1 bag	1300.00	1,300.00	
d. Organic Fertilizer	(10)(40) bags	300.00	3,000.00	12,000.00
e. inoculant	2 packs	10.00	20.00	20.00
3. Pesticides				
a. Insecticides	2 packs	900.00	1,800.00	
b. Fungicide	1 pck	400.00	400.00	
5. Sacks	50 pcs	10.00	500.00	500.00
6. Plastic twine	2 rolls	65.00	130.00	130.00
7. Drying Net	1 roll	6500.00	6,500.00	6,500.00
8. winnower	3pcs	100.00	300.00	300.00
Sub Total			**33,780.00**	**29,650.00**
B. Labor	No. of Mandays			
1. Land preparation (plowing, harrowing and furrowing)	Tractor rental		6,000.00	6,000.00
2. Planting (drill method)	8	220.00	1,800.00	1,800.00
3. Fertilizer application				
a. basal (T 14 and organic)	(5)(4)	220.00	1,100.00	880.00
b. sidedressing (0-0-60)	2	220.00	440.00	
4. Replanting	4	220.00	900.00	900.00
5. Roguing	3	220.00	660.00	660.00
6. Handweeding				
a. first weeding	10	220.00	2,200.00	2,200.00

b. second weeding	8	220.00	1,760.00	1,760.00
c. spot weeding (optional)	6	220.00	1,320.00	1,320.00
7. Cultivation (carabao drawn plow)				
a. off-barring (2 ways)	4	220.00	880.00	880.00
b. hilling-up (2 ways)	4	220.00	880.00	880.00
8. Spraying (pesticides)	2	220.00	440.00	
A. Spraying (vermitea/NFS	4	220.00		880.00
9. Harvesting and sundrying	10	220.00	2,200.00	2,200.00
10. Threshing and cleaning	5	220.00	1,100.00	1,100.00
11. Seed selection and sundrying	5	220.00	1,125.00	1,125.00
12. Seed bagginG	2	220.00	450.00	450.00
Sub Total			**23,255.00**	**23,035.00**
Contingency (10%)			**5,704.00**	**5,269.00**
Total Production Cost			**62,739.00**	**57,954.00**
Production cost/kg (conventional)		62.74		
Production cost/kg (organic)		57.95		
GROSS INCOME				
Seeds produced (Conventional)	**1,000 kg**	**90.00/kg**	**90,000.00**	
Seeds produced (Organic)	**1,000 kg**	**90.00/kg**		**90,000.00**
NET INCOME			**27,261.00**	**32,046.00**

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