

Excerpt from the Nutrition & Education International (NEI) Foundation

Soybean Manual

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Soybean Botany

Soybean is an annual plant which its height is about 1m to 1.5m. The plant has a main root that goes down in the depth of 1.5 meters to the ground. Its stem is straight and has multiple branches covered by brown color corks. This is a plant with three leaflets. The straight pods consist of 2-4 grains which is covered by thin pads. The grain color is yellow, green and black. Soybean can plant in almost all lands but the suitable soil is semi-clay and semi-sandy soils. The optimum pH is 5.5-6. This plant from the first stage of growth in compare to the cotton has more resistance to the drought. Lack of moisture during flowering up to grain filling causes yield loss. High humidity has a positive effect on the plant growth and increase in the number of pads and excessive moisture causing fungi disease. The color of seed varied from yellow, gray, green and black. The color of flower is purple or white or mixture of both. This diversity reflects the genetic variation in the properties of different varieties of soybean and this provides the opportunity to work for a genetic engineering. In normal condition soybean is a self-pollinate crop. Flowers are in cluster form which each cluster includes 3-35 blooms depending on the type and environmental factors such as humidity and temperature during the flowering. Factors stimulate flowering are: day and night length, temperature and the genetic property of the plant. Each bloom consists of 5 petals and 5 stamens which are sticking together and a stigma which cover the wall. The sepals of lateral flower are 3-5. Pollination occurs before or after the opening of the flower but the possibility of cross is low and some genetic specialist believe that this possibility is about 1%. Cross pollination in soybean is a difficult and boring work because small flower. There are many varieties of soybean in the world.

Soybean varieties

After soybean planting was promoted around the world, great efforts done to develop plant varieties which are adaptable to location of planting. In the countries engage with soybean more there are almost 100 varieties. The varieties are cultivated in Afghanistan are:

- Stine 3300
- Stine 3870
- Stine 3387

The proper time to plant grow

The best time to plant soybean seed can be when the temperature is higher than 16 degrees Celsius. Usually the spring plant is done from the first to last of the May and the summer planting from the first to the last of the June

The Land Preparation

The land which prepare for soybean plant should be free of weeds and stones. Then the land should be irrigated and plowed in the depth of 15-20cm. To gain a better yield the land should be soft. In planting time the field should be flat and smooth. Irrigation water should be covered the plant cultivation area. Soybean cultivation not be ordered in the hills that soil quickly loses moisture.

Seed Rate

Before determining the amount of seed rate in per unit of land should be considered the percentage of plant growth. It should be prevented the planting of two years seeds, because loss of the viability of plant. The amount of seed rate according to plant distance and row distance is different. In this case, the percentage of germination and soil types should consider. Usually in 1 hectare of land about 50-60kg of soy seed is used (1jerb=10kg).

Soybean cultivation methods

To obtain more yield and better care of the plants is better to use row plantation method. In Afghanistan the optimum plant distance is 50cm and row distance 20cm. the seed is planted in the depth of 2-3cm which varies according to the soil properties.

Soybean Irrigation

Irrigation for soybean is a key factor that from the planting time up to harvesting 8-10 times is required which this factor varies according to soil type, location condition and some other factors. An important issue is irrigation interval which the plant has resistance to shortage of water from the first stage of growth up to flowering but from this stage up to seed forming the plant should not expose to the drought and lake of moisture. Humidity should be such that plant growth is not interrupted. Lack of attention to the amount of irrigation has a negative impact on the yield. Soybean farm should not be immersed in water otherwise it causes the weed growth and diseases.

The Uses of Fertilizers

Soybean belongs to legume family then it can fix nitrogen in the soil. Soybean can use the existing substances in the soil when pH of the soil is 5.5-6 and Rhizobium available in the root zone. To determine the amount of Potassium and Phosphorus it is need to analysis of soil and location condition. It should be tried that the seeds of this plant is not in direct contact with chemical fertilizers. For this purpose the fertilizers should mix with the soil. Magnesium deficiency in the soil can observe by discolored leaves. In some areas between the veins of leaves are pale green or white green. NEI distribute two types of fertilizers (DAP= 20kg/jerib and Urea= 10kg/jerib along with inoculant= 24gr/jerib). Urea uses in two stages. First stage is when plant height reaches to 20cm and the second stage in the flowering stage. DAP uses after plowing and weed controlling.

Weeds

A **plant** considered undesirable, unattractive, or troublesome, especially one growing where it is not wanted.

- Weeds are the main enemy of the plants
- Weeds use the nutrient elements of the soil
- Weeds compete with the main crop to catch the sun
- Weeds prevent the main crop growth
- Weeds causes diseases
- Weeds are good place for insects
- Weeds decline yield

Hence, we should be serious to control weeds to increase the yield. The best time to control the weeds is when the soil is chord. The best method to control weeds is the mechanical method because it is costly and prevents weed resistance against pesticides as well decline the negative impact of pesticide. The mechanical method causes softening of the soil, air movement in the soil and quick growth of the plant.

Harvesting

Soybean harvest may vary according to the cultivation target. If the purpose of cultivation is, seed production or extraction of oil, the best time to harvest is when most of the leaves become yellow and the lowest pods are yellowish-brown and green color changes. When you press the seed soybean with nails it is hard and does not sap. In some types of grains they may be hardened and the moisture is 14-15% but leaves are not shed. In some kinds delay in harvesting result in the pod opens and seeds

pour. When grain moisture is less than 12 percent, the grain break and harvest losses are high. When the matter is important that soybean cultivates for the seed. The broken grain will be reduced the quality of seeds and they won't green. In Afghanistan and some other areas where soybean cultivate in small size land, the harvest done by hand. If the purpose soybean cultivation is providing forage, the harvest occurs in the flowering stage. The much amounts of protein are obtained in the pod forming stage. The best time to harvest is when half of soybean seeds and pods are formed. The forage varieties have thinner stem in compare to seed varieties. The yield depends on seed variety, climate. Location and care is taken for that. The yield varies: In Iran 4000kg/hectare, United State 6700kg/hectare, In Afghanistan in different provinces 3650kg/hectare.

The points should be considered in soybean harvesting:

- When soybean close to maturity, leaves shedding start and pods remain.
- The time for harvesting is when 10-20% of pods take brown color and leaves are yellow.
- In Afghanistan the grow period for soybean is 100-120 days

Soybean ripening stages:

- The pod count has a large role in raising the production level. First, the pod color is green then after 5-10 days becomes dark green.
- At this stage the pod skin harden and the color changes to yellowish green. The soybean leaves become yellow and shed and this time soybean should harvest. The early harvesting causes grain shrink and low quality grain and loss the viability.
- Late harvesting grain shed from pod and declines the yield.

Soybean Collecting Stages

After soybean collecting, it is kept in a dry place for 2-3 days to decline the moisture. After 2-3 days the seed and pod are separated and keep them in dry place.

- Put soybean in the sack then transfer it to storage
- Clean the soybean and store amount for next year consumption

Soybean Storage

Where the plant is kept should be clean and the moisture content is controlled (13%-15%). Low moisture causes seed burst and broke. In addition, qualitative value dropped and the viability of the

seed decline. If soybean seeds are stored in the plastic bag, the moisture content must not exceed of 8 to 9 percent. Store seed in a plastic bag of soybean increases storage capability.

- Storage should be free of moisture
- Circulation of air should be available
- Free of brushwood and extra materials
- The interval cares
- The seed transfer to the storage should be free of excess moisture

Soybean pests and diseases

Due to the geographic location of each region plants shall be to have been exposed to attack by pests and diseases. That number of pests and diseases are more than 50. The methods of controlling and preventing of each disease needs more discussion. On the other hand, this plant is a new plant in our country and they have not done enough research on pests and diseases but the research and experiment is going on by Ministry of Agriculture.

1- Bacterial Blight

Bacterial blight (*Pseudomonas savastanoi*) of soybeans is typically an early season disease, which over winters in the field on plant residue. Initial infection of soybeans occurs when wind or splashing water droplets from plant residue on the soil surface to the leaves carry bacterial cells. The bacteria enter the plants through stomata and wounds on leaves. In order for infection to occur, the leaf surface must be wet. Seedlings may be infected through infected seed.

Bacteria that enter the host produce a toxin, which prevents chlorophyll production. Bacteria can also be spread to uninfected leaves when they rub against infected ones during cultivation, rain, and wind.

Symptoms

Brown spots on the margins of the cotyledons characterize plants infected early in the growing season. Young plants may be stunted and if the infection reaches the growing point, they may die. Symptoms in later growth stages include angular lesions, which begin as small yellow to brown spots on the leaves. The centers of the spots will turn a dark reddish-brown to black and dry out. A yellowish-green “halo” will appear around the edge of water soaked tissue that surrounds the lesions. Eventually the lesions will fall out of the leaf and the foliage will appear ragged. Generally young leaves are most susceptible to blight infection. Lesions can also occur on the pods causing the seeds to become shriveled and discolored. However, seeds usually do not show symptoms.

Controlling

- Crop rotation can be an effective method to avoid inoculum from a previously infected crop
- Use of resistant varieties
- Bury infected plant debris by deep plowing under the ground
- Use clean and disinfected seed
- Refrain from agricultural operations when the ground is wet

2- Soybean Rust

Soybean rust, also referred to as Asian soybean rust is caused by *Phakopsora pachyrhizi* and is an aggressive pathogen that, in the past ten years, has spread from Asia to Africa, South America, and now the U.S. Yield losses can be severe with this disease and losses of 10-80% have been reported. Soybean rust was first detected in the U.S. in the fall of 2004. Since this time the national sentinel plot network has been monitoring the spread and development of this disease.

Symptoms

Soybean rust symptoms are most commonly observed on the leaves and will start in the lower canopy. Lesions can also develop on petioles, pods and stems. Symptom development occurs rapidly once the plant starts flowering and can result in significant levels of defoliation under favorable environmental conditions. Lesions first appear as small yellow and irregularly shaped spots. As the disease progresses, lesions enlarge to 1/16th to 1/12th of an inch in diameter, and are tan to dark reddish brown in color. Within each lesion are a few to several volcano-shaped uredinia (spore producing structures). As rust severity increases, plants prematurely lose their leaves and commonly mature early. Lesions from soybean rust can appear similar to other foliar diseases of soybean and can be confused with brown spot and bacterial pustule.

Controlling

- Use of resistant varieties
- Crop rotation
- The use of fungicides
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 - II. Bayleton

3- Downy Mildew

Downy mildew is a common fungal leaf disease of soybean that occurs wherever soybean is grown, especially when weather conditions are rainy and humid. The downy mildew pathogen, *Peronospora manshurica*, survives in crop residue and on the surface of seed. Spores carried onto plants by wind and rain infects soybean leaves and can spread quickly through a field during periods of cool, wet or humid weather. The fungus can also infect seedlings systemically if mildew-infected seeds are planted.

Symptoms

Downy mildew is very weather-dependent and is most likely to occur during periods of cool, wet weather. Younger leaves are more susceptible to downy mildew than older leaves, so the disease will generally appear first on the upper surface of young leaves.

Look for pale green to light yellow spots which enlarge into pale to bright yellow spots. The center of the spots eventually turns brown, bordered by yellow margins. Check the leaves for signs of grayish to pale-purplish spores on the lower leaf surface during humid weather. The presence of this sporulation is diagnostic for downy mildew. Some soybean varieties express mild leaf distortion that may resemble symptoms caused by common soybean viruses.

Pods can also be infected without obvious external symptoms. Infected seed has a dull white appearance and is partially or completely covered with a pale coating of fungal spores which can be confused with white mildew.

Controlling

- Use of resistant varieties
- Bury infected plant debris by deep plowing under the ground
- Crop rotation
- The use of fungicides

4- Brown Spot

Brown spot is caused by the fungus *Septoria glycines* and may also be called Septoria leaf spot. It was first reported in the U.S. in 1923 infecting soybeans in North Carolina and is now widely distributed through the north central states, the Mid-Atlantic States, and the southeastern U.S. Brown spot rarely affects soybean yield in Nebraska. In some years it may hasten maturity by causing premature defoliation. Yield loss estimates due to brown spot range from 8 to 15% nationally and occur when 25-50% of the canopy prematurely defoliates. Severe brown spot infection usually results in smaller

seed size. The disease is most severe when soybean is grown continuously in the same field, particularly in fields where tillage is reduced, since this is a residue-borne disease.

Symptoms

Infection occurs as early as the V2 growth stage on lower leaves. Under favorable weather conditions (warm, wet weather), the disease may continue to spread to the upper canopy. Late in the growing season, infected leaves may turn rusty brown or yellow and drop prematurely.

Symptoms start as dark brown, irregular spots on both upper and lower leaf surfaces. Lesions typically will have a yellow or chlorotic halo when held up to a back light. Adjacent lesions frequently merge to form irregularly shaped blotches. Leaves become yellow to rusty brown. Symptoms of Brown Spot can also develop on stems and pods of plants approaching maturity. Stem and pod lesions have indefinite margins, are dark in appearance and range in size from flecks to larger areas.

Controlling

- Bury infected plant debris by deep plowing under the ground
- Use varieties with less sensitivity
- Use fungicides from flowering stage up to pod filling
- Crop rotation

Insect Diseases

1- *Agrotis segetum*

The larvae attack the field and cut the plant stem in the first stage of growth.

2- *Spodoptera exigua*

The larvae feed leaves and the butterflies lay eggs under the leaves.

3- *Thrips*

Small and yellow insect that sucks the sap of the plant.

4- *Prodenia litura*

An insect that eats everything and larvae feeding the leaves.

5- *Crihis unipuncta*

The larvae feed leaves parenchyma and after maturity attack to leaf, stem and pod.

6- *Heliothis dipsasea*

This insect has attacked to soybean farms in the stage of pod. The butterflies mostly has come from cotton farms and the larvae has attacked to the soybean pods and causes loss of soybean pods.

7- *Etiella Zinkenella*

The larvae feed soybean seeds and young larvae pierce the pods and eat the seeds.

8- *Nezaa viridula*

A green insect and usually comes from other farms to the soybean farm. Mostly they are attacked in pod forming stage and suck the sap.

There are some others pests which attack to soybean farms: Calliptamuus, ocoistorus, Locsuta migratoriz,...

Soybean forage

Soybean is a plant with much consumption. Soybean not only uses for its grain but also as forage uses for animals. It usually has grown together with sorghum. For this purpose soybean harvest when the grains are in milk stage and then grinding it for animal feed. It can be achieved about 4.5 tons of dry forage per hectare.