

Soybean *Glycine max*

Importance

- Owing the nutritional and health benefits of soybean, it is popular in the world as “WONDER CROP” of the 20th century.
- Soybean contains about 20% oil and 40% high quality protein.
- Soybean protein is rich in amino acid lysine (5%) in which most of the cereals are deficient.
- It is self pollinated crop.
- Soybeans are processed for their oil (see uses below) and meal (for the animal feed industry).
- A smaller percentage is processed for human consumption and made into products including soy milk, soy flour, soy protein, tofu and many retail food products.
- Soybeans are also used in many non-food (industrial) products.
- Soybean oil is used in cooking and frying foods. Margarine is a product made from soybean oil. Salad dressings and mayonnaises are made with soybean oil.
- Some foods are packed in soybean oil (tuna, sardines, etc.) Baked breads, crackers, cakes, cookies and pies usually have soybean oil in them.
- Biodiesel — biodiesel fuel for diesel engines can be produced from soybean oil by a simple process called transesterification. This process removes the glycerine from the oil, leaving soy biodiesel. Soy biodiesel is cleaner burning than petroleum-based diesel oil. Its use reduces particulate emissions, and it is non-toxic, renewable and environmentally friendly.
- Soy oil produces an environmentally friendly solvent that safely and rapidly removes oil from creeks, streams and shorelines without harming people, animals and the environment. Soy is an ingredient in many industrial lubricants, solvents, cleaners and paints.
- Candles made with soybean oil burn longer but with less smoke and soot.
- SoyInk is superior to petroleum-based inks because soy ink is not toxic, renewable and environmentally friendly, and it cleans up easily.
- Soy-based lubricants are as good as petroleum-based lubricants, but can withstand higher heat. More importantly, they are non-toxic, renewable and environmentally friendly.
- Capable of transforming nearly 60-100 kg atmospheric nitrogen into 30-40 kg nitrogen in the soil.

ORIGIN and DISTRIBUTION

- Soybeans are reported to have originated in eastern Asia or China.
- Domestication of soybean has been traced to the eastern half of North China in the eleventh century B.C. or perhaps a bit earlier soybean production was localized in China until after the Chinese-Japanese war of 1894-95.
- Brazil, USA, Argentina, China, India, Paraguay are the major soybean growing countries.
- The USA alone has about 50% of the world acreage and accounts for about 66% of the world production.
- In India, the major soybean growing states are Madhya Pradesh, Maharashtra, Rajasthan, Karnataka, and Telangana.
- India is having soybean production of 13.5 m t from 11.4 m ha area with a productivity of 1185 kg/ha (April 2019 Report of ICAR – Indian Institute of Soybean Research, Indore).

SOIL and CLIMATE

- Soybean has been adopted under wide range of climate and soil with better performance under Vertisols with good organic content. Well drained and fertile loam soils with a pH between 6.0 and 7.5 are most suitable for the cultivation of soybean.
- Sodic and saline soils inhibit germination of seeds.
- Soybean is a short-day plant and is highly sensitive to photoperiod.
- Soybean grows well in warm and moist climate.
- The optimum temperature for soybean is 20-30 °C, with temperatures of 35 °C and above considered inhibitory to production.
- Temperatures below 21°C and above 32°C can reduce flowering and pod set. Extreme temperatures above 40°C are harmful for seed production.
- Soybeans can be grown throughout the year in the tropics and subtropics, if water is available.
- Soybean requires 400 to 500 mm of water in a season for a good crop.
- High moisture requirement is critical at the time of germination, flowering and pod forming stage. However dry weather is necessary for ripening.
- Soybeans can tolerate brief water logging but weathering of seed is a serious problem in the rainy season.

LAND PREPARATION

- One deep summer ploughing is required.
- Farmers are advised to incorporate organic manure (well decomposed FYM @ 5-10 t/ha or Poultry Manure @ 2.5 t/ha) at the time of land preparation.
- Soon after arrival of monsoon, the land may be prepared by harrowing followed by planking to level the field.

VARIETIES

Zone	Recommended varieties
Northern hill zone (HP and Uttarakhand)	Bragg, Lee, Shilajeet, Soya-2, Pusa-16 & 20
Northern plain zone (Punjab, Haryana, UP, Delhi)	Bragg, Ankur
North-eastern zone (Assam, West Bengal, Bihar, Meghalaya)	Bragg, Birsa soy – 1, Pusa-16, Pusa-22 and Pusa-24
Central Zone (MP, Rajasthan, Gujarat, Odisha)	Bragg, Durga, Gaurav
Southern Zone (AP, Kerala and some parts of Maharashtra)	CO-1 & 2, Pooja, Monetta, improved Pelicon

SEED and SOWING

- Two cropping seasons of soybean *kharif* and spring.
- In case of *kharif* season most common time of sowing is onset of monsoon or last week of June to first week of July while **spring** sowing is done between 15th of February and 15th of March.
- To reduce the fungal attack the seed should be treated prior to sowing with fungicides like Thiram @ 4.5 gm per kg of seed.
- For efficient nitrogen fixation it is essential that soybean seeds should be inoculated with suitable strain with *Rhizobium japonicum*.
- 70-80 kg seed per hectare is required for soybean crop but for late planting the seed rate should be 100-120 kg per hectare.
- Sowing should be done in lines 45-60 cm apart with the help of seed drill or behind the plough. Broad Bed Furrow planting and Ridges & Furrows planting methods are best.
- Plant to plant distance should be 4-5 cm with sowing depth 3-4 cm.

Zone-wise optimum sowing time, seed rate and row spacing for soybean

Zone	Sowing Time	Seed rate (kg/ha)	Spacing (cm)
North Eastern Hill	15th June - 30th June	55	45
North Plain	20th June - 5th July	65	45
Eastern	15th June - 30th June	55	45
Central	20th June-5th July	65	45
Southern	15th June-30th June	65	30

Note: The fertilizer dose may be supplemented through addition of recommended quantity of organic manures.

Nutrient Management

- 14-20 tones of FYM or compost per hectare may be added 15-20 days before sowing.
- Application of 20-30 kg N per hectare as starter dose is given to meet the nitrogen requirement of the crop in the initial stage.
- Soybean requires relatively large amount of phosphorus than other crops.
- 70-80 kg P₂O₅ and 50-60 kg K₂O per hectare is given to meet the requirement of the crop

Zone	Recommended N:P ₂ O ₅ :K ₂ O:S (kg/ha)	Fertilizer Sources
North Eastern Hill	25:100:50:50	56 kg Urea+625 kg SSP+ 84 kg MoP
North Plain	25:75:25:37.5	56 kg Urea+470 kg SSP+ 42 kg MoP
Eastern	25:100:50:50	56 kg Urea+625 kg SSP+ 84 kg MoP
Central	25:60:40:20	56 kg Urea+375 kg SSP+ 67 kg MoP
Southern	25:80:20:30	56 kg Urea+500 kg SSP+ 34 kg MoP

Note: The fertilizer dose may be supplemented through addition of recommended quantity of organic manures.

WATER MANAGEMENT

- Soybean is not a regularly irrigated crop, as it can be successfully grown in rainfed condition.
- Water requirement is 35 to 40 cm.
- When irrigation is provided to soybean (in summer), it is necessary to irrigate the crop at IW/CPE ratio of 0.6 or at every 10-12 days duration during summer (in sandy loam soil).
- Critical stages are Flowering and pod filling.

WEED MANAGEMENT

- Weeds cause soybean yield losses of 25-85% if not controlled.
- It is a slow growing crop at initial stage, hence the critical period for weed control in

soybean is 45-60 days.

- Control of weeds by intercultivation @ 20 DAS and 40 DAS is more cost effective, provided the ideal soil moisture permits such operation.
- Herbicides like Alachlor (1-2 l/ha), Metribuzin (1-1.5 kg/ha) or Trifluralin (1.5-2 kg/ha) may be applied as pre-emergence herbicides.
- Post-emergence herbicides are Imazethapyr 70 WG+ Surfactant (100 g/ha), Propaquizafop 10 EC (0.5-0.75 l/ha) at 15-20 DAS.

HARVESTING and THRESHING

- Optimum time of harvesting is very important for soybean as it causes yield loss due to shattering and seed viability loss due to field weathering.
- The maturity period ranges from 90-140 days depending on the varieties.
- Initiation of change of pod color (physiological maturity) of soybean is the right indication to go for harvesting. At this time, the moisture percentage of soybean seed is around 14-16%. Hence, the farmers are advised not to wait till the foliage/plant turns yellow. Harvesting can be done when 95% pod changes color from green.
- The harvested soybean crop, after sun drying for 2-3 days is ready for threshing.
- The threshed soybean should again be allowed to sun drying for 3-4 days in order to bring down the moisture up to 10% which is essential to avoid fungal infection during storage.
- 30-35 quintals of grains per hectare of improved varieties of soybean can be obtained.

Constraints to Soybean Production

Despite having made rapid stride for both coverage and total production, soybean still suffers on productivity front. There are a number of constraints, pertaining to climate, edaphic, production, and technology aspects as mentioned below that hinder higher productivity.

- Most of the area under soybean cultivation is a rainfed.
- Erratic behavior of monsoon affecting planting.
- Large spatial and temporal variability in rainfall.
- Soil moisture stress at critical growth stages, especially Seed-filling stage.
- High-temperature stress at critical growth stages.
- Biotic interferences to crop growth.
- Limited mechanization.
- Poor adoption of improved production technology
- Low risk covering ability.
- Mono cropping and poor varietal diversification increasing risk chances.
- Timely availability of quality inputs.
- Poor/inadequate technological information.
- Poor utilization in food chain owing to characteristics beanie flavor of soybean.
- Road blocks in utilization as pulses because of hard-to cook characteristics of soybean.
- Psychological stigmas and conventional food habits.
- Lack of awareness about health/nutritional benefits.

- Presence of anti-nutritional factors in soybean.