CHAPTER – 3
PRODUCTION METHOD OF SOYBEAN

Soybean is popular in Japan, Korea, USA China, India and Taiwan and its consumption is increasing at a very rapid rate. Although we can say that the variety of soybean mostly preferred is the vegetable type stills the green shelled beans as well as whole tender green pods of grain soybean can also be used as vegetable. The grain soybean is already widely cultivated in many countries.

As it is well known that soybean is one of the important crops of the world but is grown only in the selected countries of the world namely USA, Brazil, China, Argentina, India and a few others countries. Production of soybean in India at the present time is restricted mainly to Madhya Pradesh, Uttar Pradesh, Maharashtra, Gujarat, Rajasthan and a very few other parts of India, like Himachal Pradesh, Punjab and Delhi.

This chapter mainly deals with the production method or the method that is followed for production of soybean. So an attempt has been made to cover those aspects which relates to the agricultural production of soybean.

3.1 SELECTION OF AGRICULTURAL LAND:

As it is understood that a particular type of climate and soil is required for the production of any agricultural product may it be wheat, rice, maize, sorghum, groundnut or any other and soybean is no exception. The cultivation of soybean requires a particular type of climate and soil hence the agricultural land is selected keeping in mind the soil and
climate requirement. It is due to this requirement that the cultivation of soybean is restricted to only few parts of the country.

Soybean is cultivated in warm and moist climate and grown in monsoon season from June to October. Temperature of 15 – 32°C is required for its germination. Optimum temperature required for its growth and yield is 30 – 33°C. If temperature is below 10°C, crop growth is retarded. Similarly if the temperatures are above 38°C, crop and growth is retarded. Day temperatures of 25°C are good for its flowering. Crop can be grown in areas receiving 600 – 650 mm rainfall. Rainfall during maturity deteriorates the grain quality. Cloudy weather prolongs the vegetative phase. The crop is generally cultivated at an attitude of 1200 – 2000 meter. Day length is the key factor in most of the soybean varieties as they are short day plant and are sensitive to photoperiods. Most of the varieties flower and mature quickly if grown under conditions where the day length is less than 14 hours provided that temperatures are also favourable. Soybean is grown on variety of soils ranging from light to black cotton soils in different parts of India. Well drained fertile loams soils are ideal for its cultivation. Soil should be loose and well aerated. Highly compacted soils are harmful for root nodule development. Crop is sensitive to both saline and acidic conditions and can be grown with in pH range of 6.0 – 7.5. Water logging is also harmful for the crop. Soil preparation for soybean consists of one deep ploughing with mould board plough followed by two harrowing and planking. To protect the crop from soil borne insects especially termites, 25 kg endosulfan dust 4% should be mixed into the soil just before last harrowing.
3.2 CULTIVATION AND IRRIGATION:

In general the preparation of the land for soybean is more or less same as it is for maize. It requires a good seed bed with a reasonable fine texture and not too many clods. Land should be well leveled and be free from crop stubble. One deep ploughing with mould board followed by two harrowing or two ploughing with local plough is sufficient. There should be optimum moisture in the field at the time of sowing.

The sowing should be done in lines 45 to 60 cm apart with the help of seed drill or behind the plough. Plant to plant distance should be 4 – 5 cm. The depth of sowing should not be more than 3 – 4 cm. under optimum moisture conditions. If seed is placed deeper or there is a crust formation just after sowing, the seed germination may be delayed and may result in a poor crop stand. Seed rate of soybean depends upon germination percentage, seed size and sowing time. If seed is of 80% germination, 70 – 80 kg seed per hectare is required.

Usually the crop is rainfed. However in situation of early withdrawal of monsoon rains irrigations are found beneficial. Flowering and pod filling stage are the most critical stages at which moisture stress severely damages crop yield. Moisture stress at flowering and pod formation result in flower and pod dropping. Thus in case of moisture stress 1 – 2 irrigation at flowering and pod filling stages is beneficial in realizing good yield. The last irrigation should be scheduled at least 30 days before harvest. The total water requirement of the crop is 450 mm. Check basin or border strip method is most popularly used for irrigating soybean.
3.3 HARVEST:

When soybean plants mature they start dropping their leaves. The maturity period ranges from 90 to 140 days depending on the varieties. When the plants reach maturity, the leaves turn yellow and drop and soybean pods dry out quickly. There is a rapid loss of moisture from the seed. At harvest the moisture content of the seed should be 15%. Harvesting can be done by hand, breaking the stalks on the ground level or with sickle. Threshing can be done either with the mechanical soybean thresher or some conventional method used in other legumes. Threshing should be done carefully and any kind of severe beating or trampling may damage the seed coat and thus reduce the seed quality and viability. Wheat thresher can also thresh soybean after a little modification. This would involve change of sieve, reduction of the cylinder speed and increase in fan speed. A moisture content of 13 to 14% is ideal for threshing with thresher.

3.4 SEED DESCRIPTION:

Soybean belongs to family leguminosae, sub family papilionceaceae belongs to genus Glycine. It has chromosome number $2n = 40$. Based on seed size, colour, shape of grain, soybean may be classified into following groups:

(I) Manchurian Classification:

This classification is based on colour of seed. Soybeans have been divided into three groups according to this classification:
(A) Yellow Group
   (i) Yellow seeds with light hilium.
   (ii) Yellow seeds with golden hilium.
   (iii) Yellow seeds with brown hilium.

(B) Black Group
   (i) Large black seed
   (ii) Flat black seed
   (iii) Small black seed

(C) Green Group
   (i) Epidermis of seed green but embryo yellow.
   (ii) Epidermis as well as embryo green.

(II) Martain Classification:

   The classification is based on shape and size of soybean seed.
   (A) Soja Elliptica
   (B) Soja Spherica
   (C) Soja Compressa

(III) Hertz Classification:

   It is based on shape of pods.
   (A) Soja Tumida with swollen pods
   (B) Soja Platycarpa with flattened pods.

(IV) American Classification:

   The classification is based on maturity period. Varieties available in
   USA have been divided into ten groups according to their maturity
   period as given below :-
Table No. 3.1

AMERICAN CLASSIFICATION OF SOYBEAN SEEDS

<table>
<thead>
<tr>
<th>Group</th>
<th>Maturity (days)</th>
<th>Varieties</th>
</tr>
</thead>
<tbody>
<tr>
<td>(00)</td>
<td>117</td>
<td>Flambeau, Portage, Acme</td>
</tr>
<tr>
<td>(0)</td>
<td>126</td>
<td>Traverse Merit, Grant</td>
</tr>
<tr>
<td>(i)</td>
<td>126</td>
<td>Black hark, Chippiwa, Hark</td>
</tr>
<tr>
<td>(ii)</td>
<td>130</td>
<td>Amsoy, Lindarin, Harosoy – 63</td>
</tr>
<tr>
<td>(iii)</td>
<td>131</td>
<td>Ford, Kim, Sheby, Adams</td>
</tr>
<tr>
<td>(iv)</td>
<td>136</td>
<td>Delmar, Scott, Kent, Clark – 63</td>
</tr>
<tr>
<td>(v)</td>
<td>139</td>
<td>Dare, Hills, Dorman</td>
</tr>
<tr>
<td>(vi)</td>
<td>148</td>
<td>Hood, Pickett, Lee, Davis</td>
</tr>
<tr>
<td>(vii)</td>
<td>156</td>
<td>Bragg, Jackson</td>
</tr>
<tr>
<td>(viii)</td>
<td>158</td>
<td>Hardee, Bienville, Improved Pelican</td>
</tr>
</tbody>
</table>

Source: Crop Management S.S. Singh

The maximum area under soybean cultivation in India is covered under only two major varieties JS – 335 and JS – 93 – 05.

Correspondingly, maximum breeder seed indent is being placed for these two varieties only, even though hundreds of varieties have been released for cultivation under different areas.
3.5 FERTILIZERS:

For obtaining good yields of soybean, 15 – 20 tonnes of farm yard manure or compost per hectare have to be applied. A good crop of soybean, yielding about 30 quintals per hectare removes about 300 kg nitrogen per hectare from the soil. But soybean being a legume has the ability to supply their own nitrogen needs provided they have been inoculated and there is efficient nodulation in the plant. An application of 20 – 30 kg. nitrogen per hectare as a starter dose will be sufficient to meet the nitrogen requirement of the crop in the initial stage in low fertility soils having poor organic matter. Soybean requires relatively large amounts of phosphorus than other crops. Phosphorus is taken up by soybean plant throughout the growing season. The period of great demand starts just before the pods begin to form and continues until about ten days before the seeds are fully developed. The soil has to be tested for the availability status of phosphorus to meet the requirement of the crop. With the application of phosphorus the number and density of nodules are stimulated and the bacteria become more mobile.

Soybean relatively requires a relatively large amount of potassium than other crops. A crop of soybean yielding 30 quintals per hectare removes about 100 kg potassium from the soil. The rate of potassium uptake climbs to a peak during the period of rapid vegetative growth then slows down about the time the bean begins to form. Soil test is the best guide for the application of potash in the soil. In the absence of soil test, 50 – 60 kg K₂O per hectare has to be applied. The fertilizers have to be placed preferably at sowing time, about 5 – 7 cm away from the seed at a depth of 5 – 7 cm from seed level.
The Nutrient management of soybean is done in the following manner:

**Basal Fertilizer Application**:

The soil samples have to be analyzed first. On the basis of this test the fertilizer requirements are determined. The higher the soil nutrient level, the lesser will be the quantity of fertilizer needed.

To get a good harvest that is 7 – 10 tons green pods per hectare and maintain soil nutrient status of consistent productivity a fertilizer mix containing N, P 205 and K₂O at the rate of 20 – 30, 60 and 80 kg/ha respectively, is applied by broadcast as a basal dose. The fertilizer is incorporated into the soil by harrowing.

**Use of Rhizobium Inoculation**:

Usually Rhizobium inoculation is not required in fields where legumes are cultivated. But newly opened lands need Rhizobium bacteria inoculations at 10 gram per kilogram of seed. The use of Rhizobium bacteria culture promotes nodule formulation and nitrogen fixation by the plants roots.

**Top Dressing of Fertilizer**:

The first top dressing is done at the rate of 20 kg N + 25 kg K₂O per hectare along plant rows at flowering for higher pod set. A second application of 20 kg N per hectare is done at the beginning of the pod filling stage to improve seed size.
3.6 INSECTICIDES AND PESTICIDES:

Soybean being an agricultural product is opened to damages that can be caused by insect, pest and other diseases. Hence the use of insecticides and pesticides becomes an obvious option. Few of the common insect pests are:

# Stem fly / bean fly, a serious pest of soybean. This larvae feed inside the plant stem and their damage cannot be recognized easily. To control this Phorate (Thimet) 10% granules at the rate of 10 kg per hectare or carbofuran 3% granules at the rate of 30 kg per hectare have to be mixed in the soil before sowing.

# Gridle Beetle which may cause 50 – 60% loss in crop yield is another kind of problem. This beetle makes tunnels in stem. These beetles can be controlled by spraying of Endosulfan 35 EC or Dimethoate (Rogor) 30 EC or Oxydemeton methyl at the rate of 1.0 litre in 1000 litre of water per hectare.

# Bihar Hairy Caterpillar is a serious pest of soybean. A single female may lay 1000 – 1500 eggs on the leaf surface. These pale greenish eggs hatch in three to seven days. Newly emerged caterpillars are gregarious feeders on the leaf epidermis, skeletonising entire leaf. Young caterpillars can be killed by dusting 2% Methyl parathion dust at the rate of 25 – 30 kg per hectare. For fully grown caterpillars 1.5 litres of Endosulfan 35 EC in 1000 litres of water can be sprayed on one hectare land. Alternatively, Ouinalphos (Ekalux) 25 EC at the rate of 1 litre in 1000 litre of water can be sprayed per hectare.

The other kinds of pests are Tobacco caterpillar, Leaf roller, Leaf minor, White fly etc. A few common diseases are seedling rot, pod blight and yellow mosaic.
3.7 PRODUCTION CYCLE:

The soybean crop cycle in India starts from June, the climax arrives in October in the form of Harvest; the other months are lean period for the crop of soybean.

Most of the varieties of soybean are sensitive to photoperiod and require short day conditions for flowering. Time of planting is very important consideration in soybean.

In northern India soybean can be planted from third week of June to first fortnight of July. But the first fortnight of July seems to be the best. June planting requires irrigations before sowing and also June planting takes longer period to mature and is very much susceptible to yellow mosaic virus.

So depending on the weather conditions and forecast the farmers sow the seed.

The production cycle of soybean lasts for about 5 to 6 months after which the process of harvesting and threshing starts.

3.8 SEED PRESERVATION:

Seed preservation is also one of the important aspects of soybean production because the seeds are further needed, so here comes the necessity of soybean drying and storage.

Soybean to be used for seed in next season has to be stored under low temperature and low humidity conditions. The grains have to be dried in sun or artificially before they are preserved and stored in the ventilated rooms.
When storage moisture is too high, the beans are likely to get spoiled. High oil contents makes soybean slightly more prone to spoilage as compared to corn, so soybeans need to be about two points more dry as compared to corn for the same storage period.

For winter storage the commercial beans have to be stored at 13% moisture or less, if they are to be preserved for up to one year then the moisture level has to be 12% or less. If the preservation or storage period is more than one year then the soybeans are stored at 11% moisture.

Soybeans with less than 15% moisture can generally be dried with fans sized for routine aeration.

Due care has to be taken when the beans are dried before they are stored. Soybeans can be dried in several types of high or low temperature dryers but very carefully because the beans are fragile and can be damaged by air that is too hot that is over 140°F. The beans can also get spoiled by rough handling.

High temperature drying ranges from 130° – 140°F for commercial beans and 100 – 110°F for seed beans. Retention time in the heat section of dryers has to be less than 30 minutes.

Low temperature drying has a full perforated floor and a fan pushes airflow through the grain. A drying front develops near the floor and moves slowly upward. Drying time depends on air flow, weather and initial moisture content but low temperature dryings normally takes three to six weeks for the beans to get dried and ready for preservation.
The temperature of preserved seeds have to be maintained at 35° – 40° F during winter and at 40° – 60°F in summer. This temperature reduces mold and insect activity as well as moisture movement within the bin.

The stored soybeans have to be checked for heating or spoilage once a week in warm weather and every two weeks in cold weather.

In addition to this, periodic germinations tests have to be conducted to monitor viability of seed beans.

It is known that soybean is an agricultural product. Thus, although the topic of research is commerce oriented still an attempt has been made through this chapter to cover and explain the agricultural aspects of soybean.

Financial analysis of Soya processing industries relates to the industrial sector which is a secondary sector of the economy but the agricultural part is also important because agriculture is the primary sector on which the secondary sectors depend.

Thus the working of Soya processing industry is directly dependent basically on production of soybean. Although imports can be done but this industry is largely dependent on indigenous agricultural production of soybean.

This is the basic reason behind incorporating this chapter in the thesis.

* * * * *

– 72 –