**POPULAR ARTICLE**

# Problems in quality seed production of Soybean

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Manuscript received: November 12, 2017; Decision on manuscript: November,28, 2017; Manuscript accepted: December 2, 2017

Soybean is the most important oil seed crop in India as well as the world. The soybean has gained a significant position within a very short time of its introduction and commercial cultivation. Soybean has changed the economic status of the farmers who are growing soybean; still farmers are struggling with the problem of loss of seed quality of soybean. Good field emergence is being a problem due to one or other reasons. Soybean seed is very delicate in nature due to its structural limitations. Chemical composition – high protein and high oil content also makes it vulnerable to biochemical degradation during maturity and storage. Maintaining the quality of seed produced during month of Oct-Nov up to the next sowing time in the month of June-July is a difficult task in tropical and subtropical countries like India. Proper care is recommended for soybean seed production programme otherwise there is always some risks of loss of seed quality.

## A. Quality Seed Production

### 1. Water and Nutrient management

Soybean is mostly grown as rain fed crop. Due to detrimental effect of climate change, there are long spell of rainless days during crop growth. Soybean is highly photo and thermo sensitive crop and delay in sowing cause adversely on seed quality. If initiation of rain delays the sowing is also delayed accordingly. But for seed production programme irrigation should be followed for proper time of sowing and protecting the seed crop from long spell of water scarcity due to lack of rain. The drought may hampers quantity of produce but the loss of quality is in much more higher magnitude than loss of quantity. Similarly, the recommended nutrient doses should be followed for good quality seed production. Among all other mineral nutrients, sulphur and phosphorus are very essential for high protein containing soybean crop. Seed yield was very sensitive to S deficiency occurring during vegetative growth, but not to S deficiency occurring during reproductive growth. The 11S/7S ratio was strongly influenced by S deficiency occurring during reproductive growth, but was relatively insensitive to S availability during vegetative growth (Sexton *et al*., 1998). Phosphorus is specifically important for improving storability of soybean seeds.

### 2. Optimum plant population for proper seed growth as well as disease/pest management

The recommended ‘row to row’ and ‘plant to plant’ spacing should be followed. The seed is a living entity and should be properly grown to be able to develop a new healthy plant in the next generation. If the plant population is not maintained or uniform plant spacing is not

followed there will be competition for nutrient for growth and seed development. Scarcity of nutrient may cause deficiencies of important and critical biological units e.g. enzymes and mineral co-factors of enzymes with cause failure of germinability of seed produced or abnormal growth of seedling and plant from such low quality seed.

**3. Photoperiod and growing temperature**

Soybean is highly sensitive to the growing condition – the photoperiod and temperature. Shorter photoperiods result in stunted growth and reduced flower production. Late maturing cultivars are more sensitive to changes in photoperiod. The temperature specifically during crop maturity plays an important role to determine the seed quality. High temperature accompanied by water stress cause forced maturity of the plant. The seed size is highly affected due to this condition. Occurrence of shrunken or shriveled seeds is increased as the degree of forced maturity is increased. The occurrence of green seed also increases due to forced maturity. The germination of seed lot is more affected by the green seeds than shriveled seeds. But the vigour of shriveled seeds is significantly lower.

**4. Crop protection measures**

Seed health is an important parameter for determining seed quality. There are reports of as high as 30 seed borne fungi which infect soybean seed (Sinclair, 1982). Most prevalent field fungi associated with soybean seed as seed borne was found to be *Phomopsis sps.* Followed by *Cercospora* and *Colletotrichum sps.* Under Indian condition infection by *Cercospora kikuchii* (Purple stain of seed), *Diaporthe phaseolorum* var. *sojae*, *Myrothecium roridum, Macrophomina phaseolina, colletotrichum truncatum* are major cause of low seed quality. The incidence of seed borne diseases not only affects the seed crop; it is transmitted through the infected seed to the next crop. Diseases thus disseminated hamper the soybean production. Seed crop should be free from viral diseases like Soybean mosaic viruses. If any virus infected plant is found in the seed production plot, it should be rouged out so that virus can not spread to other plants.

**5. Seed treatment**

Seed treatment with recommended dose should be followed to improve seed germination and field emergence by protecting the seed from internal as well as external fungal infections. The texture of soybean seed coat is very smooth. Therefore, loss of chemical applied to seed through powder formulations is very high. Seed treatment becomes non-effective if the chemical is not fixed to seeds and it does not enter into the seed to give systemic effect. Soybean seed germination is epigeal type i.e. the seed comes out of the soil due to higher elongation of the seedling hypocotyl. Therefore, most of the powders applied to seed get shed out from seed surface during seedling emergence. Seed polymer coating is most advanced technique to make seed treatment most effective and economical. This polymer coating technique binds the beneficial chemicals on the surface of the seed and does not allow the chemical to get shed out of the seed neither during seed handling, sowing nor during seedling emergence. The chemical gets sufficient time to enter into the seed with the intake of moisture from soil and act systemically and check the growth of internal as well as external fungal infection.. The polymer coating technique can be used for all purposes like seed treatment with fungicide and insecticide, application of seed invigorating chemicals, micronutrients (Boron, Molebdenum, zinc, iron etc) and bicontrol agents like Trichoderma, etc.

**6. Time of harvesting**

The seed attains maximum vigour at the physiological maturity of the plant. The vigour

of seed is reduced as the seed crop approaches harvest maturity. The time of harvesting of seed is a significant determinant of seed quality. The seed moisture remains high at physiological maturity. The seed crops are to be dried naturally or artificially to reduce the seed moisture to a safe level before threshing. Drying of seed crop after harvesting at physiological maturity is a practical problem for large scale seed production. If the seed crop is not managed properly or dried in time, there is risk of growth of saprophytic fungi like *Aspergillus, Penicillium* or *Rhizopus* and the seed quality is rapidly reduced. The seeds are hygroscopic in nature. Beyond physiological maturity seed loose moisture and get dried. The seed loose moisture at faster rate during day time and absorb moisture during night time. The absorption and desorption process is detrimental to seed vigour. This process of seed quality loss in the mother plant has been described as 'field weathering'. Delay in harvesting causes more field weathering. The hour glass cells are absent in the surface opposite to the hilum. Successive rehydration and dehydration thus cause damage to the most important part of seed, the embryonic axis. Seed with moisture content less than 18% are most susceptible to rapid rehydration and dehydration cycles which promote seed coat wrinkling (Pereira and Andrew, 1985). The cotyledonary cells underlying these wrinkles are subjected to unequal pressure which causes them to bruise or even die. Thus, deterioration process gets initiated which eventually spreads throughout the entire seed.Delay in harvest may also cause shattering of pods in some varieties, thereby reducing seed yield. Shattering of pods is very severe when there is a splashes of rain followed by drying at seed crop maturity.

**B. Harvesting and threshing of seed crop**

Soybean has structural limitation towards mechanization and large scale handling. The seed coat of soybean is very thin as compared to other leguminous crops. The position of radical axis is also quite raised on the cotyledons. Mechanical damage to an individual seed can include formation of cracks or breaks in the seed coat, cracks in cotyledon, injury or breakage of hypocotyls-radicle axis and complete breakage of seed to the point where it would no longer be classified as part of pure seed fraction. The extreme of mechanical harvesting and threshing is splitting of seed thus producing "Dal' (single cotyledons). The amount of mechanical damage to the seed is inversely related to the seed moisture level. Physical damage increases as the seed moisture decreases below 12%. At higher moisture level (≥ 14%), seeds may be damaged internally and the germination be reduced Singh and Singh, 1981, Prakoboon, 1982). Large seeds tend to be more susceptible to mechanical damage than small seeds. Seeds that have been exposed to field weathering or that have been dried at high temperatures are more susceptible to mechanical damage. The resistance to mechanical damage has been reported to be a genetically governed by mostly seed coat lignin content, seed coat thickness and structure and distribution of 'Hourglass cells' in seed coat. Seed moisture content is greatly correlated to the seed damage during mechanical harvesting and threshing. The safe moisture for mechanical harvesting and threshing of seed had been recommended to be 13-14%. After threshing the seed should be finally dried in thin layer on cemented floor or tarpaulin. The moisture should be reduced to 10% or below. In processing plants the seed can be dried either by natural air or hot air of below 30$^{o}$C if the moisture content is high.

**C. Seed quality loss during storage**

The storability of seeds is highly influenced by the storage condition- the relative humidity (RH) and temperature of storage (Justice and Bass, 1978). The tendency of seed to maintain

equilibrium moisture in relation to RH of storage is an unavoidable physiological phenomenon. Therefore, high RH of store increases the seed moisture and cause rapid loss of seed quality. In tropical and subtropical regions like India, the development of 'state of the art' facility where storage temperature and RH can be regulated is quite expensive. Lack of such infrastructures forces to store seeds under ambient condition. Soybean seed is being harvested in the month of Oct-Nov and stored for 8 months for next sowing in June-July. The performance of seed in storage varies with areas of storage. The seeds stored in the condition above the safe level of RH (approximately 50-60%) are deteriorated rapidly. Occurrence of mycoflora on and in seed has detrimental effect on seed quality at storage. The seed deterioration is accelerated by the infection of storage fungi – namely *Aspergillus sp, Penicillium sps. and Rhizopus sps*. In the tropical and sub-tropical regions where relative humidity is higher during seed crop maturity, the risk of attack of saprophytic fungi is more. Rains during seed crop maturity may cause devastating loss of seed quality. The infection of storage fungi has cumulative effect on biochemical degradation of seed. Prophylactic spray of fungicide (e.g Carbendazime) during crop maturity has a positive effect to control seed deterioration. The initial seed quality also determines the performance of seed in storage. If initial seed moisture is high then maintenance of seed germination for the next sowing season is at risk. The seeds which have suffered from field weathering or damaged during mechanical harvesting and threshing lost their seed quality at storage very rapidly (McGee, 1986).

**D. Chemistry of seed deterioration**

The biochemistry of seed deterioration has been documented as lipid peroxidation of the phospholipid fraction of cell membrane, disruption of cell membrane, damage to electron transport system in the mitochondrion membrane, inactivation or damage to enzyme system, damage to genetic materials of cell-DNA, mRNA. The production of highly reactive free radicals (superoxide or hydroxyl radicals) during different metabolic pathways triggers the biochemical deterioration of seeds. First and primary site of attack of free radicals are the phospholipids of cell membrane of mitochondria. The lipid peroxidation of phospholipids produces different small chain aldehydes and ketones which attack the genetic material of cell and cause damage to DNA. Damge to the cell membrane cause leaching loss of intra-cellular substances. The antioxidant enzyme system scavenges the free radicals produced in seeds. The expression and activity determine the degree of free radical scavenging. Anti oxidant chemicals like α-tocopherol and ascorbic acids content of seed also determine the level of protection of seeds to scavenge free radicals.

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