INTRODUCTION

Sesamum (*Sesamum indicum* L.), commonly known as til. It is also known as sim sim, beniseed, gingeli, it is called safed til, kala til or Tillie in hindi. It is one of the important edible oil-seeds cultivated in India. It is grown in the country since antiquity. Sesamum belongs to the order Tubiflorae, family pedaliaceae, which comprises 16 genera and 60 species widely distributed over tropical and Southern Africa. According to De Candolle (1886) and several other investigators were of the view that sesamum originated in South-Western Africa, where all the wild and cultivated species of the genus sesamum are found to occur.

The plant is usually 60 to 120 cm tall and the fruit is a dehiscent capsule held close to the stem. When ripe, the capsule shatters to release a number of small seeds. The seeds are protected by a fibrous ‘hull’ or skin, which may be whitish to brown or black depending on the variety. The seeds have a high oil content of 44-60%.

The plant is deep rooting and well adapted to withstand dry conditions. It will grow on relatively poor soils in climates generally unsuitable for other crops, and so it is widely valued for its nutritional and financial yield from otherwise inclement areas. It is well suited to smallholder farming with a relatively short harvest cycle of 90-140 days allowing other crops to be grown in the field. It is often intercropped with other grains.

It is one of the earliest domesticated plants. It is a short duration crop grown throughout the year. The seeds of the plant yield edible oil. Due to the presence of potent antioxidant, sesame seeds are known as “the seed of immortality”. Two distinct types of seed are recognized, the white and the black. There are also intermediate coloured varieties varying from red to rose or from brown to grey.

Sesame is now cultivated around the dry tropics between the latitudes of 40° N and S. It is scarcely cultivated in the USA or Europe, not only because of climate but also because of the low returns per unit area. Non-shattering varieties have been breed in order to mechanize the crop, but the great majority of the world’s output is still harvested by hand.
Seed is the most vital and basic input in agriculture on which the efficacy of other agricultural inputs depend. Modern concept of genetic engineering has made a significant impact on the evolution of varieties in quick succession. Use of good quality seed when combined with complimentary inputs like fertilizer, irrigation, pesticides and herbicide etc. has the potential for rapid and substantial increase in crop production. Seed quality refers to its genetic-purity, physical-purity, seed health and physiological quality. The former three can be maintained by adopting scientific agricultural practices while the latter one which refers to the maintenance of vigour and viability. Thus, it is very vital to maintain the physiological status of seed so that every seed sown should readily germinate and produce a vigorous seedling. Thus, proper storage of seed is a vital attribute to increase productivity of crop.

Good quality seed should possess at least the following four major characteristics:

- Seed must have the high yielding potentiality,
- Seed must be viable,
- Seed must be pure *i.e.*, free from varietal mixture and
- Seed must be healthy *i.e.*, free from seed-borne pathogens or the seed must have the maximum acceptable tolerance limit of infection by a given pathogen in a given seed lot.

Seed vigour and viability are two important aspects of seed quality which considerably influence crop productivity. The vigour definition, as accepted by ISTA, “Seed vigour is the sum of those properties which determine the potential level of activity and performance of the seed or seed lot during germination and seedling emergence.”

Modern agriculture demands that every seed sown should readily germinate and produce a vigorous seedling ensuring high yield. Use of poor quality seeds in the third world countries like India is one of the reasons for declining agricultural productivity. High quality seed is the key to successful agriculture.

India ranks first in the area, however, as per 2006 data it comes after China in production of sesame seeds in the world. During the year 2007 however, India leads world in sesame production. India's contribution to the production of sesame seeds in the world is 18.8% in 2006-07. Other major sesame producing countries are China...
World scenario

Major producing states

Importance of sesamum

(19.9%), Myanmar (17.3%), Sudan (5.9%), Uganda (4.9%), Nigeria (2.9%), Pakistan (0.8%), Ethiopia (4.7%) and Bangladesh (1.4%). The productivity of sesame in India is 0.33 tons/ha compared to world average of 0.44 tons/ha in the year 2006-07.

Gujarat is the leading sesame producing state contributing 22.3% of total production, followed by West Bengal (19.2%), Karnataka (13.5%), Rajasthan (9.8%), Madhya Pradesh (9.06%), Tamil Nadu (4.7%), Andhra Pradesh (4.52%) and Maharashtra (4.52%). In India its cultivation is mostly confined to Uttarpradesh, Rajasthan, Madya pradesh, Andhra pradesh, Orissa, Gujarat, Tamil Nadu, Karnataka and West Bengal.

Sesame seeds (or sesameum or benniseed) are the seeds of the tropical annual Sesamum indicum. The species has a long history of cultivation, mostly for its yield of oil. The original area of domestication of sesame is obscure but it seems likely to have first been brought into cultivation in Asia or India. Oilseeds, the raw material for vegetable oil, occupy a significant place in India’s economy. Next to food grains, oilseeds account for 10 per cent of the cultivated area and value of all agricultural produce. Nearly 85 per cent of the oil and fat needs of the country is primarily met by vegetable oils. India is the third largest producer of oilseeds in the world. No other country has its range of perennial and annual oilseeds. In terms of area, India ranks first in groundnut, sesame, linseed, safflower, niger and castor. Although India has 20.8 per cent of the world’s area under oilseeds, it accounts for less than 10 per cent of world’s production. In terms of vegetable oils, India is the fourth largest oil economy in the world after the U.S., China and Brazil. Favourable agro-ecological conditions in the country have supported commercial cultivation of seven annual edible and two non edible oilseed crops, besides a number of minor oilseeds of horticultural and forest origin, including in particular coconut and oil palm. With the growing population along with raising per capita income, the demand for vegetable oil is likely to grow unabated in the coming years. The impact of green revolution has made our country self sufficient in the production of cereals. The situation so far as oilseeds are concerned is not very right. Although India is one of the world’s largest producer of oil seeds, the quantity of edible fat available falls far short of the country’s requirement.
Sesamum (Sesamum indicum L.) is one of the important oilseed crops in Indian agriculture. Sesame seeds are rich source of food, nutrition, edible oil and biomedicine. Sesame oil has excellent nutritional, medicinal, cosmetic and cooking qualities for which it is known as ‘the queen of oils’. Due to the presence of potent antioxidants, sesame seeds are called as ‘the seeds of immortality’. Sesame cake or meal obtained as a by-product of the oil milling industry is rich in protein, vitamin (Niacine) and minerals (Ca and P). India ranks first in area (29%), production (26%) and export (40%) of sesame in the world. In India, sesame is grown on an area of 13.85 lakh hectares with an annual production of 4.34 lakh tonnes. The average yield of sesame in India is very low that is 311 kg per ha. It is cultivated on a large area in the states of Maharashtra, Uttar Pradesh, Rajasthan, Orissa, Andhra Pradesh, Madhya Pradesh, Tamil Nadu, West Bengal, Gujarat and Karnataka. In Karnataka, it is grown on an area of 0.73 lakh hectares with an annual production of 0.29 lakh tonnes with a productivity of 397 kg per ha.

In world, area under cultivation of sesamum was 6566 hectare with a production of 2942 million tonnes and productivity of 448 kg/ha in 2003. In India, area under cultivation of sesamum was 1.79 million hectare with a production of 0.59 million tones and a productivity of 313 kg/ha in 2004. In the state West Bengal, the area under cultivation of sesame was 142 hectare and production was 66 tones with a productivity of 465 kg/ha in 2006-2007.

Sesame (Sesamum indicum L.) is one of the world’s oldest spice and oilseed crop grown mainly for its seeds that contain approximately 50% oil and 25% protein (Burden, 2005). The presence of some antioxidants (sesamum, sesamolin and sesamol) makes the oil to be one of the most stable vegetable oils in the world. The world production is estimated at 3.66 million tones with Asia and Africa producing 2.55 and 0.95 million tons, respectively. The continent of Africa is naturally endowed with favourable weather conditions that can support sesame production. The crop requires only 500-650 mm of rainfall per annum. Unfortunately, average world yield of sesame is still low at 0.46 ton ha-1 (FAO, 2005). Low yield had been attributed to cultivation of low yielding dehiscent varieties with low harvest index values, significant yield loss during threshing and lack of agricultural inputs such as improved...
varieties, fertilizers and other agro-chemicals (Ashri, 1994, 1998; Weiss 2000; Uzun and Cagirgan, 2006). However, non-dehiscent sesame varieties with yield potential of over 1 ton ha\(^{-1}\) and suitable for mechanical combine harvest have been developed by Sesame Coordinators (SESACO) in USA (SESACO, 2007).

The production of oilseed crops in our country including sesame is not enough to meet the domestic demand of the large population. Low production of sesame is attributed to the fact that the crop is usually grown during rainy season on marginal and less fertile soils. Further, lack of proper nutrient management is one of the major causes for low yields.

Low productivity is attributed to many factors, including high dependence on rains, delayed sowing, transplanting inadequate, high plant population, low seed replacement rate, frequent floods and droughts, low sunshine hours with a cloudy weather, deficiency of micro nutrients and impaired soil health. The technological and nutrient-related constrains together have affected the total factor productivity, which has declined sharply over the years. This signifies reduced rate of response in terms of unit gain in productivity with application of similar inputs over time.

Seed is the most vital input in agriculture on which the efficacies of other agricultural inputs depend. Seed acts as a catalyst in agricultural production. Modern concept of genetic engineering has made a significant impact on the evolution of varieties in quick succession. Use of good quality seed when combined with complimentary inputs like fertilizer, irrigation, pesticides etc has the potential for rapid and substantial increase in crop production. Seed quality refers to its genetic-purity, physical purity, seed health status and physiological quality. The former three can be maintained by adopting scientific agricultural practices, while the latter one, which refers to the maintenance of vigour and viability. Thus, it is very vital to maintain the physiological status of seed so that every seed should readily germinate and produce a vigorous seedling. Thus, proper storage of seed is a vital attribute to increase productivity of a crop.
Agricultural crop seeds are classified under two broad categories, the orthodox dry stored seeds in which viability of seed is extended by drying, within a range of seed moisture content, storability is inversely related to seed moisture and recalcitrant seeds of fleshy fruits and plantation crops in which seed longevity drastically falls when the seed moisture content falls below a certain critical moisture level for that particular kind of seed. Most of our annual crops commonly used agricultural and horticultural seeds belong to the orthodox group. This would imply that if the seed is thoroughly dried and stored in moisture impervious containers, it can be maintained at a high level of germinability for a prolonged period. In India, seed used for planting of majority of our field and horticultural crops are medium to low vigour in quality. According to Banerjee (1984), less than 15% of our fields are shown by quality seeds and the remaining areas are covered by seeds produced by farmers, bulk of which is without any form of quality control. He also reported that merely by using quality seeds, yield could be increased substantially (Banerjee, 1984). There are several key factors regarding our poor seed quality. Although scientific seed production has made a good beginning, it falls far short of the target. Seed processing and quality control are just taking shape. Seed protection in storage, although a serious problem, has not yet received due attention of the farmers. But, for a seed of the ideal planting value, all these are of great importance.

Storage of sesamum seed is a major problem in eastern India and coastal belts of our country due to high relative humidity and high temperature during the storage period, storage of orthodox agricultural and horticultural crop seeds are great problem. Harrington and Douglas (1970) and subsequently Agrawal (1976) have identified specific locations in the country which are better for seed storage than other areas and have suggested safe moisture levels for storage of seeds of various crops. In India, especially eastern parts of our country, the average relative humidity is about 80% and temperature 30˚C and as a result storage of seed in moisture pervasive containers such as gunny bag or cloth bag under ambient conditions is a really problematic. The facilities of humidity and temperature controlled storage are not available to the average seed producers. Even sealed storage
Importance of seed may not be feasible; firstly, metal containers or other moisture barrier containers are not readily available and secondly, the seed very often cannot be dried to the safe limits of moisture permissible for sealed storage. Unless the seed is properly dried, storage in sealed containers may do more harm than good.

To maintain vigour and viability of stored paddy seeds under ambient conditions is really difficult. Very often, the locally stored seed becomes unsuitable for sowing and the cultivators have to depend on seed supplied by various agencies from sources outside this state and most of our farmers stored their seeds in cloth bag or gunny bag under ambient conditions is a really problematic.

Seed is a means of dispersal for plant populations in space (spatial) and time (temporal), representing continuity and change, and thus adaptation to the local environment. Seed has played a pivotal role in India’s green revolution and will continue to be a vital component for the decades to came. In fact, the importance of quality seed in agriculture has been recognized as primary wealth in agriculture since Vedic period (Yajur Veda). In one of the oldest books on Indian Agriculture, Parashara (400BC) states ‘Origin of plentiful yield is seed’. Further he recommends that seed should be produced in specified season and dried well under sun without putting them directly on ground. Although the importance of seed was recognized in ancient agriculture, the need for organized seed production was identified only at the beginning of twentieth century when the Royal Commission on Agriculture recommended, among other things, the introduction and spread of improved varieties and seed distribution. Since then, the seed quality has been perceived as an essential ingredient in agriculture. It is recognized that improved seed quality alone can contribute about 20 per cent for yield. In modern agriculture, the role of seed is well recognized in crop improvement as seed is a carrier of new technology, principal component to secured food supply. Thus, the quality of seed becomes an important aspect and should be considered for obtaining assured yields, particularly for resource-poor farmers.

Improved or quality seed is the cheapest input in crop production than other inputs like fertilizer, irrigation and plant protection. One of a farmer’s most critical management decisions is the selection of seed source and variety. The cost of seed stocks usually is less than 5 to 10 per cent of total production costs. Yet seed stocks
can affect the yield potential of a crop more than any other input factor. Besides, the secondary inputs (fertilizer, irrigation and plant protection) in crop production are expensive and require repeated application. Therefore, a farmer always looks upon seed as the answer to the problem for making other agro-inputs productive and cost-effective. In a country like India, where more than two-third of the population is actively engaged in agriculture and the majority of them are marginal farmers, an input like quality seed holds the key to enhanced crop production. Thus, seed is the single well recognized carrier of production technology facilitating our quest for higher and better crop yields.

In eastern India, sesamum seeds are generally harvested in the month of May and June respectively and then stored in moisture pervasive containers under ambient conditions would show a rapid fall in vigour and viability and by sowing time, the viability may go down below 20 per cent. Sesamum is an herbaceous annual plant basically grown in the warm regions of the tropics and subtropics. In eastern parts of India, maintenance of seed vigour and viability, especially in high-medium vigour and medium-vigour seed stock is a difficult problem. During monsoon months (June-August) the ambient relative humidity increase substantially and as a result, the seeds stored in gunny bag or cloth bag absorb a lot of moisture from humid atmosphere. This, coupled with prevailing high temperature, greatly hasten the ageing process of the seed with a consequent loss of germinability and productivity of the crop (Heydecker, 1972 and Teckrony and Egli, 1991).

During monsoon months (June-August) the ambient relative humidity and temperature increases substantially and would show a rapid decline in vigour and viability and by sowing time viability may go down to zero. In fact, high humidity and high temperature not only accelerates the seed ageing but also increase susceptibility of seed borne fungi and influence to grow other stored grain pests.

In West Bengal, sesamum seed is harvested in the month of May and then stored in moisture pervasive containers under ambient conditions. In the monsoon season (June-August), the relative humidity of the atmosphere and temperature is very high and the seed stored in cloth bags or gunny bag absorb a lot of moisture from the
atmosphere. The high seed moisture coupled with high temperature accelerates the ageing processes. As a result, rapid deterioration in vigour and viability of stored seeds with a consequent reduction in the yield potential of the crop takes place (Heydecker, 1972).

Occasional rains during harvesting and threshing would cause significant deterioration of the seeds. The maintenance of vigour and viability of rain-soaked seeds becomes serious especially, in case where the germination process is too advanced; even sprouting taking place, in large number of instances. Further, an increase in seed moisture content either in the standing ready-to-harvest crop or in the threshing floor would advance the physiological and pathological deterioration of the seed. Drying to a safe moisture content would reduce such deterioration. It, however, needs to be mentioned here that under ordinary conditions, the ageing process of the partially deteriorated rain-soaked seed cannot be completely halted. More specific alternative methods should be standardized for controlling further deterioration in storage.

In West Bengal, storage fungi, insect and pests cause considerable damage to stored seeds. Activity of storage micro flora increase with the increase of relative humidity rather than moisture content of seeds because different seeds have different relationship between these two factors. Pest such as weevils, fungi that attack seeds during storage and reduce vigour and viability of seed (Christensen, 1972). Insects can completely destroy the seeds by eating the seeds and they are often responsible for the conditions that facilitate fungi infestation. Since, farmers store seeds in plastic sacks, seeds are prone to pest infestation. However, farmers do not control these pests with chemicals. The chemicals are expensive and impractical since seeds are stored for a short time only. Moreover, chemicals can have adverse effects on seed viability and vigour and some of them dangerous to handle (Roberts, 1972b). Instead, farmers ensure that seeds are properly dried prior to storage. Weevils, fungi do not like low seed moisture (Christensen, 1972 and Agrawal, 1988).

Orthodox seeds will retain viability longer, when dried to a low moisture content (4-8%) and then stored in a sealed container or in a room in which humidity
and temperature is controlled. But, in general, seed growers and seed merchants store seeds mostly in gunny bags or cloth bags which do not prevent entry of moisture from the humid atmosphere resulting in significant loss of vigour and viability. In West Bengal, after harvest of sesamum, proper drying of the seed followed by sealed storage in moisture proof containers under controlled conditions (at low temperature and low humidity) would minimize the loss of vigour and viability of seeds. However, majority of farmers are unable to afford the expensive method of storing seeds at low humidity and low temperature conditions and they have practiced to store their own produce seeds in moisture-pervasive containers. Occasionally, sun drying to remove moisture is practiced to maintain better germinability, but the same does not solve the problem due to lack of artificial drying facilities. Therefore, an easily practicable storage technology would be welcome in such a situation.

For at least the past fifty years, there has been an interest in the possibilities of enhancing seed performance, particularly with respect to improved germination and seedling establishment. Seed treatments that initiate or complete the germination process under controlled conditions prior to sowing would possess a number of practical advantages, particularly if germination could be both synchronized and accelerated. Rapid establishment of a uniform population of seedlings improves the ability of the crop to compete with weeds, and further economics result from the management of a uniform population of plants, including enhanced uniformity of the yield at harvest. Rapid germination can reduce the exposure of the planted seed to infection, thus reducing the need for extensive chemical control of conditions such as damping off. An attempts have been made in the present laboratory to develop an easy and inexpensive method of seed invigoration treatments for the maintenance of germinability. Seed invigoration implies an improvement in seed performance by only post-harvest treatment resulting in improved germinability, greater storability and better field performance than the corresponding untreated control seed (Basu, 1990). Basically, an invigoration treatment is physiological in nature and should bring about an improvement in seed performance which should persist for a long period after treatment.
Factors affecting seed ageing

Seed ageing both pre- and post-harvest, is the major factor, which decides the germination and vigour of a seed lot. Viability loss due to ageing causes seed death, but other symptoms precedes it. Physiologically, the rate of seed ageing depends on three main factors namely i) high temperature ii) high relative humidity and iii) oxygen pressure. The relative humidity and temperature are the two most important factors that influence the life span of orthodox seeds. The effects of relative humidity (and its subsequent effect on seed moisture) and temperature of the storage environment are highly interdependent. According to Harrington (1973), because of this interdependency, the sum of the percentage of relative humidity plus the temperature in degrees Fahrenheit should not exceed 100 for safe storage. Low temperature and low moisture content are the ideal for prolonging storability of orthodox seeds. Harrington (1972) suggested the two rules of thumb regarding optimum seed storage: a) each 1% reduction in seed moisture doubles the life of the seed and b) each 5°C reduction in seed temperature doubles the life of the seed. Roberts (1972) constructed a viability nomographs based on the viability equations with temperature and seed moisture as the extrinsic factors. Ellis and Roberts (1981) have presented a new improved viability equation to predict seed longevity and storage environment of a number of agricultural crops. Roberts (1972a) notified that the storability of seed significantly increases with a reduction in the partial pressure of oxygen. The likely involvement of lipid peroxidation in seed ageing implies a profound role of oxygen.

The manifestation of seed deterioration may be either visible or invisible to the naked eye. Some of the chief visible manifestations of seed deterioration are i) deterioration is often observed as various abnormalities in germination e.g., reduction in per cent germination, delay in onset of germination, increase in the frequency of chromosomal aberrations, abnormal seedling etc. ii) often there are changes in the colour etc. of deteriorated seeds iii) such seeds may show a reduced tolerance to stress during germination and storage iv) finally deteriorated seeds may exhibit an enhanced sensitivity to radiation treatments, e.g., in terms of chromosomal damage. Non-visible manifestations of seed deterioration include changes in such physiological and biochemical features as respiration activity, enzyme action, membrane permeability, macromolecule...
biosynthesis and stored food materials. Generally, these changes precede the visible changes. Changes in respiratory activity and enzyme activity which participates in breakdown and synthesis of carbohydrates, fats and proteins and peroxidative changes in cellular membranes and other vital bioorganelles (Anderson, 1970; Abdul Baki and Anderson, 1970, 1972; Berjak and Villers, 1972; Saxena and Maheswari, 1980; Saxena et al., 1985; Khan et al., 1996). Wilson and McDonald (1986b) reported that seed deterioration would take place via lipid peroxidation and it has been pointed out that free radical flux during ageing would be concurrent with accumulation of both co-oxidative injury and oxygenated fatty acids.

Physiological and biochemical studies on seed deterioration have shown changes in respiratory activity and activities of enzymes which participate in breakdown and synthesis of carbohydrates, fats and proteins and peroxidative changes in cellular membranes and other vital bio-organelles (Matthews and Bradnock, 1967; Takayanagi and Murakami, 1968b; Ching and Schoolcraft, 1968; Anderson, 1970; Abdul-Baki And Anderson, 1970, 1972; Berjak and Villiers, 1972; Saxena and Maheswari, 1980; Saxena et al., 1985; Khan et al., 1996).

High relative humidity and temperature not only accelerate the physiological deterioration of seeds but also make it susceptible to mould growth and attack by storage grain pests and storage microflora (Grewal and Kapoor, 1966).

A comprehensive studies have been made in the Institute of Agricultural Science (Formerly University College of Agriculture), University of Calcutta to develop an easy and inexpensive method of seed treatments for the maintenance of vigour and viability. It has been shown that mid-storage hydration-dehydration treatment would remarkably slow down the loss of vigour and viability under ordinary storage conditions of stored seed of a wide range of agriculturally important crops (Basu et al., 1974; Basu and Dasgupta, 1974; Basu, 1976; Mandal and Basu, 1982). They have also suggested that mid-storage hydration-dehydration treatments of stored seeds of several crops would considerably improve post-storage life, yield per unit area and other yield attributes than their untreated respective control (Kundu and Basu, 1981; Mitra and Basu, 1979; Mandal and Basu,
The efficacy of hydration-dehydration treatment has also been reported and confirmed by research conducted in many other laboratories (Savino et al., 1979; Ray, 1982; Goldsworthy et al., 1982; Dey and Mukherjee, 1988; Burgas and Powell, 1984; Vanangamudi and Karivaratharaju, 1986; Rudrapal and Nakamura, 1988). The efficacy of hydration-dehydration treatment depends on the kind of seed and initial seed vigour at the time of treatment. High-vigour harvest-fresh seed is not responsive to the hydration-dehydration treatment for the maintenance of vigour and viability. The treatment is usually given in July-August, drying conditions are not favourable and it has been noticed that storage of seeds which are not adequately dried would adversely affect storability (Mandal and Basu, 1987). To overcome such eventualities, standardization of dry seed treatments which will not involve hydration would be more appropriate.

Hydration-dehydration treatments are effective in maintaining vigour and viability when it is given to 4-5 month-old seeds (medium-vigour) and are not suitable for harvest-fresh high-vigour seed (Basu, 1994, 1995; Kundu and Basu, 1981; Mandal and Basu, 1983, 1987; De et al., 2003; Kapri et al., 2002, 2003). But during this time it is difficult to dry back the seed to its original weight due to monsoon months (July-August). The artificial dying facilities are also not available to small and marginal farmers of our country. Besides, hydration-dehydration treatments have some technological problems in handling bulk quantities of seed. Prolonged soaking may show adverse effects because of anaerobic respiration leading to accumulation of toxic metabolites.

Leguminous seeds are less responsive to wetting-drying especially when long term soaking duration are employed resulting soaking injury (Armstrong and McDonald, 1992). Hydration-dehydration treatments are ineffective in leguminous seed because soaking-drying treatment would adversely affect germinability due to soaking injury (Saha and Basu, 1984; Bhattacharya and Basu, 1990). Storability of soybean and other legumes would be adversely affected because of soaking injury during rapid imbibition of water (Ross and Pollock, 1971; Powell and Matthews, 1978; Woodstock and Tao, 1981; Woodstock and Taylorson, 1981b). Imbibational
Dry seed treatment with halogen

Dry permeation of chemicals

damage is common to all grain legumes (Powell et al., 1984). In Phaseolus vulgaris poor field emergence of 10 cultivars having unpigmented testae was associated with rapid imbibition and high incidence of imbibition damage (Powell et al., 1986) compare with the high field emergence and slower imbibition of 21 cultivars having brown or black testae. Similar differences in field emergence and incidence of imbibition damage have been observed in chick pea (Legesse, 1991), long bean (Abdullah et al., 1991), cow pea (Legesse and Powell, 1992; Asiedu and Powell, 1998).

For the maintenance of vigour and viability, the seed can be given ‘dry’ treatments, which do not require use of water. Direct use of volatile chemicals such as iodine at very low concentration was reported by Basu and coworkers for extending seed longevity of mustard (Basu and Rudrapal, 1980), mung bean (Rudrapal and Basu, 1982) and rice (Pal and Basu, 1988). For commercial use, iodine premixed with carriers such as talc, French chalk and calcium carbonate (i.e., iodinated calcium carbonate), and the mixture then used for dry-dressing of seed on closed containers. Rudrapal and Basu (1982) in mung bean and Dey and Mukherjee (1984) in soybean and sunflower recorded significant extension of storability using carriers impregnated with low concentrations of iodine. For commercial use, calcium hypochlorite (the ordinary bleaching powder which slowly releases chlorine) used for treating harvest-fresh (high-vigour or high-medium-vigour) leguminous and non-leguminous seeds for extending vigour and viability in storage (Mandal and Basu, 1986; Pal and Basu, 1988; Bhattacharya and Basu, 1990). Rudrapal and Nakamura (1988) confirmed the beneficial effects of chlorine, iodine and bromine on the post ageing germinability of harvest-fresh egg plant (Solanum melongena) and radish (Raphanus sativus) seeds.

The dry permeation technique employing solvents like dichloro methane and acetone has been successfully used for introducing antiageing chemicals into the seeds. Various chemicals such as potassium iodide, p-hydroxybenzoic acid, tannic acid etc. introduce in to the mustard via acetone significantly minimized the loss of viability (Basu et al., 1980) Gorecki and Harman (1987) reported that pea seeds treated with ά-tocopherol and butylated hydroxy amizole dissolved in acetone
Dry seed treatment with crude plant material retained the highest seed viability and vigour compared to non-treated seeds. Tao et al., (1974) successfully prevented seed deterioration by using antiageing compounds like actinomycin-D, antibiotics, chloramphenicol in a medium of different organic solvents. Dey and Mukherjee (1988) successfully invigorated the seeds of maize and mustard by using chemicals like para-aminobenzoic acid, α-tocopherol and caffeine through actone.

However, farmers faced some problems who may consume the surplus seeds, which have been treated with potentially harmful toxic chemicals. In this consequence, Mandal, Basu and other coworkers tested a range of plant preparations for the improvement of germinability of stored seeds (as leaf powder, rhizome powder, seed powder etc.) which are edible and are rather non-toxic (De et al., 1998; Mandal et al., 2000; Kapri et al., 2002, 2003, 2005; Biswas et al., 2012; Biswas and Mandal, 2012; Guha et al., 2012; Layek et al., 2012; Guha and Mandal, 2013). They have reported that treatment of high-vigour seed with red chilli powder (Capsicum frutescens L.), turmeric (Curcuma longa L.) rhizome powder, nisinda, neem leaf powder, Trigonella seed powder, Catharanthus leaf powder etc. significantly slowed down seed deterioration. Basu and coworkers also found that acetyl salicylic acid (aspirin), a plant derivative and widely used pharmaceutical formulations (ASPRO), proved very effective in controlling seed deterioration (Pal and Basu, 1994; De et al., 1998, 2003; Mandal et al., 1999, 2000; Kapri et al., 2005; Biswas et al., 2012; Biswas and Mandal, 2012; Guha et al., 2012; Layek et al., 2012; Guha and Mandal, 2013). Umarani et al., (1997) reported that Albizia amara leaf powder proved effective in slowing down seed deterioration in Casuarina equisetifolia seeds.

The dry seed treatments (which would not involve drying) with halogenated compounds such as bleaching powder or iodinated calcium carbonate has been successful in a number of harvest fresh non-leguminous and leguminous crop seeds (Basu and Rudrapal, 1980; Mandal and Basu, 1986; Mandal et al., 2000). Mandal, Basu and other workers tested a range of plant preparation to control the loss of seed deterioration. They have found that treatment of harvest fresh (high-vigour) orthodox seeds (viz., wheat, onion, okra and sunflower) with finely powdered crude plant
materials such as red chilli powder, vinca leaf powder, turmeric rhizome powder and pharmaceutical formulation such as acetyl salicylic acid (aspirin) at a very low concentration significantly slowed down seed deterioration under different storage conditions (Mandal et al., 1999; 2000; De et al., 2003; Kapri et al., 2005; Biswas et al., 2012; Biswas and Mandal, 2012; Guha et al., 2012; Layek et al., 2012; Guha and Mandal, 2013).

Against the aforesaid background the present investigation was taken up to develop a simple, inexpensive and easily practicable method of seed treatments for improved storability and productivity of stored sesamum. Studies were also made on the vigour bioassay of invigorated and non-invigorated seeds by employing jute seeds as bioassay material.

Apart from these practical objectives, experiments were taken up to elucidate the physiological and biochemical basis of the beneficial effects of seed invigoration treatments.

Aims and Objectives

A. Development of simple and inexpensive seed invigoration treatments for the maintenance of vigour and viability of sesamum (cv. Rama and B-67).

B. Studies on the efficacy of dry and wet seed treatments for improved field performance and productivity of sesamum (cv. Rama and B-67).

C. Seed vigour bioassay of invigorated and non-invigorated sesamum seed.

D. Elucidation on the mode of action of seed invigoration treatment in viability maintenance.

The laboratory experiments on seed invigoration including physiological and biochemical bases of the beneficial effects of dry physiological and wet (soaking-drying) treatments in the laboratory and field experiments conducted over a period between January, 2009 and August, 2013.
REVIEW OF LITERATURE