CHAPTER - 1

Introduction
INTRODUCTION

Plants are the greatest and the most precious gift of nature not only to the mankind but also to all the other living beings on the earth surface and atmosphere. More interestingly the origin of most of the plants lies within their seeds. Thus seeds can be considered as the most important part of a seeded plant and its life cycle. Seed may be defined as the ripened ovule which comes to existence due to proper fertilization. The plant seed is not only an organ of propagation and dispersal but also the major plant tissue harvested by mankind (Ramakrishna and Rao, 2005). All spermatophytes, including Gymnosperms and Angiosperms show presence of seed. Difference between these two categories of higher plants as per the type of seed they bear is that, Gymnosperms do not form ovary, hence ovules are exposed and so also the seeds. But in Angiosperms, seeds are enclosed within the fruit. These Angiospermic seeds may have either one cotyledon called monocotyledonous or two and called dicotyledonous.

A mature seed consists of two important parts; one is seed coat and the other is embryo. Embryo is the young or miniature plant, enclosed within the seed coat. It consists of four distinct parts, cotyledons, plumule, hypocotyls and radicle. Amongst all, cotyledons play the most important role during the initial stages of germination, while radicle, plumule and the hypocotyls together form the embryonic axis or tigellum. At the same time cotyledons are also considered as seed leaves those are attached to the embryonic axis. On the basis of the number of cotyledons, angiospermic seeds can be categorised as dicotyledonous; having two cotyledons, situated opposite to one another. Similarly monocotyledons have only one cotyledon which is highly modified. In most of the plants the cotyledons are food storage organs and in others they also serve as photosynthetic organs after germination, therefore germination is found to be performed by the two totally different types of seeds as per their number of cotyledons.

Germination is an important event in the life cycle of plants and it is initiated when the apparent metabolic dormancy of desiccated seeds is
disrupted by imbibition (Agboola, 2003; Ajiboye, 2010). It leads to extensive breakdown of stored carbohydrates, lipids and proteins in the storage organs of seeds to provide energy and other nutritional requirements of the growing embryo (Usha and Singh, 1996; Botcha et al., 2011).

The process of germination in angiosperms can also be divided on the basis of the behaviour of the cotyledons. There can be two types of germination, one is epigeal and the other is hypogeal. In case of epigeal germination, the cotyledons are brought above the ground due to the elongation of the hypocotyls. Such type of germination is seen in cotton, papaya, onion, castor, fenugreek (Trigonella foenum-graecum), etc. where flat green leaf like cotyledons can be seen in the young seedlings. So in this case cotyledons, besides food storage also perform photosynthesis till the seedling becomes capable of independent existence, while in case of some plants like bean and tamarind, the cotyledons being thick do not become leaf like, and they shrived and fall off. At the same time, in hypogeal germination, the cotyledons do not come out of the soil surface. So in such cases, the epicotyls elongate pushing the plumule out of the soil. Generally all monocotyledons show this type of germination. Some dicotyledons like gram, pea, groundnut, mango, etc. are common example of hypogeal germination. The part of the embryonic axis lying just above the point of attachment of the cotyledons is known as epicotyls and at the tip of the epicotyls, there is plumule. The part of embryonic axis below the point of attachment of the cotyledons is known as hypocotyls. This is the part where stem changes in to root and also known as root stem transition region. The radicle is the basal tip of the hypocotyls. During seed germination, radicle becomes the primary root of the seedling. Though radicle and hypocotyls are difficult to be differentiated externally, they are totally two different parts internally and functionally.

In seeds, food is stored either in the cotyledons or in a special food storage tissue, the endosperm. Seeds are endowed with food reserves required for providing nutrients for seedling growth and are mobilized during germination and post-germinative growth (Borisjuk et al., 2003; Padmakar et
In leguminous seeds, food is stored mainly in the cotyledons and there is no endosperm. In such type of seeds, endosperm has been completely utilized by the growing or developing embryo. Thus these are called non-endospermic or exalbuminous seeds. So the seed of a typical legume generally consists of an outermost covering called seed coat, made of two different layers- the testa which is thick and brownish and the tegmen which is thin, whitish and fused with testa. The seed coat of legumes is generally a thin covering of seed in case of herbs or shrubs. But it may be thick and hard in case of trees. There is micropyle and just above it, there is a small depression called hilum. Raphe is another structure that extends beyond the hilum and looks like a small ridge on the testa.

The embryo of leguminous seeds consists of two somewhat circular or oval shaped, yellowish or white cotyledons. Both of these are attached to the embryonic axis, opposite of each other. The plumule lies immediately above the point of attachment. Reserve materials are stored in the embryo or in the extra embryonic tissues. Usually, most of the stored carbohydrates and protein reserves of cereals and graminaceous seeds is located in the endosperm. Fleshy cotyledons serve as the major storage organ in most of the non-endospermic and many endospermic dicotyledonous seeds. Non-endospermic legumes belong to the former category, where the cotyledons serve as major storage organs with protein and carbohydrates as the major food reserves (Hamamura, 1999; Graham and Vance, 2003).

Food material in leguminous seeds is entirely stored in cotyledons as endosperm is absent (Gorecki, 2000). The type of food stored basically includes carbohydrates, protein and fats. But legumes possess a greater amount of protein in their seeds. Thus most of them are nutritionally very rich (El-Adawy et al., 2004). The nutrition stored in the cotyledons is a form of complex food material, helps the seed to germinate and provides nutritional support to the growing seedling up to the stage where it extends its first green leaf to become photosynthetically independent (Chitwarin et al., 2011).
Seeds possess some simple polysaccharides for functioning as intermediate respiratory substrate and for wall synthesis during rapid cell divisions at the early stages of germination (Hellmann, 2008). Reserve food is broken down by the formation of various types of hydrolases like, amylases, proteases, nucleases, lipases, etc. (Young and Varner, 1959; Juliano and Varner, 1969), however, proteolytic enzymes are one of the first to be formed and releases some long lived RNA for controlling the early metabolism. These enzymes also play an important role in the conversion of reserve proteins to other enzymes. When treatment conditions are favourable, the reserve mobilization, activation and re-synthesis of some enzymes, DNA and RNA synthesis start. Rapid embryo growth results when the obstacle to germination is removed (Khan, 1992; Braccini et al., 2000). DNA does not get activated. New DNA synthesis i.e. replication and cell division occur only after or at the time of the emergence of the radical (Davidson, 1966). Activation of DNA allows rapid synthesis of new RNA. In fatty seeds, the fats are rapidly converted into carbohydrates. Part of them is used in respiration. Concentration of nitrogenous organic compounds does not alter to a greater extent. Proteins are reconstituted and some new protoplasmic proteins are synthesized.

In starchy seeds, there is a decrease in the carbohydrate level (Gorecki et al., 2000). A similar condition is found in protein rich seeds. Amides increase at the cost of total proteins because a large quantity of amino acids is used up in respiration after undergoing deamination (Krochko and Bewley, 2000). Basically germination starts just after imbibition which results the simplification of complex reserve food in the presence of adequate amount of water. It includes conversion of starch to maltose called starch degradation, protein hydrolysis to amino acids by peptidases, breakdown of lipids to fatty acids and glycerol like simpler and soluble forms. Seeds of maize (Zea mays L.) shows four different parts of a monocot seeds, the aleurone layer, the endosperm, scutellum and the embryonic axis. Starch and other carbohydrates are mostly present in the endosperm and are degraded to simple soluble sugars inside the scutellum, then move to the embryonic axis to supply energy to the
growing seedling during germination. But protein is present both in the aleurone layer and in the endosperm. These are then hydrolysed to form peptides inside the endosperm itself and then move to scutellum where they are converted to amino acids and carried to the embryonic axis in the form of amides. Thus formation of new proteins and enzymes takes place here for further growth and development of the seedling. Just like the carbohydrates, lipids also get converted to fatty acids and glycerol in order to become available to the embryonic axis in the form of simple sugars like glucose and sucrose for the proper supply of energy required for germination to happen. In a typical dicotyledonous seed utilization of reserve food is similar to Monocotyledons.

The major storage food materials of the seeds are carbohydrates, mostly, starch and proteins as well as lipids (Winton and Winton, 1932; Crocker and Barton, 1957). The major food reserves of all the leguminous seeds are carbohydrates, like basically, sugar and starch. Besides these, they have a higher percentage of protein content in them and also possess lipids as there nutritional component. The Carbohydrates are the most abundant biomolecules on Earth. Certain carbohydrates like sugar and starch are dietary staple in most parts of the world and the oxidation of carbohydrates is the central energy yielding pathway in most of the non-photosynthetic cells. Contents of soluble carbohydrates generally decline with aging of seed (Petruzelli and Taranto, 1989; Sharma et al., 2005) and this decline might results in limited availability of respiratory substrates for germination.

Carbohydrates are polyhydroxy aldehydes and ketones or substances that yield such compounds on hydrolysis. Polysaccharide contains more than 20 monosaccharide units. The plant products like starch and cellulose comes under this category of carbohydrates. Starch is one of the major food reserves of many seeds. It consists of reoccurring units of D-glucose. Proteins are the most abundant biological macromolecules, occurring in all cells and all parts of cells. Proteins occur in great variety and exhibit enormous diversity of biological function and are the most important final products of the information
pathways. Besides this, proteins are the molecular instruments through which genetic information is expressed and it is also one of the major food reserves of many plant seeds, especially leguminous plants (Mandal and Mandal, 2000; Ghavidel and Prakash, 2007). Polymers of amino acids are called peptides and proteins. Plant seeds mostly have such simple proteins or polypeptides as one of the types of stored food. In legumes 80% of the seed proteins may be of storage proteins. The amount of protein present in seeds varies from about 10% (in cereals) to about 40% (in legumes) forming a major source of dietary protein. The mobilization of seed storage protein represents one of the most important post-germinative events in the growth and development of seedling (Ramakrishna and Rao, 2004).

Biological lipids are those chemically diverse groups of compounds, the common feature of which is their insolubility in water. The main biological functions of lipids include energy storage, signalling and acting as structural components of cell membranes. Lipids may be defined as hydrophobic and amphiphilic small molecules. The simplest lipids constructed from fatty acids are the triacylglycerols, also referred to as triglycerides, fats or neutral fats. Triacylglycerols are composed of 3 fatty acids each in ester linkage with a single glycerol. In germinating seeds, there are lipases that catalyze the hydrolysis of stored triacylglycerols, releasing fatty acids for export to sites where they are required as fuel.

The stored fats get degraded to get finally converted into carbohydrates. Inside the seeds, the hydrolytic enzymes perform degradation of fats in several steps undergoing different pathways. Fats are initially converted to fatty acids and glycerols and the process is known as saponification, which is just the reverse of condensation of fatty acids and glycerols. These fatty acids thus formed are further oxidised to liberate energy which is in turn used in several physiological and metabolic activities taking place during germination (Akpinar et al., 2001; Agucilar and de Mendoza, 2006). Oxidation of fatty acids is done by three catabolic pathways: β-oxidation, α-oxidation and per-oxidation. So fatty acids are important sources of energy for germinating seeds.
Until a plant can make its own food by the chemical process of photosynthesis, seeds have to support the plant and provide everything it needs. However, the food inside the seed is not in the form of simple sugars (which is what the cells of the plant need) but instead in the form of complex, insoluble molecules such as protein and starch. Because of this, mobilization takes place to convert the molecules into something useful to the plant. Mobilization happens because of enzymes which digest the large molecules. So enzymes are large biological molecules responsible for the thousands of chemical interconversions that sustain life. Enzymes are highly selective catalysts, greatly accelerating both the rate and specificity of the metabolic reactions, from the digestion of food to the synthesis of DNA.

Germination is a process by which the dormant embryo of the seed resumes active growth and forms a seedling. Seeds of all types require three vital conditions for germination and they are; supply of oxygen, supply of water and favourable temperature. Beside this some seeds also require light for germination and some may germinate in total darkness. Under these appropriate conditions, the seeds absorb water from the soil through micropyle. Swelling of seeds is the first visible indication of a seed undergoing germination. This results the softening of the seed coat. Absorption of water leads to a series of physiological changes inside the seed which is indicated by the higher rate of respiration of the germinating seeds (Hooda and Jood, 2003). Now, the embryo inside the seed produces enzymes by means of which the food material stored in the cotyledons (in case of leguminous seeds) or endosperm is converted into their soluble form which can be easily used by the growing embryo (Hahm et al., 2008).

All the studies related to germination are incomplete till ‘dormancy’ is not studied. Seeds of many plants will germinate soon after their maturation, if placed under suitable conditions of the environment, for example, maize, pea, bean, etc. In rare cases germination may start while the seed is attached. Thus pea seeds have been reported to germinate inside the pod. In a large number of seeds, germination cannot take place immediately after harvesting on account
of the innate inhibition. This innate inhibition of germination of a viable seed even when present in a favourable environment is termed as seed dormancy (Windauer et al., 2011). Dormancy is also called rest by certain workers and another term used in connection to this is quiescence which is otherwise known as imposed dormancy. It is the inability of a viable seed to germinate because the environmental conditions required for it like, favourable moisture, aerature, temperature, light, etc. are not available (Kuo et al., 2003; Pascual et al., 2013).

Seed dormancy can be due to many reasons like: immaturity of the embryo where germination will not occur till the complete development of the embryo has taken place (Eira and Cadlas, 2000). Such type of dormancy is not very common. But some type of seeds may require after-ripening. These are that category of seeds which gain power to germinate after a period of dormancy when kept under dry environment at normal temperature, for example, Oat, Wheat, Barley, etc. (Barton, 1965; Trugo et al., 2000). This type of dormancy can be broken by supplying gibberellic acid, a growth hormone for plants. There are certain seeds, which may require some kind of chilling treatment (Ajiboye et al., 2009). These seeds require a low temperature treatment before they can become capable of germination. Some of the dormant seeds need high temperature treatments before sowing in order to attain better germination ability (Ajiboye, 2010; Morozov, 2013; Hasanuzzaman et al., 2013). There are some seeds which are light sensitive and require a specific light treatment before being able to germinate, for example, lettuce. Generally the seeds from plants belonging to families like, Leguminosae, Malvaceae, Solanaceae, Convolvulaceae and Chenopodiaceae are impermeable to water. These remain dormant till their outer coverings are broken down by mechanical injury and microbial action. More often, in some members of Leguminosae, the seed possesses a small valve called strophioler plug which is a counter palisade tissue. This plug swells up when external moisture is more than internal hydration and blocks the entry of water which later leads to serious dormancy of the seed (Hyde, 1954).
Similarly there are some seeds having seed coats impermeable to oxygen. Such seeds fail to germinate because their outer covering does not allow oxygen to penetrate the interior (Gupta and Aneja, 2004). In such seeds, low availability of oxygen may produce growth inhibitors which get deposited in the seed coats (Edwards, 1968, 1969). Some seed coats are so hard that they provide mechanical resistance to the growth of the embryo. Such seed coats are often permeable to water and gases (Meyer and Anderson, 1952, Fasidi et al., 2000). At the same time some seeds may require high CO₂ concentration to germinate (Ballard, 1958). It is observed that seeds of *Trifolium subterraneum* L. do not germinate till CO₂ concentration of the environment has been raised to 2.5%. Some seeds have a very high osmotic concentration (Koller, 1957) which prevents their germination and cause dormancy. Seed dormancy can also be caused due to the presence of growth inhibitors like abscisic acid, alkaloids, cyanogenic chemicals, etc. Seed dormancy varies within species in response to climate, both in the long term (through ecotypes or clines) and in the short term (through the influence of the seed maturation environment), (Molina and Diaz, 2013).

There are several methods to break dormancy of seeds, depending upon the type of dormancy the seed is going through. Several treatments have been developed to break the dormancy of seeds but the dormancy caused by the immaturity of the embryo cannot, however, be overcome. Some of the methods are scarification i.e. the treatment which ruptures or weaken the seed coat. Impaction that is vigorous shaking of dormant seeds may remove the plug if present and overcome dormancy. There is also a pressure treatment which involves subjecting of seeds to a high hydraulic pressure to increase the permeability of their seed coats. Chilling treatment is one of the most effective processes to break dormancy and make the seed germinate successfully which involves a supply of very low temperature ranging from 0°C to 5°C for a period of about a couple of weeks to a few months. Low temperature depresses growth inhibitor, increases gibberellin content and mobilizes food materials towards the embryo. Exposure to alternate temperatures (high and low) is also helpful
in breaking seed dormancy in many cases (Taylorson and Hendricks, 1972). These seeds which have seed coats impermeable to oxygen can be successfully germinated by providing high concentration of oxygen which can cause destruction of growth inhibitors (Roberts, 1964).

There are certain specific wavelengths of light which can remove the cause of dormancy in some seeds, for example, red light hastens germination under humid condition in positively photoblastic seeds by stimulating the synthesis of cytokinins (Vanstaden, 1973). Some growth regulators are ultimately useful for the dormant seeds to overcome serious dormancy like; gibberellins, 2-chloroethanol or ethylene chlorohydrins, thiourea, etc. By knowing the details of such treatments and the reason of dormancy behind, it becomes easier to get 100% survival of the seeds which is very necessary for the economically important varieties.

After sorting out dormancy, when a seed becomes viable for germination under adequate supply of water, several physiological and biochemical changes take place in seeds during germination, starting from imbibition which includes macromolecular synthesis, several enzyme activities, increase in germinating power and vigour and overcoming of dormancy (Fu et al., 1988; Khan, 1992; Smith and Coob, 1992; Sung and Chang, 1993). Highly vigorous seeds germinate rapidly and uniformly and are able to withstand environmental adversity after sowing (Del Giudice, 1996; Braccini et al., 2000). As the first and foremost metabolic change taking place during seed germination is the increase in the rate of respiration (Ajiboye, 2006). The rate of respiration rises slowly to a constant rate. After some time the rate of respiration starts increasing again. It appears that at first, respiration is completely anaerobic due to the impermeability of the seed coats to oxygen. There is a temporary stoppage of the increase in the rate of respiration, which occurs when the seed coat breaks due to absorption of water (imbibition). So this is the transition period between anaerobic and aerobic modes of respiration by the seedling (Lopez-Amoros et al., 2006).
After this process, cell divisions start in the growing parts of the embryo that is at the radicle and plumule, because of the availability of food at these places. The radical is the first part of the embryo to come out of the seed coat. Radicle is positively geotropic. As soon as the expansion of embryo happens, the seed coat ruptures and the plumule lying between cotyledons comes out and forms the shoot in future. During radicle emergence and post-germinative stages, the cotyledons grow by absorbing the endosperm and becoming green slowly freeing themselves from the seed wrapping (Wellman, 1961; Giorgini and Campos, 1992).

During the process of germination, reserve food is broken down to their simpler and soluble form by the activities of some very important category of enzymes called hydrolytic enzymes or hydrolases like, amylases, proteases, lipases, etc. (Mng’omba et al., 2007; Sangronis and Machado, 2007). Hydrolases are the enzymes that speed up the hydrolysis of chemical bonds. These enzymes thus catalyze the hydrolysis of chemical bonds of compounds such as proteins (proteases), nucleic acids (nucleases), starch (amylases), fats (lipases) phosphate esters (phosphatases) and other macromolecular substances.

Seeds contain an embryo plant. It also contains a food store in which the embryo will rely while it is germinating, until it has grown leaves and can start to photosynthesize (Taraseviciene, 2009; Velluppillai, 2009). For example, bean seeds have a lot of starch but starch is insoluble. When the seeds begin to germinate, the enzyme amylase is secreted. It breaks the starch into maltose, which is soluble and simpler (Nodaa, 2004; Oboh, 2005; Pescador et al., 2008). The maltose can then be absorbed by the growing embryo, which can break it down to glucose. The seedling can then use it to supply energy for growth and also to build up cellulose to make up cell walls for the new cells those are made as the seedling grows.

Rate of amylase activity thus increases rapidly in early stages of germination, which is 1 to 2 days after proper imbibition due to rapid conversion of stored starch to its simpler forms (Shafqat, 2013). Then after this phase the rate of amylase activity slows down and shows a sharp decline.
towards the progress of germination day by day (Lee and Kim, 2000). All amylases are glycoside hydrolases and act on α-1, 4-glycosidic bonds.

Amylase enzymes can be divided into two categories depending upon their roles and pattern of starch degradation. α- amylase and β- amylase are the two types, α- amylase by acting at random locations along the starch chain, breaks down long chain carbohydrates. β- amylase is another form of amylases working from the non-reducing end, it catalyzes the hydrolysis of the second α-1, 4 glycosidic bond cleaving off 2 glucose units (maltose) at a time. Both α and β – amylases are present in seeds. β - amylase is present in an inactive form prior to germination, whereas α- amylase and proteases appear once germination has begun (Misra and Kar, 2002). Changes in α and β- amylase activities were minutely studied in many varieties of seeds in order to understand the degradation of starch and its utilization during the process of germination.

Proteins are one of the major parts of reserved food especially in legumes (Urbano et al., 2005). In seeds where protein is present as stored food material, another category of hydrolases that is peptidases becomes activated in order to hydrolyse the propeptides to make them available to the growing seedling. To understand the mechanism of storage protein mobilization, a variety of germinating seeds has been examined. These studies have led to the realization that proteases and peptidases act in a concerted manner to hydrolyse storage protein during this period and the combination of enzymes varies from seed to seed. Recent studies have also revealed the existence of more than one system of proteases in the same seed for the storage protein mobilization process, as there is a multiplicity of storage proteins in many seeds (Usha and Singh, 1996). Proteolytic enzymes play central role in the biochemical mechanism of germination (Bewley and Black, 1994; Shewry et al., 1995; Muntz, 1996). Mostly protease activity in germinating seeds shows an increase in rate of action in the earlier stages of germination. That is during the changes taking place in between the start of germination and about few days of it (Al-Shehri and Mostafa, 2004). But after that it begins to decrease in almost at a
regular rate. Numerous reports in which increase in activity of proteases are correlated with the breakdown of storage proteins support that these proteases are responsible for protein degradation (Storey and Beevers, 1977; Nandi et al., 1995, Senyuk et al., 1998; Rajeswari and Rao, 2002; Ramakrishna and Rao, 2004; Arunachalam, 2009).

To study the mechanism of protein mobilization process, many have undertaken the task of purifying and characterizing a variety of proteases and peptidases, some of which occur only transiently in germinating seeds (Ashton, 1976; Shutov and Vaintraub, 1987; Davy et al., 1998; Ramakrishna and Rao, 2005; Kimrizi and Guleryuz, 2006; Kimrizi, 2007). In legumes 80% of the seed proteins may be of storage proteins. The mobilization of seed storage proteins represents one of the most important post-germinative events in the growth and development of seedlings. The proteolytic enzymes play a central role in the biochemical mechanism of germination. Solvation of insoluble proteins, activation of pre existing enzymes and de novo synthesis of enzymes and degranulation of storage proteins are apparently a chain of events occurring mainly in the cotyledons of germinating seeds, leading to the transport of the products to the growing axis for the synthesis of new proteins and other nitrogenous compounds (Padmakar et al., 2005).

Lipases are another group of hydrolases that perform again a very important role in reserve food mobilization during seed germination and seedling growth. These are the enzymes that catalyze the breakdown or hydrolysis of fats (lipids). These act as a sub-class of the esterase enzyme and perform essential roles in degradation, transport and processing of dietary lipid like, triglycerides, fats, oils, etc. in plant seeds during germination. In plant systems lipases are involved in hydrolyzing the stored oil in germinating oil seeds to provide energy for growth and other metabolites for synthesis of new compounds (Bahri, 2000). Germinating oil seeds such as castor, soya bean, sunflower and ground nuts possess an appreciable level of lipase activity and hence may be used as a readily available source of lipase enzyme. Basically lipases are extracellular, inducible enzymes also designated as glycerol ester
hydrolases as they can act on fats to release fatty acids and glycerol (Shah and Gupta, 2004; Nahak et al., 2010).

Generally there are lipases in a single plant system performing under different $p^H$ levels. Like in castor bean (*Ricinus communis* L.), two lipases are found in extract of endosperm. One with optimal activity at $p^H$ 5.0 (acid lipase), is present in dry seeds and displayed high activity during initial stages of germination and the alkaline lipase that acts at higher $p^H$ values. Such lipases are more active at the later stages of germination (Muto and Beevers, 1974).

Leguminous seeds are generally very rich in their nutritional values because of high carbohydrate, protein and lipid contents in comparison to other seeds included in everyday diet of human food as well as fodder of cattle. Present study is based on the procedure of germination of two leguminous seeds which are widely distributed in the flora of India as well as several other countries abroad. Though these varieties of legumes have similarity in the type of germination they show that is epigeal, the seeds are very much different in their size, shape, features and above all the duration taken to complete the process of germination. Thus the study and related results will provide interesting comparisons so far the nutritional value and their changes during germination is concerned. The seed varieties chosen for present investigation have many purposes to solve. The plants of fenugreek (*Trigonella foenum-graecum* L.) are cultivated worldwide, the products, especially the seeds are majorly used for different medicinal purposes in most part of the word. But the consumption of the seeds for their nutritional qualities is somehow limited to very specific areas because of restricted awareness and acceptance. Similarly the seeds of tamarind (*Tamarindus indica* L.) are one of the least studied species belonging to leguminosae family. Because of lack of proper information regarding the nutritional qualities, their consumption is very low and still considered as a non-commercial and wild plant in several parts of India as well as foreign countries. Thus In order increase awareness and provide encouragement for proper cultivation of such economically important plant varieties, the aspects of germination ability, dormancy problems,
assessment of nutritional value of the seeds will be helpful and convincing. Biochemical analysis of the changes in their nutritional quantity as well as quality during different phases of germination will lead to understand and accept the view of consuming such seeds at that particular stage to get maximum nutrients out of it.

Thus the study of the whole process of seed germination will give inference about the size of the cotyledons, the time taken for full imbibitions of seeds and rate of germination of these less studied but equally important leguminous varieties. By considering the causes of dormancy and required ways to prevent it will be more useful to make the related work significant as it will open path for the study regarding 100% survival of these or any other variety of economically or biologically important seeds in future. The results will be helpful in planning the seed sowing time and conditions for best germination results and in turn the maximum yield of products. The outcome of the work will also be helpful in planning for storage of these seeds which will increase their usefulness to many folds. The study of nutritional value will give an idea of stored contents in the seed of selected seeds and the related study of nutrients will also focus the comparative usefulness of these seeds as per their contents. This study will also conclude the biochemical changes of the contents before and after germination. This investigation and the results will be helpful in knowing the utilization of vital nutrients during the process of germination. The cotyledonary contents and their utilization during the intermediate stages of germination, involvement of important hyrdrolases in the degradation of complex insoluble stored food materials and their mobilization will be of great research value. Above all, in light of above knowledge present research work was planned and done.