recorded on 100 seed weight (test weight) of all the medicinal plant seeds under study were categorized into three groups i.e. small seeded (Plantago ovata, Withania somnifera and Abutilon indicum) medium sized seed (Cassia angustifolia, Aegle marmelos, and Emblica officinalis) and bold seeded (Sapindus trifoliatus and Glycyrrhiza glabra). As per nature of the seed coat, the plants were identified as very hard seed coated (Sapindus trifoliatus and Glycyrrhiza glabra) hard seed coated (Emblica officinalis, Abutilon indicum and Cassia angustifolia) normal seed coated (Aegle marmelos, Withania somnifera and Plantago ovata) categories. The diversity in seed size, seed weight, nature of seed coat are the inherent characters of different genera and species.

5.1.1 Seed dormancy status and viability

The seeds of almost all the medicinal plants under study showed very poor germination under favourable germination conditions varying from zero to 10 per cent. This nature of the seeds can be attributed to the existence of seed dormancy which has also been ascribed to the condition of dormancy as per its definition proposed by Evenari (1959) and Benech Arnold et al. (2000). This finding conrdes with the observation of other scientist regarding the occurrence of dormancy in Plantago ovata (McNeil and Duran, 1992; Patel et al., 1999), Withania somnifera (Kattmani et al., 1999), Abutilon indicum (Veena Gupta et al., 2001), Cassia angustifolia (Bhuse et al., 2001), Aegle marmelos (Nayak and Soni, 1999), Emblica officinalis (Pawshna et al., 1997; Munogoshi et al., 1998), Sapindus trifoliatus (Brahman et al., 1996; Naidu et al., 2000) and Glycyrrhiza glabra (Ghadri and Torshiz, 2000, Sheela Verma et al., 2001).
The better staining reactions of seed embryos level with tetrazolium test indicated the high viability of the seeds which varied from 95 to 100 percent in almost all the medicinal plants seeds collected for research work. The lower values of electrical conductivity of seed leachates also confirmed the fact that the seeds are viable and not aged and still maintaining the high level of intactness of cellular membrane.

Kiltock and Law (1988) reported significant positive correlation between tetrazolium viability observation of individual wheat seeds and field emergences. They also reported a good correlation between staining intensity and field emergence of the seeds. Simon (1974) reported that the release of solutes from seeds during initial phase of hydration indicates the extent of structural reorganization of the biomembranes. Electrical conductance of seed leachates is also a good indicator of the physiological status and emergence potential of seeds. An increase in leachates of electrolytes is associated with a decrease in germination.

The seeds exhibiting such high level of viability should germinate under favourable condition for germination but their failure to germinate in the present study indicates the occurrence of constraints either external or internal which forced them not to germinate and to remain dormant.

5.1.2 Imbibition rate of seeds

The water uptake through imbibition by the seeds is primary step for initiation of germination. The seeds of medicinal plants taken under study revealed that the maximum water imbibition rate was recorded in Plantago ovata followed by Abutilon indicum and Cassia angustifolia. A moderate imbibition rate was observed in Glycyrrhiza glabra, Aegle marmelos, Emblica
attains and *Nitrospora nemorosa* whereas the minimum moisture level was shown by the seeds of *Sapindus minor* in waters.

The imbibition of water by seeds generally depends upon the seed food reserve and the nature of the seed coat. The maximum imbibition rate recorded by *Plantago* while seeds may be ascribed to the presence of mucilaginous matrix substance on the seed coat. The least uptake of water by the seeds of *Sapindus minor* seeds and moderate uptake of water by the seeds of *Lacerta tridactyla*. *Aegir sinuatus* and *Glycyrrhiza glabra* may be attributed to the seed coat impermeability to water due to waxy cuticle, the suberin and the thick walled palisade and osteosclerotic layers. These results are comparable to the findings of Ellis et al. (1985) who reported that in the genus *Pustacia* the endosperm can reduce the rate of imbibition.

The imbibition rate of these seeds was enhanced by exposing seeds to hot water mechanical and scarification which may be attributed to the facts that these treatments rendered the seed coat permeable to water. Rehman et al. (1999) also reported enhanced imbibition rates by the seeds of *Acacia salicina* with the application of hot water treatments. H-SCN soaking treatment and mechanical scarification over control.

5.2 SCARIFICATION

5.2.1 Hot water treatments

The hot water (50°C) soaking treatments were applied for 10, 20 and 30 minutes to overcome the dormancy constraints of the seeds of different medicinal plants under study. The hot water treatment was not too much effective rather deleterious as 20 and 30 minutes soaking treatments showed poor germination and vigour index compared to 10 minutes soaking.
treatments. Thus hot water treatment is an effective method to overcome the dormancy of Plantago ovata seeds.

The hot water soaking treatment for 10 minute duration was significantly effective and enhanced the germination percentage in Emblica officinalis, Withania somnifera and Plantago ovata whereas ineffective in Sapindus mukorossi and Glycyrrhiza glabra. The hot water treatment for 20 minute was most effective in Abelmoschus esculentus whereas deleterious in Plantago ovata and Withania as compared to their respective control and other hot water treatment. The longer duration (30 minutes) hot water soaking treatment was significantly effective in Aegle marmelos followed by Glycyrrhiza glabra. The hot water treatment was completely ineffective in Sapindus mukorossi. Similar results have been reported earlier by several researchers working on this aspect.

Hot water overcomes physical dormancy in leguminosae creating tension which consequently causes cracking of the macroweber layer (Brant et al., 1971) only affecting the estrophobic plug (Bell, 1980). The method is most effective when seeds are submerged into the hot water, not heated together with the water. Kotheo and Helum (1984) in Cassia reported better germination by soaking seeds in 85°C warm water for 1-2 minutes whereas the long soaking decreased germination percentage and reduction of viability in 95°C hot water. Hence for this species a brief exposure to high temperature (95°C) or protracted exposure to 85°C apparently caused heat damage. In an experiment on prosopis juliflora and P. flexuosa, the damage in the form of dead seeds and abnormal seedings occurred after the pretreatments of 50°C resulted into 20-30 percent of the seeds produced normal seedling.
and Vancuvell 1981; however, in an experiment by Lopez and Artes (1988) when seeds submerged into boiling water and left to cool in the water, heat damage was neither observed in these two Prosopis species nor in P. chilensis and P. walkeri. All the species tested in their experiment had a high germination after treatment with boiling water.

Heat damage was also observed for Cassia alata (Teo, Backor et al., 1983). Although the seeds of the species still maintained high viability (75%) after 7 minutes boiling longer boiling and any dry heat treatment readily reduced viability. In Cassia fistula a quick dip in boiling water killed 80 per cent of the seeds and 68 per cent were killed after 5 minutes boiling (Battersby and Kandya, 1985). Heat damage at 100°C was detrimental to Parasenaxanthus karanj and Albizia procera which 80-85°C greatly improved germination (Sajeev Kumar et al., 1995). Boiling water caused the casade layer seeds of Acacia spp. to soften and separate from the underlying mesophyll. Consequently cracks in the seed coat occurred of non-osmized (Brown and Hocysen, 1953).

Rammohan. Doodnaath and Harish, 1989, reported that hot water treatment at 70°C was the most effective method for overcoming seed coat dormancy in Acacia seyal. House et al. (2001) reported that hot water soaking for 24 h could be used for large scale plantation being a convenient and low cost method which gave 92 percent results in Cassia angustifolia.

Veena et al. (2001) reported that the hot water treatment in Abutilon dumosum was the most significant in reducing the hard seeds and the best results were obtained by treating seeds at 70°C for 10 minutes.
seededness up to 82 per cent was broken using this treatment whereas higher
temperatures of 80°C resulted in more number of dead seeds (17).

5.2.2 Mechanical scarification

The seeds of *Abutilon indicum*, *Cassia angustifolia*, *Emblica officinalis*,
*Aegle marmelos*, *Sapindus trifolius* and *Glycyrrhiza glabra* were given
mechanical scarification through rubbing on sand paper or chopping the hard
seed coat. The germination percentage was highly enhanced in all seeds. The
remarkable enhancement in germination percentage was observed in *Cassia
angustifolia* followed by *Sapindus trifolius*, *Glycyrrhiza glabra* nuts, *Aegle
marmelos* and *Abutilon indicum*. The mechanical scarification induced the
speed of germination of all the seeds studied. These findings are in
accordance with the observations of the other scientists.

Rathnavalli et al. (2002) recorded the effects of mechanical
scarification on *Cassia angustifolia* and observed that the seeds scarified
mechanically with 1:3 ratio of seeds and sand resulted into the highest seed
germination and lowest percentage of abnormal seedlings and dead seeds as
compared to acid scarification. Veena Guota (2003) evaluated the efficacy of
mechanical scarification (with sand paper) in terms of germination percentage
in *Cassia spp.*, *Withania*, *Aegle marmelos*, *Emblica officinalis*, *Plantago
lanceolata* and seven other plants. She reported enhanced germination
percentage in these medicinal plants.

Nayak and Son (1999) also recorded enhanced germination
percentage of mechanically scarified seeds of *Aegle marmelos* compared to
control. Gadir and Torshez (2000) also reported in *Glycyrrhiza glabra* that the
mechanically scarified seeds had higher germination percentage (94-98%) at
35°C temperature. Venkat Gupta et al. (2000) also recorded low percentage of germination in mechanically scarified seeds of *Abutilon indicum*.

Rehman et al. (1999) reported in *Cassia salicina* that seeds scarified mechanically by chipping the seed coat improved the germination percentage from 46 per cent to 59 per cent. The manual chipping was the best pre-treatment and recommended for germination tests reliable research for small lots in *Acacia sp.* (Doran and Gurn 1987).

Thus mechanical scarification of seed coat helps in overcoming the seeds dormancy caused by water impermeable and or resistant seed coat difficult to break by the thrust of developing embryo.

### 5.2.3 Acid scarification

The different concentrations of H$_2$SO$_4$ was applied on the seeds to scarify the hard seed coat. The seeds of *Abutilon indicum*, *Cassia angustifolia* and *Aegle marmelos* were treated with 1N, 5N and 10N H$_2$SO$_4$ for 15 minute duration while the seeds of *Sapindus trifoliatus* and nuts of *Glycyrrhiza glabra* were treated with 25, 50 and 100% concentrated H$_2$SO$_4$ for 5-10 minutes.

The germination percentage and speed of germination was improved by 5N H$_2$SO$_4$ treatment in *Abutilon indicum*, *Aegle marmelos* followed by *Cassia angustifolia* significantly over their respective control and other acid treatments. The soaking treatment of 5 minutes duration with 25 per cent concentration of H$_2$SO$_4$ was effective for *Sapindus trifoliatus* whereas 100 per cent concentration proved to be better for the nuts of *Glycyrrhiza glabra* in terms of germination percentage and speed of germination.

In general the acid scarification treatments were highly effective in *Glycyrrhiza glabra* followed by *Sapindus trifoliatus*, *Aegle marmelos* and
Acacia indica, whereas less effective in Cassia angustifolia in terms of germination percentage.

Acid treatment is commonly used when physical dormancy is caused by a thick pericarp. A long/short soaking treatments with concentrated sulphuric acids is often necessary to weaken the hard resistant seed coat.

The scarification of hard seed coat with the treatment of concentrated \( \text{H}_2\text{SO}_4 \) is an easy and feasible method for pre-sowing treatments of seeds. There have been several reports wherein acids have been applied for different duration and were effective to overcome the seed dormancy caused by hard seed coat.

Ghadiri and Toreini (2000) also observed that the conc. \( \text{H}_2\text{SO}_4 \) treatment for 45 minutes enhanced the germination percentage upto 95 percent in Glycyrhiza glabra. However, Sheela Verma et al. (2001) reported that the sulphuric acid treatment for 5 minutes was effective in breaking the dormancy of Glycyrhiza glabra with 88 percent germination.

Brahman et al. (1996) observed that pre-treatment with conc. sulphuric acid enhanced the germination percentage in Sapium fruticosum and S. mukorossi up to 62 percent whereas which was zero in untreated seeds.

Naidu et al. (1999) also exposed the seed of Sapium fruticosum to different concentrations of \( \text{H}_2\text{SO}_4 \), \( \text{HNO}_3 \) and \( \text{HCl} \). The best results in terms of germination percentage was recorded in \( \text{H}_2\text{SO}_4 \) treated seeds.

Nayak and Sen (1999) also reported enhanced germination percentage in Aegle marmelos seeds treated with conc. \( \text{H}_2\text{SO}_4 \) for 20 minutes followed by \( \text{GA}_3 \) soaking treatments. In Acacia indica Veera Gupta (2001) also recorded notable enhancement of germination percentage with the soaking of
seeds in sulfuric acids. Bruse et al. (2001) reported that the germination percentage of freshly collected seeds of Cassia angustifolia was enhanced up to 72 per cent by 12 minutes with conc. H₂SO₄ treatments. The similar results were observed by Rathnavalli et al. (2002) in Cassia angustifolia with conc. H₂SO₄ treatment.

Khalsa (1992) found that pretreatment of Terminalia superba seeds with concentrated H₂SO₄ (95.98% w/w) for 15-60 minutes greatly improved the germination. Acid did not penetrate the pericarp hence did not come into physical contact with embryo. However, for Terminalia bellinca Bhardwaj and Chakraborty (1994) found that 0.12 minutes dipping in concentrated H₂SO₄ acid was the most suitable pretreatment which almost doubled the percentage of germination as compared to untreated control. In Trema poliflua soaking of drupes in conc. H₂SO₄ for 30 minutes enhanced the germination percentage (Vasista and Soni, 1988).

Venna et al. (1997) reported best results of germination of seeds of aquonea (Glycyrrhiza glabra) treated with conc. H₂SO₄ for 5 minutes. Venna et al. (2001) working on abutilon indicum observed that sulphuric acid treatment using 25%, 50% and 100% acid with varying time period could not improve the germinability to significant levels. 25% acid for 30 minutes gave 42% germination. In fact, 100% acid treatment for 5 minutes gave 60% germination were also resulted in increased number of dead seeds.

5.3 PRE-CHILLING TREATMENT (STRATIFICATION)

The prechilling treatment was given to all the seeds under study. Only the seeds of Plantago ovata pre-chilling exhibited positive results in terms of
germination percentage while other seeds did not show any response towards this treatment in terms of germination percentage hence not described.

The prechilling treatments of the seeds of Plantago ovata for 72 hr resulted into 100% germination followed by 48 hr pre-chilled seeds. The prechilling at 24 hr was not much effective in terms of germination percentage and speed of germination. The prechilling (24 hr) + 0.5% KNO₃ (24 hr, soaking) treatment showed maximum output followed by prechilling (24 hr) + 200 ppm GA₃ (24 hr soaking) in terms of germination percentage and speed of germination.

In cold stratification or prechilling it is pertinent to mention that at cold temperatures, more oxygen is soluble in water, so the oxygen requirements of the embryo are better satisfied (cold-moist stratification simulates over wintering in a field seed bed Young and Young, 1986). Veena Gupta (2003) also reported better germination by prechilling of seeds for Asparagus officinalis, Bunium bulbocastanum, Plantago lanceolata and Saussure species.

5.4 CHEMICAL TREATMENTS

5.4.1 Gibberellic acid (GA₃)

The soaking of seeds in GA₃ (200 ppm) solution for 24 hr was found highly effective in Plantago ovata, Withania somnifera, Aegle marmelos and Cassia angustifolia as compared to their respective controls and other GA₃ treatment in terms of germination percentage and speed of germination. The response of the seeds of Acouton indicum to GA₃ was poor while the seeds of Emblica officinalis, Sapindus trifoliatus and Glycyrrhiza glabra did not respond well when soaked with intact seed coat. Hence combination of mechanical scarification (chipping) and GA₃ soaking was applied to the seeds of Cassia
The synergistic effects of mechanical scarification and GA$_3$ soaking to the seeds of *Cassia angustifolia*, *Emblica officinalis*, *Sapindus tenuifolius* and *Glycyrrhiza glabra* were observed as significant improvement of germination percentage and speed of germination over their respective control and mechanical scarification treatments. These findings are in accordance with the previous observations of the different scientists which are being mentioned hereunder.

The hormone theory explains seeds dormancy by the opposed property of two types of hormones: the abscissic acid (ABA) that inhibits germination and gibberellins that favour the germination (Wareing and Saunders 1971). The application of plant growth regulators (especially gibberellic acid and cytokinins) have been shown to enhance germination of hard woods, but have limited effectiveness for conifer species (Leadem, 1987). GAs are known to eliminate the requirement of seeds for various environmental conditions to promote germination and to counteract the inhibitory effects of ABA frequently in combination with cytokinins (Bewley and Black 1982, 1994). GAs appear not to be involved in the control of dormancy per se but rather are important in the promotion and maintenance of germination i.e., the act after the ABA mediated inhibition of germination has been overcome. The activities of ABA and GA may be linked because in the mutants of Arabidopsis reduced dormancy is accompanied by the lowered requirement for GA to achieve germination (Leon-Kloosterziel et al., 1996).

Shcola Verma et al. (2001) reported that the treatment of *W. somnifera* seeds with 100 ppm gibberellic acid resulted in improved germination
percentage speed of germination emergence and coefficient of velocity of germination and a reduced mean germination time compared with control seeds.

Hore and Son (1995) observed enhancement in germination with GA₃ 100 ppm concentration in Bael (*Aegle marmelos*). Pawsha *et al.* (1997) determined the effect of pre-germination seeds treatments on the germination and vigour of *E. officinalis* and observed high germination percentage in GA₃ at 50 and 100 ppm. Rajamanickam and Anbu (2001) reported higher germination with 200 ppm GA₃ in aonla. The earliness of seed germination was also observed in aonla (*Emblica officinalis*) with 200 ppm GA₃ for 8 h soaking duration. Rajamanickam *et al.* (2002) and Veena Gupta (2003) reported GA₃ treatment for better germination for *Costus speciosus* and *Emblica nilies*. Bhuse *et al.* (2001) working on *Cassia angustifolia* seeds observed highest seedling vigour index (882 97) by soaking the seed in 50 ppm GA₃ for 16 h with 64 per cent germination. Naidu *et al.* (2000) reported that GA₃ was more effective in improving seed germination in soapnut than either IBA or IAA. The effectiveness increased with concentration of GA₃ up to 1500 ppm.

In *Corylus colurna* seeds Nauliyal and Tripathi (2004) reported that GA₃ treatment resulted in 93 per cent germination within two weeks. However, complete removal of testa not only brought out as high as 97 per cent germination but it was accomplished in 7 days only.

### 5.4.2 KNO₃

The soaking of seeds of different medicinal plants in KNO₃ (0.5%) solution for 24 hr was recorded to enhance the germination percentage, vigour index and speed of germination in *Withania somnifera* followed by
Anegoni normanica. The seeds of Cassia angustifolia recorded better results in 0.1% KNO₃ solution in terms of germination and germination pattern. The response of the seeds of Abutilon indicum was poor to the KNO₃ treatments. The hard-coat seeds were scarified before soaking in KNO₃ solution to assess the effect of KNO₃ correctly. The results obtained were compared to those of mechanically scarified seeds. The seeds of Sapindus trifoliatus, Glycyrhiza glabra (mucra), Emblica officinalis and Cassia angustifolia were mechanically scarified then soaked in KNO₃ solution for 24 hr. The mechanical scarification followed by 0.5% KNO₃ solution soaking for 24 hr of seeds resulted in maximum germination percentage and vigour index in Emblica officinalis and Sapindus trifoliatus. However, Cassia angustifolia and Glycyrhiza glabra showed better results in mechanical scarification + 24 hr soaking in 0.5% KNO₃ solution. The improvement in germination by KNO₃ application is possibly through oxidized form of nitrogen causing a shift in respiratory metabolism to pentose phosphate pathway. The results are similar to the findings of the previous workers.

Murugesh et al. (1998) reported enhancing germination and seedling vigour with 1% KNO₃ treatment in Emblica officinalis. However, Rajamani and Anbu (2001) observed that fresh seeds treated with 0.5% KNO₃ for 8 hr recorded highest germination percentage (52.08%) in Emblica officinalis. The seeds soaked 0.5 per cent KNO₃ for 8 hr recorded the earliness of seed germination and germination percentage by soaking seeds of amarnath Emblica officinalis in Rajamani et al. (2002), Kallimanis et al. (1999) in a field trial reported that seeds soaking in sodium nitrate 1% solution for 24 hr significantly reduced the number of days taken for germination.
says, enhanced the germination percentage 85.13; germination rate index 28.74, and vigour index 187.3; compared to other presowing treatments in Ashwagandha. The Ashwagandha seeds soaked in 1 per cent sodium nitrate recorded the greatest plant height and longest roots. Kadimani and Reddy (2001):

in the study on Ziziphus mauritiana, KNO₃ was less effective than GA₃ (Murthy and Reddy 1989). In Cassiea eugeniaefolia, germination increased from 46 per cent to the KNO₃ for 96 hours. Both higher and lower concentration and shorter duration of soaking showed a lower germination (Majid et al. 1990). Palan et al. (1995) reported that KNO₃ had a strong effect on both germination percentage and vigour over acid pre treated Acacia nilotica seeds. At 1 per cent concentration germination increased from 37 per cent in control to 78 and at 2.5% KNO₃ concentration it increased to 85 per cent.

Lamare and Badua (2004) reported KNO₃ (150 mM) significantly stimulated seed germination and reduced mean germination time over control under both laboratory and nursery as well as developed seedling vigour under nursery conditions in Angiolea glauca (Acanthaceae).

5.4.3 Thiourea

The seeds were soaked in different concentration of thiourea (0.1, 0.5 and 1.0%) for different duration (6, 12 and 24 hr). The seeds of Plantago ovata, Euphorbia semiprata, Atalanta vivida and Aegle marmelos were soaked directly without scarification. The thiourea 0.5% soaking of 24 hr resulted in maximum output in terms of germination percentage for all the
above said plant seeds. The results were significantly superior compared to their respective controls and 8-12 hr soaking.

The seeds of Cassia angustifolia, Emblica officinalis, Sapium sebiferum and Glycyrrhiza glabra must were mechanically scarified followed by 24 hr soaking in different concentration of thiourea. The seeds of Emblica officinalis and Sapium sebiferum showed better results with thiourea concentration 0.1 and 0.5 per cent, respectively over the mechanical scarification alone. The seeds of Cassia angustifolia and Glycyrrhiza glabra recorded poor response in terms of germination percentage, vigour index and speed of germination with mechanical scarification + thiourea treatment. These observations consider the findings of the previous workers.

Harrmann Kester (1983) reported that thiourea had stimulatory effect on breaking dormancy possibly by reactivity the effect of inhibitor of ABA. Naidu et al. (2001) applied thiourea (450 ppm) in soaknut seeds for duration of 50 hr and observed maximum germination percentage of 72.

Most appropriate methods for overcoming the seed dormancy in medicinal plants studied

On the basis of the findings of the present investigation conducted to workout the seed dormancy constraints and their cure in some medicinal plants, the following suitable protocol for breaking seed dormancy has been developed for different plants under study:

- The dormancy of Plantago ovata seed could be overcome by exposing the moist seeds to pre-sowing cold stratification i.e. pre-chilling for a period of 48-72 hr. This treatment is highly effective and the treated seeds scored 90 to 100% germination.
The seed dormancy of *Withania somnifera* could be broken with 24 hr soaking of seeds in 0.5% KNO\(_3\) and 200 ppm GA\(_4\) solution which brought out 85-90% and 58-60% germination, respectively.

The seed dormancy of *Abutilon indicum* could be overcome with the hot water (70°C) treatment for 20 minutes. The treatment is highly effective and the treated seeds showed 80-82% germination whereas other acid scarification and chemicals (GA\(_4\), KNO\(_3\), and thiolureal treatments were not much effective in enhancing of germination percentage.

The seed dormancy of *Cassia angustifolia* could be overcome with mechanical scarification. The mechanical scarification recorded 75-80% germination which could be improved to 90-100% with further 24 hr soaking of mechanically scarified seeds into 0.1% thidiazuron or 300 ppm GA\(_4\) or 10% KNO\(_3\) treatments showing synergistic effects.

The dormancy of *Emblica officinalis* seeds could be overcome by hot water (70°C) treatments of seeds. The exposure of seeds to hot water for 10 minutes recorded 65-75% germination which could be enhanced to 95-100% further with 24 hr soaking of mechanically scarified seeds in 0.5% KNO\(_3\) solution again showing the synergistic action.

The dormancy of *Aegle marmelos* seeds could be removed by soaking the seeds in 0.5% KNO\(_3\) or 200 ppm GA\(_4\) solution which recorded 75-90% germination. The hot water soaking of seeds for 30 minutes also recorded 85-90% germination.

The seed coat scarification with 25% H\(_2\)SO\(_4\) for 5 minutes recorded 70 to 75% germination in the seeds of *Sapindus trifoliatus*. The soaking
of chipped seeds for 24 hr in 0.5% KNO₃ resulted in improved germination of 85-95%.

The nuts of *Glycyrhiza glabra* treated with 100% H₂SO₄ for 5 minutes recorded 75-80% germination. Hence this is the most effective seed treatment to overcome the physical dormancy exerted by woody nut.