1. INTRODUCTION

The seed that germinates when requirements are satisfied is said to be 'germinating' but the seeds of some species fail to do so showing the sign of dormancy. Dormancy is the physical or physiological condition of a viable seed that prevents germination even in the presence of favourable germination conditions. Evenari (1957) defines dormancy in seeds as any condition of perfect and viable seeds which makes them resistant to germination under environmental conditions that are ordinarily favourable for quick germination. It has also been defined as an internal condition of the seed that impedes its germination under otherwise adequate environmental and gaseous conditions (Benech-Arnold et al., 2000).

A dormant seed is a seed which fails to germinate over a range of conditions favourable for germination of non-dormant seed of the same kind. Seed dormancy refers to a state in which viable seeds fail to germinate when provided with conditions normally favourable to germination i.e. adequate moisture, appropriate temperature regime, a normal atmosphere and in some cases light. It may be manifested as the complete inability of seeds to germinate as an increased specificity in their germination requirements they might require some specific temperature, moisture conditions or other special treatments.
Different types of seed dormancy also can be distinguished on the basis of the timing rather than the cause of the dormancy. Seeds that are released from the plant in a dormant state are said to exhibit primary dormancy. From a plant propagation's viewpoint, primary dormancy is a condition that is present when a viable seed does not germinate under favourable conditions. Most seeds do not germinate immediately but rather are under the influence of some type of primary dormancy present to delay initial seed germination. The seeds that are released from the plant in a non-dormant state but become dormant when conditions for germination are unfavorable exhibit secondary dormancy. The causes of secondary dormancy include temperature extremes, prolonged darkness or prolonged light, water stress, dry conditions, or oxygen extremes anoxia or hypoxia (too much or too little oxygen).

Dormancy has been classified in various ways and there is no universally adopted system. Harper (1977) classified dormancy according to development into three types viz. 1) innate, 2) induced, and 3) enforced dormancy. The latter group does not however comply with the usual definition of dormancy.

Another classification system uses the location of dormancy in different seeds parts as criteria. Any cause of dormancy related to the embryo e.g., Immature development or chemical inhibitors located in the embryo may collectively be referred to as endogenous or embryo dormancy. Analogously, mechanical resistance, physical impermeability, inhibitors or light sensitivity associated with the seed coat are called exogenous or seed coat dormancy. Embryo and coat imposed dormancies share one common feature i.e. in both
the cases, embryo is unable to overcome the constraints imposed on it. In the former case by the factors within the embryo itself and in the second by the enclosing tissues.

Asakawa (1963) is of the opinion that dormancy is of two types viz. (i) physiological dormancy which can be overcome only through the medication of certain physiological processes prerequisite to germination. In some cases, the physiological dormancy seed coat may be a kind of indirect barrier to germinate due to the presence of inhibitors. (ii) physical dormancy that can be overcome only by some kind of physical pre-treatment (mechanical/chemical scarification) which in nature is brought about by conditions wetting and drying, freezing and thawing, natural soil acidity attack by micro organism and by passage through digestive tracts of animals.

When two or more dormancy types occur in the same seed, it is called double dormancy or combined dormancy. Double or combined dormancy is found in fleshy fruit with chemical inhibitors combined with a hard endocarp (physical dormancy), or immature embryo combined with other dormancy types. Sometimes the development or degree of dormancy changes during the life time of the seed, usually as a response to external conditions. Hence dormancy may be innate, develop, be broken and redevelop in seed.

Seeds with seed coat dormancy usually have a seed coat that is impermeable to oxygen or water. Occasionally the dormancy is caused by an inhibiting chemical in the epidermis or adjacent interior membranes. Vogis (1956) suggested that the inhibitor accumulation may be mainly a consequence of high temperature experience. Gibberellins, kinetins and nitrate treatments may also modify the effective inhibitor levels in various ways, and
the other chemicals which break dormancy may act both on the effective inhibitor level and on the water or gas entity step through physical alterations of the seed coat and metabolic alterations of the tissue inside. Methods of breaking seed coat dormancy include scarification, hot water, dry heat fire, charate, acid and other chemicals, much water, cold and warm stratification and light (Emery 1987).

The internal dormancy is a general term encompassing a number of physiological conditions that delay germination. The most common one is called after ripening. Seeds that require an after ripening period even though harvested when mature germinate poorly or not at all unless they have been subjected to moisture and either high or low temperatures or both in sequence; sometimes, however, a period of dry storage is sufficient to break dormancy. The more common method for breaking internal dormancy is cold stratification. In some cases, the use of chemicals can be substituted for part or all of the stratification requirement (Emery, 1987).

Dormancy in seeds may be advantageous or problematic during seed handling. The advantage is that it prevents seeds from germinating during storage and other handling procedures, and induction of dormancy by drying and dark storage generally promotes storability. On the other hand, where dormancy is complex and seeds need a very specific pretreatment, failure to overcome these problems may result in very poor germination. Seed dormancy is an usual evolutionary phenomenon with wild species and many other plants to maximize the chances that seeds will germinate at an appropriate time and is thus one of the nature's method of survival value to a species.
Seed dormancy is generally an undesirable characteristic in agricultural crops and other medicinal plants, where rapid germination and growth is required. However, some degree of dormancy is advantageous at least during seed development. This is particularly true for cereal and weed crops, particularly rice, because it promotes germination of grains while still on the ear of the parent plant, i.e., pre-harvest sowing.

Indigenous cultivation of Indus rice (Glycine max) is low because of poor seed set and germination. Commercial plantation is done by sowing. Hence, there is a need to enhance germination through seed treatments and to work out the result of the various treatments on vigour parameters. Angelica glauca (Apiaceae) is a high-value perennial medicinal herb endemic to the Indian Himalaya. It is now endangered as its roots are used as a spice in constipation and vomiting and for its cardiac active, carminative, and diaphoretic activities. Using seeds of Uttrakhand population of A. glauca, Nautiyal et al. (2002) reported only 8.4% maximum germination. Enhancing seed germination and developing vigorous seedlings is crucial for conservation through ex situ cultivation. Pre-sowing chemical treatments have generally been used to enhance seed germination and to increase seedling vigour. Hence there is a need to work out the effective pre-sowing treatment to stimulate seed germination and seedling vigour in medicinal crops exhibiting seed dormancy and pharmaceutical activity.

Abutilon indicum (Ailō ari Kāng) is a common winter weed used as a febrifuge, antiemetic, and anti-inflammatory. Its seeds are rich in mucilage and used as a laxative and demulcent but freshly harvested seeds are highly hard seeded with poor germination. The various parts of fruit, leaves, root
seeds, spikes and pods of other medicinal plants like Aonla, Bael, Isabgol, Senna, Reetha, and Guggal exhibit pharmaceutical value but their seeds show varying level of dormancy.

The seed, roots and leaves of Ashwagandha (*Withania somnifera* L. Dunal) are used in ayurvedic and unani medicines but its seeds also exhibit dormancy. It is one of the important medicinal plant cultivated in north western region of Madhya Pradesh on about 4000 ha (Nagam, 1984). Its pharmacological activity is due to the presence of several alkaloids in roots.

Presowing soaking of seeds in minerals solution is reported to hasten seed germination in several cultivated plants (Singh and Singh, 1973). There are reports regarding increase of seedling length in pumpkin, improvement in vegetative growth and dry matter production and final yield in carrot (Alekseeva and Rasskazov, 1976). Though many presowing treatments are known to improve seed germination in general but not many of them were utilized for improving germination and to increase root/shoot length in medicinal crops. Little information is available regarding presowing treatment of seeds in mineral solution and their impacts on germination, root length and dry root yield. Some of the presowing treatments have increased root growth in other crops. Hence there is need to undertake the response of presowing seed soaking with different mineral salts, hormones and other seed treatments in order to find out their impact on seedling vigour and overcoming dormancy in medicinal crop plants.

The knowledge of the causes and cure of the seed dormancy of the medicinal plants is the need of the time with increasing interest of the farmers for cultivation/propagation of these crops being more remunerative and the
Plant breeders engage in research on various aspects of medicinal plants. In crop breeding programmes, the breeder has to assess the crop subsequently for two to three generations continuously but dormancy becomes limiting factors for such studies. Moreover limited literature is available pertaining to the seed dormancy constraints and their cure in medicinal plants. In view of the above the present investigation was undertaken with the following objectives:

1. To work out germination and viability tests for the listed plant species
2. To study the morphological and other characteristics of the seed for identifying the causes of seed dormancy
3. To work out the effect of various physical and chemical treatments on germination
4. To study the effect of temperature and light treatments on germination
5. To find out the Synergistic effect of different treatments
6. To develop a suitable protocol for breaking seed dormancy based on the above findings.