Chapter-I

INTRODUCTION

In India, thousands of plant species are traditionally used in medicines by local people especially by tribes living in and around forests for treating various ailments of human beings and domestic animals. Therefore, medicinal plants play great role in our life. The World Health Organization (WHO) has categorically reported that more than 80 % of the World’s population depends on plant base medicines (Velavan et al., 2007). Medicinal plants constitute principal health care resources to majority of population. In India, per capita consumption of drugs has been estimated to US$ 3 annually which is lowest in the world (Tewari, 2000). Research on medicinal plants becomes much more important as it is not only a potential sector for higher economic returns but also a challenge to ensure consistent but sustainable availability of natural resources.

The National Health Experts have prepared a list of 2000 different plants used for medicines in India both for internal and external uses (Arya, 2011). Singh and Bisht (1992) have reported that the medicinal plants have even been listed in Vedas for therapeutic effects including 67 in Rig-Veda, 81 in Yajur-Veda and 290 in Athar-Veda. In Ayurveda, the oldest medical system of Indian subcontinent, as many as 2000
medicinal plant species have been described to cure as many as 1200 diseases. The Charak Samhita, age old written document on herbal therapy, reports production of 340 herbal drugs for curing various diseases. The World Health Organization (WHO) has recently compiled an inventory of more than 20,000 medicinal plants. Kala and Sajwan (2007) estimated that approximately 25 % of drugs are derived from plants. With realization of importance of ethano-medicinal plants, concerted and joint efforts of India, Pakistan, China and other countries have resulted in scientific evaluation and bio-prospecting of medicinal plants for various biological and therapeutic properties as alternate source of novel drugs (Arya, 2011). The increasing global acceptance of complementary and alternative medicine has been the major reason for steep rise in demand of medicinal plants.

India ranks second in the world after China in exporting medicinal plants globally (Velavan et al., 2007). It also meets substantial demands for domestic market of medicinal plants largely from informal unorganized sector. However, the demographic and unorganized marketing sector makes it virtually impossible to assess current volume of trade in domestic market. Nonetheless, World Bank Report (1998) estimated that trade in medicinal plants and related products will touch US $ 5 trillion by the year 2050 (Tewari, 2000). Kala and Sajwan (2007) reported that there are 9493 manufacturing units, 22635 dispensaries and 1355 hospital in India. Approximately, 800 species of medicinal plants are
in active trade and still there is a gap of 40000 metric tons in the demand and supply of medicinal plants.

The National Medicinal Plants Board (NMPB), Ministry of Health Affairs, Government of India, New Delhi made concerted efforts to organize the medicinal plants sector of India and has prioritized 32 plant species at the national level for research and development including *Asparagus racemosus* Willd. as one of the important species. The genus *Asparagus* is considered to be important medicinal plants with active gradients of steroidal saponins and sapogenins (Oketch-Rabath, 1998). It has recently been moved from family Liliaceae to newly created family *Asparagaceae* (Goyal *et al.*, 2003). As many as 300 species of *Asparagus* are known to occur worldwide. *Asparagus officinalis* is reported to be one of the most popular and economically important vegetable consumed in many parts of the world (Rao, 1952). Though several species of the genus are grown in India, *A. racemosus*, *Asparagus gonaclades* and *Asparagus adsendens* are most commonly used in indigenous medicine. In fact, European species like *Asparagus officinalis*, *Asparagus sprengeri* and *Asparagus acutifolius* are grown on large scale for various purposes in India (Rao, 1952).

*A. racemosus* commonly known as ‘Satavari’ is used by the Indian traditional system of medicine for the treatment of various ailments. It is distributed throughout tropical Africa, Australia, India, Sri Lanka and southern part of China. In India, it is found in sub-tropical regions and Himalayas up to
an altitude of 1500 m (Velavan et al., 2007). The species has numerous branches, spinous under shrubs with fusiform, succulent tuberous roots and woody stem with whitish grey or brown colour spines. The plants blossom during February-March and flowers are hermaphrodite. Fruit ripens by the end of April as red berries (Anon., 1985). The species is largely propagated through seeds and by asexual means through tubers.

In India, the demand of this versatile species is enormous both for medicinal and catering purposes. During 2001–2002, a total of 10,924.70 tonnes of A. racemosus was needed which rose to 16,658.5 tonnes in 2004–2005 calculating an annual growth of 15.10 %. In fact, it has been estimated that the demand for A. racemosus would not be possible to meet through exploitation of natural resources alone (Velavan et al., 2007).

Though almost all parts of A. racemosus are used for some or other purposes, roots are most commonly used in medicine. The roots are used as an ingredient in an Ayurvedic preparation to control nervous disorders. It also slows down inhibitory effects on the digestive enzymes, lipase and trypsin, and even stops degradation of food material in the intestinal tracts (Anon., 2000). The species is found to have several therapeutic attributes and specifically recommended for galactogogue, and aphrodisiac, diuretic, rejuvenating, carminative, stomachic and antiseptic. It is known to improve
defense mechanisms of the body and enhances longevity (Bhattacharya et al., 2000).

Over the years with increased populations, the demand of medicinal plants has also increased substantially which has led to over-exploitation of natural resources. Apart from this, the global interest in herbal medicines has consistently been enhancing owing to its multifarious uses. *A. racemosus*, in particular, is one of the most commonly used plants for traditional medicine and exploited unscientifically. The situation has now become alarming as the species in its natural habitat has become endangered due to unsustainable harvesting and over-exploitation (Bopana and Saxena, 2007). Therefore, the genetic conservation of the species has become utmost essential for not only to subvert threat of extinction (Velavan et al., 2007) but also to meet the future requirements as raw material for commercial use.

The genetic diversity is a fundamental component of biodiversity and in natural population contributes to long-term sustainability for several reasons as it increases ability of population to adapt to changing environment. The genetic variability is influenced by the geographical, seasonal and edaphic factors of environment. The quality of adaptation of a population to different environmental conditions is directly dependent on its amount of genetic diversity. On the other hand, if a population loses its genetic diversity it may experience fitness reduction and increased extinction risks due to inbreeding depression (Arya, 2011).
Genetic diversity is also a fundamental component of bio-prospecting to identify useful genotypes, genes and alleles for plant improvement. Bio-prospecting entails research and exploration of biodiversity for commercially and economically valuable genetic and biochemical resources. Though analysis of genetic variations holds great promise on specific attributes of herbs and their therapeutic and industrial value, scanty information on genetic variation among medicinal plants is matter of concern. It has now been understood that loss of genetic variation within a species as genetic erosion is usually much more serious that occurs much earlier than total extinction of species itself (Arya, 2011).

The success of any breeding programme depends on the nature and amount of variability existing within available germplasm. The genetic reconstruction of plant is required for developing high yielding varieties by incorporating and improving the characters. Yield improvement through genetic means usually comes from exploitation of new germplasm or traits. Germplasm serves as the most valuable natural reservoir in providing needed attributes for engineering successful varieties (Hawkes, 1981). The collection, evaluation and conservation of germplasm are therefore essential for present as well as future improvement programme, which offers determination of genetic variability. A little work on germplasm collection, conservation and evaluation has so far been accomplished in *A. racemosus* in India.
The choice of potential genetically diverse parents for use in hybridization programme is based on the hypothesis that crosses involving divergent parents offer greater possibility of obtaining desirable recombinants. Several workers have emphasized need of parental diversity in optimum magnitude to obtain superior genotypes in segregating generations (Kumar et al., 2007, 2008 and Barbosa et al., 2010). It is therefore required that the effort should be made to increase the wider use of existing diversity through germplasm collection and evaluation. Similarly, the conservation and management of biodiversity are a complex challenge that requires a basic understanding of distribution and abundance of species as well as their mutualistic interactions, reproductive biology and genetic structure. Frankel (1978) emphasized for evaluation of existing collections and retention of only core collections in the repository.

Though a lot of phyto-chemical studies have been carried out in A. racemosus, little attention has been paid to understand genetic variability, correlation, path analysis, divergence of different lines as well as selection of desired types with higher root production and saponin content. Therefore, investigations are required to be directed towards these areas so that superior varieties with specific purpose are developed.

Keeping above point in view, an investigation entitled 'Variability analysis for root production and saponin
content in *Asparagus racemosus Willd.* was proposed with following objectives,

- To determine variability of various morphological traits in different seed sources of *Asparagus racemosus*
- To quantify variability for saponin content in different seed sources
- To study different genetic parameters and establish relationship with reference to saponin production
- To establish germplasm bank