Chapter 1

INTRODUCTION
The stone fruits (Prunus spp.) are extremely diverse group of woody plants that include over 400 species of trees and shrubs grown worldwide either for their edible fruits and nuts or for their ornamental interest or even as valuable rootstocks. Economically the most important stone fruits are peaches, plums, cherries, apricots and almonds.

The cultivated almond (Prunus dulcis (Miller). D.A. Webb; Syn. P. amygdalus L. Batsch.) belongs to family Rosaceae, sub family Prunoideae with a diploid chromosome number as 2n=16. It is a native of Central Asian mountain areas (India, Pakistan and Iran), where it is still possible to find its many wild species (Kochar, 1981). The cultivated almond is believed to have originated from three wild species—Prunus bucharica, P. fenzilance and P. ulmifolia (Kester and Asay, 1977). Almond is cultivated mainly in countries between the latitudes 36° and 45°N, although under certain mild climatic conditions, cultivation may extend further north. Major almond producing countries of the world in the form of decreasing production include United States of America (California—more than 60% of world production), followed by Spain, Italy and Iran, with limited amounts produced in Greece, Turkey, Israel, Tunisia, Morocco and Australia. In India almond cultivation is exclusively restricted to Kashmir Valley. However almond plantation in Chini and Lahul areas of Himachal Pradesh and over hilly tracks in U.P. is reported to bear encouraging results as well (Kochar, 1981).
In Kashmir valley almond trees are grown at a height of 1500-1800 ft, covering an area of 18322 hectares with an annual production of 9663 M. tones. The average yield is 4.4 M. tones per hectare and the major almond producing area is district Pulwama (Anonymous, 2002).

The existing plantation of seedling almonds in Kashmir is gametophytically self incompatible and thereby maintains a high degree of heterozygosity. Variation in fruit shell, size and yield due to heterozygosity and assortment has resulted in emergence of innumerable varieties or ecotypes, which are regarded as cultivars despite the fact they lack uniformity. Attempts were initiated to upgrade the genetic base of almond industry of J&K State from modern varieties (Dalal et al., 2000) which culminated into the release of four almond cultivars viz. Mukhdoom, Parbat, Waris and Shalimar in 1995 (Anonymous, 1999). Besides these released cultivars the traditional varieties remain equally important because of their characteristics as well as source of genetic diversity. These varieties sometimes have superior performance in particular locations especially in marginal environments (Alexandratos, 1995). In order to circumvent loss of valuable genes as a result of erosion of genetic diversity ex-situ germplasm repository of almond has been established in SKUAST, (Sher-i-Kashmir University of Agricultural Sciences & Technology) Srinagar, J&K. The repository besides also contains 10 exotic cultivars like Primaskij, Pranyaj, Nonparioel, Nikitskij, Jordanolo, Marced etc. used for future crop improvement programme.

Most of the seedling origin almonds are early bloomers, which limit almond production because of early spring frost. Mid and late bloomers, to a great extent can escape onslaught of spring frost. All the four released cultivars like Parbat, Shalimar, Mukhdoom and Waris are not only mid and late bloomers; but also posses some unique characteristic as under:

(1) **Parbat:-** Tree is medium sized; mid bloomer; nut size small, shelling percentage 49; crops from 1-2\textsuperscript{nd} week of August and the average yield is 5Q/h. (Pl.1, Fig. 1; Pl. 2, Fig. 1).
(2). *Shalimar:*- Tree is medium in size; mid bloomer. Nut large sized with appealing appearance. Shell moderately pored; shelling percentage 40; crops in last week of August and the average yield is 5Q/h. (Pl. 1, Fig. 2; Pl. 2, Fig. 2).

(3). *Mukhdoom:*- Tree is large in size, late bloomer, nut and kernel size medium, shelling percentage 38-40; crops in first week of August and the average yield is 7Q/h (Pl. 1, Fig. 3; Pl. 2, Fig. 3).

(4) *Waris:*- Tree is medium sized; late bloomer. Nut and Kernel size medium, shell densely pored; crops in last week of August and the average yield is 6-7Q/h. (Pl. 1, Fig. 4; Pl. 2, Fig. 4).

All these cultivars are commercially desirable thin shelled and posses resistance against some indigenous pathogens/diseases.

Commercial breeding of woody fruit species is a slow and difficult process due to high levels of heterozygosity and long generation cycles (Sriskandarajah et al., 1994). For this reason it is important to develop gene transfer methods for fruit crops to accelerate the breeding process and broaden the germplasm sources available for crop improvement, since almond is regarded as one of the cash crops of the valley and the main objective of investigation is to explore the new methods of breeding for quick multiplication of these desirable cultivars. Presently all the four released indigenous cultivars are being propagated through budding on sweet and bitter almond root stocks. Since budding is not only skillful, but also a cumbersome process and upsurges the need for some non-conventional methods of plant breeding like *in vitro* regeneration.

In order to boost the horticultural industry of J&K State and keeping in view the important horticultural characteristics of these four released cultivars, work has been initiated to propagate these through modern non-conventional breeding techniques like in vitro culture of various types of explants. This technique includes micropropagation and indirect
Plate-1. Fruit bearing trees of almond in blooming season at SKUAST-K.

Fig.(1). A 5 year old plant cv. Parbat.
Fig.(2). A 10 year old plant cv. Shalimar.
Fig.(3). A 5 year old plant cv. Makhdoom.
Fig.(4). A 10 year old plant cv. Waris
Plate-2. Almonds.

Fig.(1). Cultivar – Parbat.
Fig.(2). Cultivar – Shalimar
Fig.(3). Cultivar – Mukhdoom.
Fig.(4). Cultivar – Waris.
regeneration through callus culture. The micropropagation not only maintains clonal integrity but also results in production of countless plants from a single shoot, irrespective of season while the callus culture will open a new door for production of transgenic almonds in near future. The in vitro almond culture also aims at genetic improvement and cryopreservation of germplasm (Rugini, 1986; Kester et al., 1986).

To maintain the clonal purity, seed derived material is generally not used for propagation and in considering the application of genetic transformation to almond, it is important to develop protocols to regenerate plants efficiently from adult tissue. Persual of literature shows that till date there has been no report of in vitro regeneration from adult almond tissues. Presently an attempt has been made in this direction to regenerate four indigenously released cultivars (Mukhdoom, Parbat, Waris and Shalimar) of almond from their adult tissues. The work on such lines (micropropagation and callus culture) will surely help in the upliftment of horticultural industry of J&K State vis-a-vis welfare of poor farmers, besides the development of such protocol will act as a stepping stone not only for future research in this field but also for new entrepreneurs interested in such trade.