CHAPTER 1

INTRODUCTION
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Cherries are one of the most important deciduous fruit trees as well as ornamental crop worldwide. They are the member of the genus *Prunus* of *Rosaceae* family. Cherry trees are distributed throughout the temperate region of Asia, Europe, Northern Africa, Australia and most of North America. The commercially important edible cherries are mainly obtained from *Prunus avium* (sweet cherry) and *Prunus cerasus* (sour or tart cherry).

Cherries have a very short growing season and they are mostly harvested during summer. In Australia, they are usually at their peak around Christmas time, in Southern Europe and North America in June, in South British Columbia (Canada) in July to mid August and in UK in mid July ([http://en.wikipedia.org/wiki/Cherry](http://en.wikipedia.org/wiki/Cherry)).

Sweet cherries are produced commercially in 65 countries on over 900,000 acres and the worldwide yield averages just over 4500 lbs/acre ([http://fruit-crops.com/cherry/](http://fruit-crops.com/cherry/)). Top ten sweet cherry producing countries are Turkey, USA, Iran, Italy, Russia, Syria, Spain, Ukraine, Romania and Greece. According to FAO statistics, total production of cultivated cherry in 2007 was about two million tonnes. Around 40% of world cherry production originates in Europe and around 13% in the United States.

Virus is a nucleoprotein entity that has the ability to cause disease. It multiplies only in living cells and is too small to be seen individually with a light microscope. All viruses are parasitic in cells and causes a number of disease in all forms of living organisms, from single celled microorganism to large plants and animals. The total number of viruses known to date exceeds 2000, and new viruses are described almost every month. About one-fourth of all known viruses attack and cause diseases in plants (Agrios, 2005). Plant viruses generate economic loss for farmers, producers and consumers by adversely affecting plant growth and reproduction; causing death of host tissues, reduction of yield or quality, crop failure, increased susceptibility to other stresses, loss of aesthetic value (Waterworth and Hadidi, 1998, Langham, 2004)

Plant viruses in fruit trees present a potential danger that could injure the fruit industry and the planting stock industry (nurseries), causing direct losses to growers and nurseries. Fruit growers are affected by reduced plant growth, yield and quality of plant products. Consumers
are affected by higher prices and reduced quantity of fruit. In general, viral infections have a greater effect on crop yield and fruit quality than on vegetative growth. With the most virulent strains, the yield losses can reach up to 98% (Nemeth, 1986). Viral diseases in perennial crop plants are more dangerous than in annual crops (Agrios, 1997). The perennial woody plants in production cannot be cured once infected with viruses. Virus infected fruit trees are subject to permanent damage of fruit quality and yields, a general decline of tree growth and even death. It is possible for a virus to infect a tree without causing any obvious symptoms called a latent virus or sleeping virus. A latent virus may become more virulent due to changes in the environment or through propagation, often onto a different rootstock. The degree of virus symptom development and effect on a plant is influenced by the virus strain, plant variety, and environment.

Cherry, like other stone fruits such as almond, apricot, peach and plums are perennial crops and usually propagated by grafting and therefore, are easily infected with viruses when contaminated material is used as propagation source. Cherry trees are prone to a number of diseases caused by viruses and virus-likes agents. Diseased tree frequently develops chlorotic ring, chlorotic-necrotic ring spots, shot holes and yellow mosaic in leaves caused by Prune dwarf viruses (PDV), Prunus necrotic ring spot virus (PNRSV) and Apple chlorotic leaf spot virus (ACLSV) in single or mixed infections. Strains of these viruses are reported to cause discolorations, dark spots, pits and necrosis in the fruits (Desvigens, 1999). A survey of cherry growing areas of Mediterranean region (Albania, Bosnia and Herzegovina, Italy, Jordan, Lebanon, Morocco, Palestine, Serbia, Syria, Tunisia and Turkey) which supplies about 38% of the world cherry production revealed that 48% cherry plants were infected with at least 29 identified viruses. About 30% of the infected trees showed natural mixed infection. The percentage incidence of PDV, PNRSV and ACLSV were 80, 14 and 14, respectively (Myrta and Savino, 2008).

Little cherry disease (LCD) is one of the major diseases of sweet cherry worldwide which has been described as a serious threat to the commercial cherry production (Eastwell, 1997; Eastwell and Bernardy, 1998; Rott and Jelkmann, 2001a). LCD was first identified in 1933 in the Kootenay Valley, British Columbia, Canada (Bajet et al., 2008) and spread quickly to all orchards and production declined by 90% by 1979 (Theilmann et al., 2004). LCD has now
been reported from most parts of cherry producing areas of the world (Welsh, 1976; Nemeth, 1986; Eastwell and Bernardy, 2001). LCD affected cherry trees generally produce small pointed fruit with poor color, flavor, and sweetness which renders cherries unmarketable (Rott and Jelkmann, 2001; Theilmann et al., 2004). Little cherry virus 1 (LChV-1) and Little cherry virus 2 (LChV-2) have been found to be associated with LCD of sweet and sour cherry (Rott and Jelkmann, 2001; Theilmann et al., 2002, 2004; Bajet et al., 2008). A study in Japan reports that, 14% LChV-1, 65% LChV-2, 14% CNRMV, 49% CVA and 92% CGRMV were associated with sweet cherry. ACLSV and PNRSV have also been identified in sweet cherry in Japan (Isogai et al., 2004). In China PDV, PNRSV, APMV, ACLSV, CVA, LChV-2 and CGRMV are reported from sweet cherry (Rao et al., 2009, 2011; Zhou et al., 1996, 2011).

In India, Cherry is mainly grown in the North-Western Himalayan region of Jammu and Kashmir (J&K), Himachal Pradesh (H.P.) and Uttarakhand hills. Many cultivars of sweet cherry had been introduced from Europe, British Columbia and former USSR before India’s independence in 1947, while commercial cultivars of sour cherry had been brought mainly from USA (Ghosh, 1999).

Kashmir has 3,106 hectares of land under cherry cultivation and produces 3.5 tonnes per hectare annually; Himachal Pradesh has over 2,000 hectares of land under cherry cultivation and production of cherry was 698 tonnes in 2007, 438 tonnes in 2008 and 650 tonnes in 2009. In Himachal Pradesh cherries are mainly grown in the higher reaches of Shimla, Kullu, Mandi, Chamba, Kinnaur and Lahaul & Spiti districts, at an altitude from 6,000 to 8,000 feet above sea level. Rampur, Narkanda, Rohru, Kandayli, Kotgarh and Kotkhai are the main cherry production belts in Shimla district of Himachal Pradesh.

There are several reports of viruses associated with cherry plants from different parts of the world but in India little effort have so far been made in this direction specially for detection and characterization of cherry viruses at molecular level. The cherry viruses so far, reported from India are PNRSV from sweet cherry (Chandel et al., 2010) and Wild Himalayan Cherry (Prunus cerasoides; Chandel et al., 2007) and ACLSV from Wild Himalayan Cherry (Rana et al., 2007). Viral diseases have become the most important of all diseases in modern fruit production. Their control requires intensive, specialized and complex detection and
characterization techniques. At the moment, unlike bacterial and fungal disease, there are no direct methods available to control the viral disease. Therefore, detection of harmful viruses in the plant material and vectors is essential to ensure sustainable production. Plenty of works exist on survey, identification and characterization of cherry viruses in most of the cherry growing countries. Keeping this in view the present study has been undertaking with the following objectives:

1. Survey of viruses infecting cherry in Western Himalaya.
2. Molecular characterization and variability analysis of viruses infecting cherry.
3. Development of multiplex RT-PCR for detection of major cherry viruses.
4. Development of ELISA based diagnostics for cherry virus A.