Chapter 1
INTRODUCTION
World is endowed with a rich wealth of medicinal plants. Medicinal plants are the local heritage with global importance. The World Health Organization estimated that up to 80% of people still rely on herbal remedies for their health care (Chevallier, 1996). In India, medicinal plants serve as the main source of health care for a majority of the population because of cultural preference and also because of the unaffordable high cost of synthetic pharmaceutical products. India holds a share of 2.5% in the international market, occupying a unique place in Indian socioeconomic (Jakhar et al., 2003). Many researchers have repeatedly advocated undertaking applied and fundamental work on cultivation of medicinal plants, several of which may attain the position of important cash crops for Indian farmers in future (Swaminathan, 1982; Atal and Kapur, 1982; Jakhar et al., 2003; Singh and Tyagi, 2004).

Among the various medicinal plants, *Withania somnifera* locally known as ashwagandha, has a great potential for the treatment of several maladies. *W. somnifera* belongs to family *Solanaceae* (Bentham and Hooker, 1862-1883) and is an erect, evergreen, tomentose shrub attaining a height of 30-150 cm. Leaves are alternate and exstipulate. Inflorescence is an axillary cluster of 2–8 flowers. Fruit is a pendulous, globose berry 5–7 mm in diameter, orange to red, many-seeded, enclosed by persistent, membranous to papery calyx. Roots are stout fleshy with characteristics odour and bitter in taste (The Wealth of India, 2003; Purohit and Vyas, 2004). Seeds are lens-shaped to kidney-shaped and of 2–2.5 mm × 1.5–2 mm in size and orange, bright red or pale brown in colour.

The plant is widespread in Africa, Mediterranean region and The Middle East (Mabberley, 1997; Doaigey, 1991). In India, the plant is distributed throughout the dry region especially in wastelands ascending to an altitude of 2000 m in the Himalaya. There are two subspecies of *W. somnifera* described as *Withania somnifera* Dunal and *Withania somnifera* Kaul (Dhalla et al., 1961)
Ashwagandha is considered a RASAYAN herb in Ayurveda (Handa, 1994). The Ayurvedic scholar Charaka (10 BC) described the reputed effects associated with W. somnifera, ‘One obtains longevity, regains youth, gets a sharp memory and intellect and freedom from diseases, gets a lustrous complexion and strength of a horse’. W. somnifera enjoys a considerable therapeutic repute and future (Elsakka et al., 1989) in Allopathic, Homeopathic and Unani systems of medicine and is considered equivalent to Korean ginseng (Sangwan et al., 2004). The herb possesses antistressor (Archana and Namasiyam, 1998), Antioxidant (Keshavkant, 2008), adaptogen (Kulkarni and Ninan, 1997) and anticarcinogenic effects in animal and cell cultures (Yang et al., 2007).

Ethnic or aqueous extract of the root alone or in combination with other herbal materials is used in many commercial herbal formulations under various trade names such as Mentat (Kumar and Kulkarni, 2006), Gerifortate, Stresscom, Ashwagandharist, Ashwagandha-ghrit etc. Eumil, a polyherbal formulation consists W. somnifera as one of its ingredient (Gupta and Rana, 2007).

W. somnifera is cultivated over an area of 10,780 ha with a production of 8429 tones in India (Praveenkumar et al., 2007). While the annual demand increased from 7028 tones (2001-02) to 9127 tones (2004-05) necessitating the increase in its cultivation and higher production. According to one estimate, the production from cultivated sources touches around 6000-7000 tons per year, while the rest is from wild sources. Annual consumption by the Indian pharmaceutical industries is approximately 500 tons (Annex-x/1, Planning Commission Report, 2000). The most important trade centre of the country is Nimach mandi in MP state and other trade centers as Bombay, Calcutta, Delhi and Amritsar. It’s a profitable crop in MP (Nigam, 1984).

W. somnifera is prone to several pests and diseases such as fungal, nematode, phytoplasma and viral diseases. Like other pathogens that affect the economic value of the plant, viruses are of significant importance due to absence of therapeutic control measure against them in plants. Despite their simplicity in comparison with cellular organization, viruses are extremely important and deserving of close attention.
The losses caused by plant viruses in the tropical and subtropical regions are of greater significance causing an estimated US$60 billion loss in crop yields worldwide each year. The tropical location of Indian subcontinent with its diverse climatic conditions provides ideal conditions for a large number of viruses and their vectors to flourish thus affecting various cropping systems. Since plants do not produce antibodies, they neither recover from a virus infection nor become immune. Once a plant is infected, it may remain infected for life, although the symptoms of disease become masked or the plants grow out of symptoms under certain conditions.

A very few plant viruses are reported on medicinal plants: *Cucumber mosaic virus* on *Rauwolfia serpentina* (Raj et al., 2007) and *Ocimum sanctum* in terms of incidence and yield loss (Raj et al., 1997). Several viruses have been associated with disease symptoms in mint (Mentha spp.): *Strawberry latent ringspot virus* (Postman et al., 2004), *Impatiens necrotic spot virus* (Angelis et al., 1993), *Tomato spotted wilt virus* (Sether et al., 1991) and *Tobacco ringspot virus* (Stone et al., 1962). Mosaic virus infecting Indian long pepper and betel vine have been reported in India (Hareesh et al., 2006).

The impact of viruses on crop losses is more dramatic in annuals because damages are caused within the brief span of cropping season. Around 70% of all known plant viruses are transmitted from plant to plant by invertebrate mobile vectors such as aphids, leafhoppers, whiteflies, mites, thrips and beetles etc. Virus infections are generally characterized by the induction of disease symptoms such as developmental abnormalities, chlorosis, and necrosis. Recent studies indicate that symptoms are derived from specific interactions between virus and host components.

Geminiviruses, belonging to family *Geminiviridae*, are a group of DNA viruses that are classified into four genera- *Mastrevirus, Curtovirus, Begomovirus*, and *Topocuvirus* based on genome organisation, insect vector and host range (Fauquet and Stanley, 2005). They have geminate (twinned) particles approximately 18–20 nm in diameter and 30 nm long, consisting of two incomplete T = 1 icosahedra (Thomas et al., 1986) joined together in a structure with 22 pentameric capsomers and 110 identical protein subunits. The diseases
caused by geminiviruses are of utmost concern (Cohen, 1966) in the tropical and subtropical areas of the world. In the past 15-20 years, both prevalence and distribution of whitefly transmitted geminiviruses (WTGs) have increased and the impact has been devastating. Depending on the crop, season, whitefly prevalence and other factors, yield losses range from 20-100%. More than 80% of the known geminiviruses are transmitted by whiteflies and belong to the genus Begomovirus, which mostly has bipartite genomes designated as DNA-A and DNA-B and infect dicotyledonous plants although numerous begomovirus with a monopartite genome occur in the old world. Begomoviruses are transmitted by whitefly vectors and many can also be transmitted by mechanical means and grafting.

More recently virus research has been focused on understanding the genetics and molecular biology of plant virus genomes, with a particular interest in determining how the virus can replicate, move and infect plants. Understanding the virus genetics and protein functions has been used to explore the potential for commercial use by biotechnology companies. In particular, viral-derived sequences have been used to provide an understanding of novel forms of resistance. The recent boom in technology allowing humans to manipulate plant viruses for production of value-added proteins in plants (Plant virus, wikipedia).

Mosaic, vein clearing and mild downward curl of leaves like viral symptoms were observed on *W. somnifera* in our survey during 2008-09 at various locations of Aligarh and Lucknow of Uttar Pradesh and Hindaun city of Rajasthan with a significant (15-25%) disease incidence. In view of medicinal potential of *W. somnifera* and to provide the clean healthy plant materials to the herbal based pharmaceutical industries, attempts were made to identify the virus associated with the mosaic disease of *W. somnifera* and to develop a reliable detection procedure of the virus. The detailed aims and objectives are as under:

**Aims and objectives:**

- Biological characterization of the virus isolate.
- Detection of virus by molecular diagnostic tools.
- Molecular characterization of the virus isolate.
- Pathological study of the virus isolate on *W. somnifera*. 