INTRODUCTION
Lichens are essential components of ecosystems representing symbiotic associations of fungi (mycobionts) and green/blue green algae (photobionts). In the association, algae serve as a source of carbohydrates for fungi, and fungi in turn protect algae against dehydration, UV radiation, and mechanical destruction. Majority of fungi that participate in the formation of lichens belong to the group Ascomycetes (40%) (Hawksworth & Hill, 1984) and a few belong to the group of Dureomycetes and Basidiomycetes fungi. The photobiont belongs to the order Chlorococcales (83%), Ulotrichales (9%) and cyanobacteria (8%) (Ahmadjian, 1993). The peculiar association of fungus and algae in lichens enables them to grow and survive in extreme ecological conditions of cold and dry environments, either at polar latitudes or at extreme altitudes (Boustie & Grube, 2005). In an ecosystem, lichens provide food, shelter, and nesting material for a variety of wild animals and birds (Mc Cune & Geiser, 1997) and the cyanobacterial symbionts contribute significantly for forest nitrogen fixation (Slack, 1988). Besides being economically important as medicines, perfumery, dye stuffs, and spices, lichens are also used as pollution monitors.

There are around 20,000 species of lichens reported throughout the world and India represents more than 2,300 species inhabiting eight lichenogeographical regions of the country (Fig.1) out of which 23% species are endemic (Singh & Sinha, 2010). Eastern and Western Himalaya together with Western Ghat regions of the country represent rich lichen diversity areas of the country.

Lichens are broadly categorized into two groups namely macrolichens and microlichens which can be further subdivided, on the basis of growth forms, into foliose (leaf-like forms), fruticose (thread-like pendent forms) and crustose (closely adpressed to substratum) with intermediate leprose (powdery forms), squamulose (closely adpressed to substrate from centre and free from margins) and dimorphic forms (primary foliose thallus and erected finger-like projection in secondary thallus). Although taxonomic studies of macrolichens (foliose and fruticose) are thought to be easier as compared to those of microlichens because of their macroscopic size but systematic and taxonomy of lichen genus *Usnea* Dill. ex Adans. (a fruticose lichen) at species level is considered a difficult task (Clerc, 1987b, 1998; Articus, 2004) because of phenotypic plasticity of the species. The morphological features of species vary greatly under different environmental conditions and similar species appear radically different.
Fig 1. Map of India showing different licheno-geographic regions.
The name *Usnea* was first given by Dillenius in *Historia muscorum* (1742). The genus was placed in family Usneaceae until studies on apothecial ontogeny and ascus apical structures proved that *Usnea* belongs to the family Parmeliaceae (Halonen, 2000). One can easily recognize *Usnea* in fields by its shrubby to pendent greenish yellow thallus, radial symmetry and presence of central cartilaginous axis (Ohmura, 2012). There are three forms of fruticose thallus in Usnea, erect/bushy when thallus is small (e.g. *U. orientalis, U. ghattensis*), long pendulous thallus hanging from the tree branches (e.g. *U. angulata, U. longissima*) or sub-pendent thallus of intermediate length (e.g. *U. aciculifera, U. rubicunda*). The dominant branching patterns observed are dichotomous, sub-dichotomous and sympodial. The basic characters used for identification of *Usnea* up to species level include morphological features like habit of thallus, branching pattern, pigmentation of basal part, presence or absence of sorelia together with its morphology, isidia, pseudocyphellae, papillae, tubercles, fibrils, faveolae, shape of branches etc.; anatomical features like ratio of thickness of cortex (C), medulla (M) and central axis (A), the compactness of fungal hyphae in medulla and presence or absence of specific secondary metabolites. Combination of morphological, anatomical and chemical characters can be used to delimit species.

Usnic acid, an active principle in medicines, mouthwash, deodorants and sunscreens products, is present in all the species of the genus *Usnea*, responsible for yellowish green colour of the thallus. *Usnea* has also been reported to be most frequently used genus for medicinal purposes (Hale, 1967). In addition to antimicrobial activity against human and plant pathogens, it exhibits antiviral, anti-protozoal, anti-proliferative, anti-inflammatory and analgesic activities (Cansaran, 2006). Singh et al. (2015) developed noval herbo-matalic colloidal nano-formulation using extracts of *U. longissima* for biomedical use. The unicellular green algae found in *Usnea* belong to genus *Trebouxia*. *Usnea* generally found growing in moist and well lit forest areas between 1000 to 4000 m altitudes and is vulnerable to environmental pollution (Halonen 2000). Majority of *Usnea* species are corticolous (90%) and preferably grow on *Quercus leucotricophora, Quercus semicarpifolia* and *Rhododendron* spp. The trees of *Taxus baccata, Cedrus deodara, Pinus* spp. *Betula* spp., *Abies* spp., *Pyrus* spp., and *Berberis* spp. too harbour species of *Usnea*. Only few saxicolous species are known. Mostly found in Alpine regions, *Usnea* is the fifth largest genera of lichens in India, belonging to the family Parmeliaceae, order Lecanorals and class Ascomycota.
The first world monograph on *Usnea* was published by Motyka (1938) where 451 species were described in detail without mention of morphological features induced by environmental factors. As a result, too many species were identified, differing in just few modifiable characters. Since then, many taxonomic revisions were made in Europe (Clerc 1987b; Halonen et al., 1999), North America (Clerc & Herrera-Campos, 1997; Halonen et al., 1998), East Africa (Swinscow & Krog, 1978), East Asia (Ohmura, 2001, 2012) and Australia (Stevens, 1999) to overcome the taxonomic problem that prevailed in the genus for a long time. Many new species were described as well as most of the existing species were synonymised.

In India, G. Awasthi (1986) revised the taxonomy of *Usnea* in India and provided detailed description of 54 species including 9 species namely *U. austro-indica* G. Awasthi, *U. fischeri* G. Awasthi, *U. ghattensis* G. Awasthi, *U. nepalensis* Awas. ex G. Awasthi, *U. nilgirica* G. Awasthi, *U. norketti* G. Awasthi, *U. pictoides* G. Awasthi, *U. pseudojaponica* G. Awasthi and *U. stigmatoides* G. Awasthi, as new to science. Since then, the records of *Usnea* were available in many regional floristic accounts from the country (Joshi et al., 2010; Kumar et al., 2011; Vinayaka et al., 2012) but no taxonomic revision was made. In recent studies, Singh and Sinha (2010) mentioned in their checklist the presence of 42 species of *Usnea* from Eastern Himalayas out of which 6 species were endemic to the region whereas Western Ghats in the southern part of the country represent the occurrence of 40 species out of which 11 species were endemic.

During the last more than three decades a large number of specimens belonging to genus *Usnea* were collected from different phyto-geographical regions of India and were preserved as unidentified material in the herbarium of CSIR-National Botanical Research Institute (LWG), which need identification up to species level. Following the modern concepts, the systematic studies on *Usnea* from different regions of world were studied. However, the Indian *Usnea* species are so far not studied after applying the recent concepts. The gap area thus created in the taxonomy of *Usnea* since past two and a half decades were required to be fulfilled using modern concepts of taxonomy. It was necessary to employ features that were least affected by environmental conditions of an area rather than those that vary greatly with changing environmental conditions. Clerc (1998) reported that characters like brilliancy of cortex, thickness of internal structures, isidiomorphs, pigmentation of basal part of and
morphology of soralia in *Usnea* were least affected due to changing environmental conditions.

Together with the taxonomy, the abundance, density and species diversity of *Usnea* species were required to be studied to understand the ecological role *Usnea* play in forest ecosystems.

Thus, the present research work is proposed to accomplish comprehensive study on lichenized Ascomycetes *Usnea* from India with the following objectives:

1. Fresh collection of *Usnea* species in Uttarakhand Himalayas from the area not explored in the past.
2. Identification of freshly collected and samples already preserved in different herbaria of the country.
3. To provide detailed taxonomic account of *Usnea* species in India.
4. Preparation of keys for segregation and identification of different species of lichen genus *Usnea* in India.
5. To study the distribution, diversity and conservation aspects of lichen genus *Usnea*.
6. To update the taxonomy of genus *Usnea* in India and prepare an illustrated account of the Indian *Usnea* species.