an altitudinal gradient, as the altitude increases the net surface area decreases for floristic growth. Consequently, the competition for space and nutrients required for the growth and development will increase. If the upward movement of temperate plants begins due to increasing temperature, possibly the subalpine and alpine habitats may face the additional threats of global warming[5]. Increase in temperature could enhance evapotranspiration, while low precipitation may induce water stress. Also, sporadic precipitation will favour bog conditions in moist and shaded habitats. Rise in temperature may also increase the growing season (snow-free period) in the highland ecosystems. The changes in received volume of snowfall and duration may hamper regular chilling and post-chilling phenomena. Thus, a small shift in the consistent weather conditions of a unit area and at a specific time may be indeterminate variable for driving phenology, growth and reproduction of mountains vegetation. Sometimes unique features of plants may also hinder them while coping with the variation in ambient climatic conditions.

Phenological events in the oaks growing in subalpine–timberline forest are triggered with the commencement of favourable growth season[1]. Simultaneously occurring leaf fall and emergence of new leaves, overall growth and development, regeneration and distribution of oaks in their specialized habitats are governed by the ambient conditions[6]. Interrupted regeneration, susceptibility to frugivory and viviparous germination are the key features in some species of oaks. If the mast fruiting year is not accompanied by satisfactory precipitation, the viviparous species may lose the opportunity for regeneration due to desiccation or water stress. Shift in the required weather conditions in due course of seed maturation and leaf emergence may either enforce the retarded investments in leaf production or may induce changes in the regular process of seed development. Emergence and establishment of seedlings in the oaks under their habitat conditions is reported to be unsatisfactory[7]. Massive lopping for fodder, habitat degradation and trampling damages caused by grazers and browsers are considerable factors for poor regeneration of oaks in the mountain regions. Vertically upward or downward and randomly the mid opening in the oak forests seem to be caused by biotic factors. In future, due to meagre regeneration and climate change, it will be merely possible to find the identical oak forest replaced by its next generation. Growth and reproduction in the highland ecosystem are controlled by temperature and with increasing temperature, tree species and other vegetation will start moving upward[4]. The morphology of acorn in majority of oaks is not compatible to upward or wind-aided migration. Despite the possibilities of dwelling-down of morphologically round or conical acorn, high-altitude oaks species are rarely observed to flourish at lower altitudes. Therefore, the acclimatization of oaks in their specialized habitats may rarely follow the variation in ambient conditions.

Therefore, the effects of climate change may be drastic to the species of oaks. Because the oaks are well adapted to their peculiar growth habitats, seed production strategy and germination behaviour in their specialized habitats. Degradation of these ecologically vital tree species and replacement colonization of uncertain and unknown species will certainly alter future ecological functioning of the present oak forest. Protection of oak forests with rotational approach, mass production and planting of seedlings in their natural habitats, and preventing movement of grazing animals during seedling emergence and establishment may be useful conservation plans for oak forests in the mountain areas. Despite the incidence of climate change, currently we are comfortable with our ecosystem and its important components. Maintaining its serenity will be useful for combating the impacts of climate change. In view of some physiological and morphological characters, and biotic and abiotic pressure, oaks are certainly vulnerable to climate change.

1. Bisht, V. K., D Phil thesis, HNB Garhwal (Central) University, Srinagar-Garhwal, 2010.
2. Singh, J. S. and Singh, S. P., *Forest of Himalaya*, Gyanodaya Prakashan, Nainital, India, 1992, p. 257.
3. Shenbin, S., Yunfeng, L. and Thomas, A., *Climate Change*, 2006, **76**, 291–319.
4. Wieser, G., Matyssek, R., Luzian, R., Zwerger, P., Pindur, P., Oberhuber, W. and Gruber, A., *Ann. For. Sci.*, 2009, **66**, 402p1–402p12.
5. Beniston, M., *Climate Change*, 2003, **56**, 5–31.
6. Faisal, A. M., *New Age*, 3 March 2008.
7. Vetaas, O. R., *Plant Ecol.*, 2000, **146**, 137–144.

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Clonal seed production technology – alluring prospects for temperate mulberry genotypes

Sericulture is being practised in Kashmir for decades. Also, Jammu & Kashmir (J&K) is the only exclusive bivoltine area and a leading producer of bivoltine silk among the North Indian states of the country. The region indeed forms an important belt for sericulture. The oldest historical chronicle of Kashmir, *Raj Tarangni* also provides a reference to silk in Kashmir.

The state offers immense scope for increasing the production of high grade bivoltine silk. Presently, raw silk production in J&K is around 115 metric tonnes (mt)/yr (2011–12) as against 102 mt/yr in 2006–07, with an increase of 12.75%. Sericulture is an important component of the state economy, besides tourism. Kashmir valley, with temperate climate offers a salubrious environment for production of bivoltine silk. Rearing of livestock, production and manufacture of handicrafts, shawls, carpets and embroidery also contribute to the state economy.

Figure 1. Heterogeneity in mulberry fruits.

Mulberry leaf is the sole food for silkworm and the cocoon produced is the raw material for the silk industry. The mulberry genotypes, which have over the years become popular in the region are of Japanese origin and do not produce saplings in good percentage when propagated through stem cuttings[1]. Some of the popular mulberry genotypes which gained popularity amongst sericulturists in the region are Goshoerami, Ichinose and Kokuso-27.

These varieties are poor rooters with less rooting capacity[2]. Because of this shortcome, they are propagated through root grafting or bag grafting which takes 2–3 years from nursery to establishment, thereby being uneconomical and time-consuming. Studies carried out to induce *ex vitro* rooting through plant growth regulators at the Central Sericultural Research and Training Institute (CSR&TI), Pampore, have indicated less effect on rooting in Japanese genotypes[3].

However, many of these Japanese genotypes have been found to be good in terms of leaf yield and quality parameters under rainfed conditions of Kashmir[4].

The breakthrough technology developed by a group from the Centre for Cellular and Molecular Biology (CCMB), Hyderabad in collaboration with the Institute of National Recherche de la Agronomique (France) and the University of California, USA has succeeded in demonstrating that clonal seed formation in plants opening up new avenues in agricultural research[5].

The recent advances in various biotechnological techniques will pave the way for introduction of desirable genes and promise to revolutionize the agricultural industry. In this context mulberry clonal reproduction through seeds will have the greatest impact to revolutionize the sericulture industry, reduce heterogeneity and would benefit researchers in hybridization programmes to produce high-yielding varieties and raising large number of saplings through seeds (Figure 1). This technology will furthermore cut short the time-period in research required to produce the hybrid variety developed through traditional hybridization technique and the seed produced can be easily stored in gene banks through cryopreservation[6].

The research carried out by the CCMB team is praiseworthy for its strategies for engineering apomixes in food crops. The technology has been successfully demonstrated in the model plant *Arabidopsis thaliana*, by manipulating the genes involved in sexual reproduction leading to clonal seed formation.

If we can reproduce the seeds by this technology in temperate mulberry genotypes, it will represent an exact clone of the mother plant. It will also help farmers overcome the problems associated with breeding and propagation. The successful adoption of this technology will depend upon commercialization of this technology and regulatory authorities.

1. Bindroo, B. B. *et al*., *Geobios*, 1988, **7**, 36–39.
2. Baksh, S. *et al*., *Indian J. Sericult*., 2000, **39**, 30–32.
3. Fotadar, R. K. *et al*., *Sericologia*, 1990, **30**, 347–361.
4. Ganayee, M. S. and Baksh, S., Annual Report, CSR&TI, Pampore, 1997, pp. 30–39.
5. Mohan, P. A. *et al.*, *Science*, 2011, **331**, 876.
6. Rathore, M. S. *et al.*, *Curr. Sci*., 2010, **99**, 557.

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