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Is the future of *Eurotia ceratoides* safe in Changthang?

Eurotia ceratoides is one of the most common plant species of the Tibetan plateau and the Trans-Himalayan grasslands. It usually occurs in loose sandy soils and can be found growing up to 5300 m. The plant has small woolly hairs and a thick root stock that are its adaptation to the cold arid conditions of the Tibetan plateau (Figure 1). Changthang is the westernmost extension of the Tibetan plateau that extends to the eastern Ladakh in India. In India it is inhabited by *changpas* (nomadic community that rears the famous Pashmina goat) who are dependent on the surrounding resources for fuelwood and fodder. *Eurotia ceratoides* is one of the most important fuelwood and fodder species of the region. Presently its wide distribution and common occurrence may not be a cause for concern.



Figure 1. *Eurotia ceratoides*.

But does this assure that the future of *Eurotia ceratoides* is safe?

Keeping in view the pressures on *Eurotia ceratoides* for fuelwood and fodder we feel that the future of this species may not be that green. Our observations on the plant species and the resource use pattern of the *changpas* in the Changthang region of Ladakh indicate that its common distribution may no longer remain as such, although the decline may not be noticed in the coming 3–4 years. The plant is under tremendous pressure, its leaves are highly preferred as forage by the domestic (mainly sheep and goat), as well as the wild ungulates¹. Most of the wild ungulates were seen feeding on this plant (pers. obs.). It is one of the most important forage plants during winter season, hence is also called 'winter-fat'. It may be because the protein level in the palatable parts of *Eurotia ceratoides* is comparatively higher than other forage species of the Changthang (Uniyal *et al.*, unpublished data). Similarly the rootstock of the plant, that is quite thick and deep is usually dug out and heavily extracted for fuelwood by the *changpas*. The size of the root is perfect for burning in the *bukharis* (local hearth). In brief it can be said that this plant is under dual pressure, both above ground, due to grazing and below ground, due to fuelwood

extraction which might affect its population and regeneration in the near future thus threatening its survival. Unlike other woody plants of the area such as *Caragana versicolor*, which have thorns to protect themselves from the pressures of fodder and fuelwood extraction, *Eurotia* does not have this protective strategy. In fact the best growing and flowering *Eurotia* can be seen inside the *Caragana* bushes, that provides it a refuge. The disappearance of this species from the mountain landscape may make life even harsher for the inhabitants, livestock and wild ungulates of Changthang. Hence ecological studies on this species are of immediate concern.

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Development of eco-friendly, beneficial microbial biofilms

Considerable attention has been focused recently on microbial interference in degradation and synthesis processes in the environment, known as biodegradation and biosynthesis (e.g. refs 1 and 2) in lieu of physical and chemical methods. These processes occur in association with biotic or abiotic surfaces. Certain microbes can attach to the surfaces and differentiate to form complex, multicellular communities called biofilms. A biofilm consists of microbial cells (algal, fungal, bacterial and/or other microbial) and an extracellular biopolymer these cells produce, known as exopolysaccharide (EPS), which provides structure and

protection to the community. These communities can be found in medical, industrial and natural settings. The microbes undergo profound changes during their transition from planktonic (free-swimming) organisms to cells that are part of a complex, surface-attached community. Recent genetic and molecular approaches used to study bacterial and fungal biofilms have identified genes and regulatory circuits important for initial cell-surface interactions, biofilm maturation, and the return of biofilm microorganisms to a planktonic mode of growth³. In general, biofilms show an increased resistance to antimicrobial agents.

They cause recurrent microbial infections in humans and animals, due to their antibiotic resistance. Apart from that, a recent study has shown antifungal resistance of a fungal biofilm⁴. Owing to the heterogeneous nature of the biofilms, it is likely that there are multiple resistance mechanisms at work within a single community⁵. Biofilms are responsible for loss of billions of dollars in industrial productivity and both product and capital equipment damage each year, because of corrosion, contamination, fouling, etc.⁶. Biofilm reactors have been designed to promote microbial growths that are effective for treating environmental wastes

such as sewage, industrial waste streams, or contaminated groundwater. The microbial communities can be used to produce a wide variety of biochemicals that are then purified and utilized for public good, including medicines, food additives, or chemical additives for cleaning products. The microbes attached to particles of contaminated soils and aquatic sediments help degrade soil-bound contaminants occurring from chemical releases into the environment. Biofilms attached to the plant roots of some crops help cycle nutrients as well as biocontrol of pests and diseases, resulting in increased agricultural productivity. As such, the microbial communities exert either beneficial or harmful effects to the total environment. Therefore, there is a great scope for developing a biofilm technology of producing eco-friendly, beneficial microbial (EBM) biofilms for numerous applications.

In the past and the present to a great extent, microbes have been used in various biotransformation processes, of which single (pure) strains in their biofilm mode are employed. Biologists have observed naturally-occurring biofilms in various environments, and their biological activities have been examined. However, complex interactions of their resident microbes have not been studied adequately. Knowledge on those is very important in any attempt of designing effective EBM biofilms. Co-inoculation⁷ and co-culture⁸ of microbes have been observed

to perform the tasks better than their individual microbes. An interesting example of co-culturing microbes is the development of effective microorganism (EM) technology in Japan⁹. This consists of lactic acid bacteria (LAB), phototrophic bacteria (PB) and yeasts in an anaerobic microenvironment. LAB produce lactic acid through carbohydrate fermentation, and keep the medium acidic, which excludes many pathogenic microbes. They also produce antifungal compounds to inhibit undesirable fungal growth. PB produce carbohydrates required for LAB and yeasts, without generating O₂, which helps to keep the medium anaerobic. In addition, PB break down toxins in the medium. Yeasts produce ethanol and CO₂ by glucose fermentation. Ethanol and CO₂ are important for maintaining antifungal activity of LAB, and for photosynthesis of PB, respectively. In this manner, this microbial community maintains an excellent metabolic cooperation leading to self-sufficiency, which helps its stability and a wide range of activities in the environment. This community has specific mechanisms to survive even in the dark, and even under aerobic conditions.

My project recently developed and observed *in vitro* a rhizobial-fungal biofilm using common soil fungi¹⁰. This has important implications in rhizobial survival and soil N economy under conditions devoid of vegetation. It also has applications in producing improved biofertilizers that

supply most of the nutrients required for plant growth. As such, we can manipulate the development of EBM for optimized effectiveness.

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MEETING REPORTS

Freshwater prawns*

Freshwater prawn farming the world over has registered increase in the past decade. In India, a spurt in freshwater prawn farming activities can be seen in the recent years. The objective of the symposium was to evaluate globally the progress made and to critically analyse the constraints and shortcoming in fresh-

water prawn farming and research. K. V. Thomas, Minister for Fisheries and Tourism, Government of Kerala while inaugurating the symposium, stressed on the importance of freshwater prawn farming in India, especially in Kerala. He expressed concern over the pollution of the freshwater bodies in the country and suggested a scheme for cleaning Vembanad Lake, one of the largest lakes in the country.

The business session of the symposium started with a keynote address by

Michael New (European Aquaculture Society, UK). In the address, New reviewed the current global status of freshwater prawn farming with comments on the statistical information available. Going by statistical information of FAO for 2001, India produced 24,230 mt of the popular freshwater prawn variety *Macrobrachium rosenbergii*, standing at the 3rd position after China and Vietnam, which produced 128,338 and 28,000 mt respectively. He predicted that national production of scampi in India will be

*A report on the International Symposium on Freshwater Prawns, 2003 held at the College of Fisheries, Panangad from 20 to 23 August 2003.