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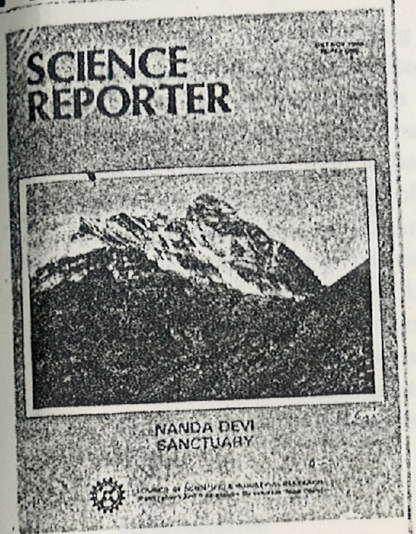

Cover : South-west face of Nanda Devi peak (7817 m)

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future. If harvested after three years, nearly 200 tonnes- 250 tonnes of firewood can be obtained from one hectare of land. After 5-6 years, the yield doubles up and is almost twice the yield obtained from casuarina plantations.

Energy plantations

Apart from providing fuelwood, leucaena wood is well suited for large-scale energy plantations (for electricity generators, rail-road locomotive, for drying fish, tobacco, etc.). Even today, nearly 8% of Sweden's energy and 10% of Finland's energy is generated from wood. In the Philippines and the U.S.A., leucaena wood is being used for thermal power generation. It has been estimated that 1000 ha. of leucaena plantation can run a 5 megawatt thermal station.

Reforestation

The adaptability of leucaena to establish and thrive on steep mountainsides, marginal soils, and in areas with prolonged dry seasons, has made it as one of the ideal tree species for plantations and for restoring denuded forest cover. In Indonesia, more than 30,000 ha. of land has been brought under leucaena plantations for rejuvenating unstable volcanic slopes. In Philippines, leucaena reforestation programme has received official patronage.

Miscellaneous uses

Leucaena can be planted as avenue tree for providing cool shade, increasing aesthetic value and improving the landscape. It can also be planted within the surroundings of schools, factories, parks and in the premises of offices and residences for providing fresh cool climate. Leucaena exudes gum profusely and yields good quantities of quality gum. Its tender leaves, pods and seeds are commonly consumed by people in Indonesia and Mexico.

Leucaena is generally free from any serious disease and pest problem. Among diseases, a few fungi have been recorded such as for pods (*Verticillum dehliae*), leaf spots (*Alternaria tenius*) and petiole blight (Alternaria sp.). The species exhibit profuse gumosis (oozing of gum) and many plants with gumosis turn black (Fig. 2). *Fusarium semitectum* is associated with the phenomenon of gumosis in some parts of India.

Among mammals goats, rats, deer, hares and other herbivorous animals relish seedlings and young plants. For protection against them, thick fencing is needed right from seedling stage.

Leucaena thus is a wonderful tree species with numerous benefits. Its cultivation and propagation should therefore be encouraged in India. Further availability of genetic diversity in leucaena offers to plant breeders a promising field for evolving cultivars with desirable characteristics.

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Alnus nepalensis—The multiple use tree of the eastern Himalayas

FORESTS usually represent the climax or relatively stable and balanced state of biotic communities and their environment. In the process of organic evolution, man appeared rather very late in the geological time scale. Forests then occupied almost every bit of the available land. He remained a part of the balanced forest ecosystems for hundreds of thousands of years but, in the past few centuries, he destroyed forests to make room for intensive agriculture and agro-industries. By now man has become the severest force of destruction of vegetation, ecobalance and environmental quality. He is now faced with ecological backlash of far greater intensity and severity than possibly he can bear. His very existence is at stake as a consequence of imbalance of nature, forest destruction and pollution. The remedy lies in the restoration of greenery to earth.

India, a country of dense human population and relatively lower technological growth, is in bad ecological shape. For him, forest restoration and management is of foremost importance. Fertile plains are best suited for agriculture and urbanization, but rolling topographies on hills and mountains have to be covered as quickly as possible by fast growing,

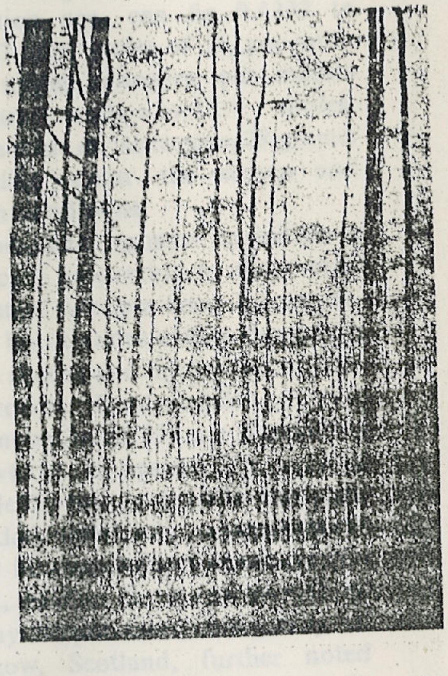

Fig. 1. *A. nepalensis* monoculture (30 yr. old) showing straight boles

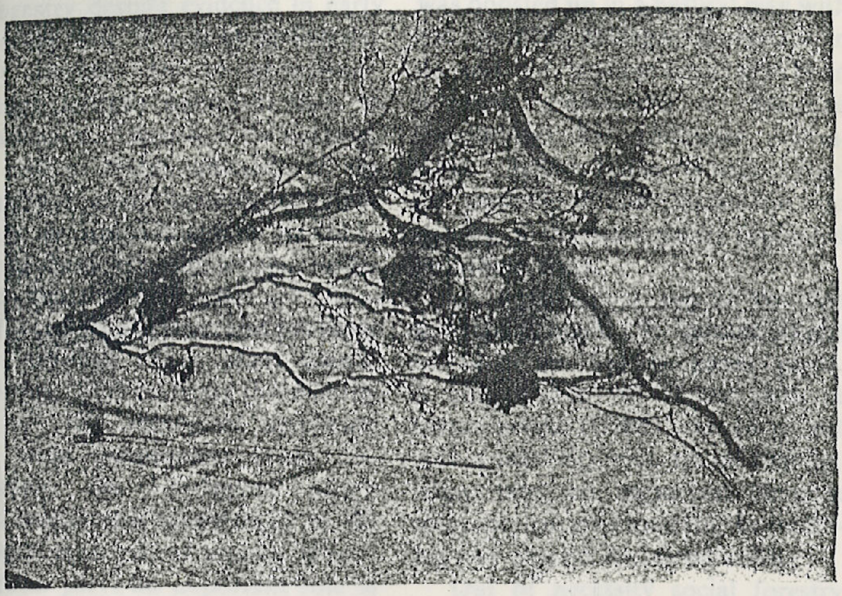

Fig. 2. Rootnodules of *A. nepalensis* which have an actinomycetous symbiont

economically and ecologically suitable trees to check soil loss, improve fertility and provide useful products like fuel, timber, fodder, etc.

On the Himalayas in east India, one such tree species is Alder or botanically *Alnus nepalensis* D. Don, which grows naturally as well as in plantations and meets most of the ideal qualities of economic and ecological significance. It colonises on landslide exposed soils, grows quickly, binds the soil, its symbiont (associated microorganism in its root nodules) fixes atmospheric nitrogen, its leaf litter provides nitrogen-rich manure and in its shade such delicate crops as *Amomum subulatum* (cardamum or *elaichi*) and *Cinchona*, are profitably grown on the hills of Darjeeling.

Out of the thirtyfive species of *Alnus*, only two species are known to exist in India, i.e., *A. nepalensis* in the Eastern and *A. nitida* in the Western Himalayas. As far as we see the history, *Alnus* have been dominant from post-glacial period. The genus has an extensive geographical distribution in the north temperate regions. It belongs to family Betulaceae of the order Fagales of Angiosperms, which is rather isolated from other six genera like *Betula*, *Corylus*, *Carpinus*, etc., of the family in being actinorhizal, i.e., nodulated with a N_2 fixing actinomycete symbiont. Actinomycetes are microscopic heterotrophic organisms (deriving food from organic sources) that are more evolved than bacteria but less than fungi. Besides *Alnus*, thirteen other angiospermic genera are found belonging to six families which have actinomycetous symbionts in their roots.

Alnus nepalensis is locally called 'Uttis'. It is distributed in the hills of Darjeeling, Eastern Nepal, Sikkim, Bhutan and in the Khasi Hills of Meghalaya on an altitude from 900 m to 2800 m. The trees are tall, reaching the height of 28 m to 35 m in 30 years. It is one of the fast growing species in the region. Its wood costs about Rs. 500/- per cubic metre. The wood is a good fuel and also good for various other purposes such as teachest frame making, inner partition, logs as boundary poles. Softer parts can be blended with conifers to produce paper of good quality in paper pulp industry. The wood, being soft, may not give the expected economic return as other good timber species but its outstanding ecological importance should be recognized. The intact leaves have upto 4 per cent nitrogen content and there is upto 3 per cent nitrogen in the fallen leaves. Leaves are palatable to cattle and are mixed with cattle feeds. The litter or fallen leaves are gathered by the villagers for making manure. In this age, when use of biofertilizers is being encouraged by scientists, leaf litter of *A. nepalensis* from the plantations of Kalimpong Forest Division, District Darjeeling, has worked as an excellent biofertilizer. The catkins with light seeds are produced in large numbers, and can be easily disper-ed even by slow wind.

The roots bear nodules upto a depth of 20 cm. So nodules are distributed in the upper region of soil profile where there is proper aeration and maximum root biomass. We have been studying the ecology of *A. nepalensis* in Pankhasari range in Kalimpong General Division, West Bengal, and we have found that different ages of nodules from *A. nepalensis*, irrespective of plantation age, can fix 0.1333 to 11.7767 nano moles of N_2 per milligram nodule nitrogen per minute (1 nano mole$=1\times10^{-9}$ moles, 1 gram mole of nitrogen$=$28 grams) depending upon the season and growth conditions.

Nodulated legumes contribute a significant proportion to the overall harvest of nitrogen from the atmosphere but it varies widely depending on the species and the conditions during growth. Root nodules of *Alnus* are known to fix 814 mg N/g nodule dry wt. yr. as against 539 mg N/g nodule dry wt. yr. fixed by field pea. The data reflect the importance of *Alnus* in our nitrogen economy (G. Bond, 1958). G. Bond (1958) of Botany Department, University of Glasgow, Scotland, further noted that little interest has been shown in exploiting beneficial effects of *Alnus* in forestry despite evidence in early literature that it may be to forestry what legumes are to agriculture. In high latitude countries such as Scandinavia, Canada, New Zealand, etc. and in higher altitudes of the Himalayas where legumes are either absent or insignificant in the indigenous flora, the non-legume nodulated plants such as *Alnus* are ecologically more significant and probably more efficient than other plants. By virtue of their being more hardy and of wide ecological amplitude with wide temperature range distribution, the non-legume plants have contributed enormously to the nitrogen economy of natural areas.

Alnus plays an important role in the improvement of soil. It mostly grows as a pioneer plant in raw habitats where nutrients are very low to support plant growth. Both in Europe and America, *Alnus* has long been recognized for its use in soil improvement in forestry. *A. nepalensis* grows well on sandy eroded soil, rocky slopes, freshly exposed soils of the landslide affected area, steep stream side and natural areas. The trees give only partial shading. So, we find luxuriant undergrowth under *A. nepalensis.* Soil erosion rate on vulnerable slopes are reduced by the undergrowth as well as the ramified roots and nodules at the upper 20cm. zone of *A. nepalensis* plantations. In the landslide affected area, *A. nepalensis* comes as a pioneer plant and creates conditions for other species to colonise.

In the hills of Darjeeling, *A. nepalensis* plants are grown both as monoculture plantations and as a chief associate of some timber trees, *Cinchona* plantations and *Amomum subulatum* plantations. *Cinchona* yields quinine and *Elettaria* the spice cardamum. It serves the cardamum plants in innumerable ways like giving necessary partial shading, fixation of atmospheric nitrogen, saving the sloping areas from soil erosion and landslides. Cardamum production was boosted up in a natural way with the available nitrogen increment in the soil. *A. nepalensis* has also been properly maintained at Mangpu (Darjeeling) for *Cinchona* plantations. British botanists had correctly understood that production and quality of *Cinchona* plants depended on *Alnus* trees.

A. nepalensis is one of the fast growing species. It attains height of 14 m to 17 m in seven years. A sample tree of 72 cm girth at breast height (GBH) was 14 m tall with a total dry biomass of 209 kg. *Alnus* tree, an important biomass resource, can go a long way in resolving our present fuelwood crisis.

Out of necessity social forestry has neen introduced. *A. nepalensis,* being a fast growing species and possessing ability to increase fertility of the soil in a natural way, can be recommended as one of the good species in social forestry. Due to its fast growing nature, the daily fuel need of the local people can be met.

The following verse quoted by Charles R. Goldman (1961) of California University, U.S.A. and written by William Browne of Tavistock, England, in 1613 further illustrates an aspect of ecology of *Alnus* (Alder):

The Alder, whose fat shadow nourisheth
Each plant set neere to him long flourisheth.

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Penicillins—yesterday, today and tomorrow

SIR Alexander Fleming's discovery of penicillin was an epochmaking event in the annals of medicine where chance and observation played a predominent role. It all began with a stray spore falling on a petriplate seeded with *Staphylococci.* The spore grew well exhibiting its antagonism towards the growing bacteria around it. Fleming was innovative and thoughtful to apply this phenomenon of antagonism to control human disease. Due to the unstable nature of crude penicillin, earlier investigations were unsuccessful and failed to make an impact in the scientific circles. In 1938, with the outbreak of World War II there was profound interest in developing new and better anti-infectious agents. In 1940 Sir H.W. Florey—an australian and E. B. Chain—a jew, both working in Sir William Dunn school of Pathology at Oxford decided to make a survey of antimicrobial substances produced by microorganisms. It was again a good fortune that penicillin was chosen for investigation. They developed a procedure and successfully carried out clinical trials. The amazing curative properties of the antibiotic were fully known by 1943 and the War brought out excessive demand for the drug which changed the approach from surface cultivation in bottles to submerged fermentation in aerated tanks. In a span of few years rapid advancements were made in penicillin fermentation technology. Large fermenters with facilities of high power agitation were brought into operation. Gradually other innovations like pH control system, foam control, etc., were taken up. Later importance of precursors in penicillin fermentation was understood and high yielding strains were developed by mutation and natural selection. Penicillin in large quanti-