Creating the Nation's first BioPark

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Letter from the Desk of David Challinor
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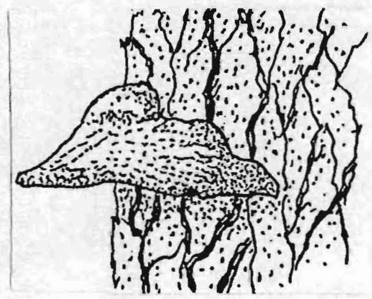
In my January letter to you I discussed the dependency of some trees on the cooperation of birds and mammals to insure their seed germination. This letter is about trees and their fungal and bacterial symbionts, that is, fungi and bacteria that grow with, on, or in certain trees and how the host trees benefit from such an association. (Symbiont = an organism in a close relationship with another, generally of benefit to one or both.)

The most common fungal symbionts on forest trees are mycorrhizae. Unlike the conks or shelf fungi often growing on living or dead tree trunks, mycorrhizae grow only on roots. The fungal hyphae (thin white thread-like filaments) attach to tree roots, and in so doing increase the tree root surface capable of absorbing nutrients from the soil. The fungus-tree root interactions are complicated, but simply stated, trees growing in relatively infertile soil grow faster and larger if their roots are innoculated with mycorrhizae.



Tree conk

A practical application of this knowledge occurred in the 1930's when the U.S. government instituted a massive shelterbelt planting in the Great Plains to control the loss of soil from wind. Other than willows and cottonwoods found along the stream and river bottoms there, trees do not do well on the open Great Plains. Thus myocorrhizal fungi that normally live in the soil of forested areas were not present in prairie soils. Many early shelterbelt plantings failed to thrive until the prairie soil was innoculated with handfuls of soil from hardwood forests further east, full of mycorrhizal fungus spores ready to infect the roots of the newly planted trees.

Among the tree species frequently used in Great Plains shelter-belts are black locust, a common hardwood of eastern North America, and Russian olive, a small bushy tree from southeastern Europe and Asia. Both species are temperate zone nitrogen fixing (NF) trees; however, most of the 1200 or so species of NF trees grow only in the tropics where they are especially valuable in agroforestry.

A common soil bacterium, rhyzobium, innoculates the roots of NF trees, just as a farmer innoculates clover and alfalfa seed with bacteria before planting. The bacteria produce nodules which attach to the roots of NF trees. The nodules range in size from small buckshot to lima beans according to the species of both the host and the bacteria. The rhyzobia take nitrogen (N) from the atmosphere and concentrate it in the nodules. N makes up about 80% of the air we breathe, oxygen (O) is about 20%, and all the other gases are less than 1%. N is what makes lawns and the plants in florist shops so green, but atmospheric N has to be converted to a form that plants can use. This is often achieved by producing chemical fertilizers from petroleum products or from a process as simple as that practiced by Native Americans -- letting a dead fish decompose in a corn hillock. In both cases N is released into the soil and becomes available to the growing plant. Take my word for it, because the biochemical explanation of the process would be too long for this letter.

To promote crop yields in the tropics through agroforestry, fast growing NF trees are planted in rows along the contour in sloping land about 10 m (33 feet) apart. The food or fodder crop is then planted between the rows. In a few months the seedlings grow a meter or more tall. So much N is concentrated in the growing shoots and leaves of these rapidly sprouting trees that the farmer merely has to lop off the sprouts and put them on the soil surface. The next rain leaches the N from the leaves and sprouts into the soil where it becomes available in solution to the growing crop. The lopped NF tree stumps keep resprouting and growing in diameter, which allows the process to continue almost indefinitely. The farmer cuts the stumps for fuel wood as they become too large and crowded. The foliage of NF trees is also a valuable livestock fodder, especially in the dry season.

The agroforestry system I have described seems easy, but it is not. The appropriate NF tree species has to be selected, the soil should ideally be checked for rhyzobia that is appropriate for the tree species being planted, and the stump sprouts must be lopped at regular intervals to keep branches from adjacent rows of trees from intersecting and thus shading the crops growing beneath.

NF trees are especially valuable in the Third World. With enough work a Third World farmer can improve his source of fuel, food, and fodder by using NF trees. The more we learn about fungi and bacteria and how they help trees to grow, the better we can apply our knowledge to the benefit of humankind. We must not only retain the health of the organisms around us, but we must also understand more about their requirements to survive. An ominous warning of what is happening to the fungal flora of our forests is attached. There is much to be done and a great deal to be learned to keep the threat to our habitat within manageable bounds. Time is running; our understanding and ingenuity must keep pace with the ticking ecological clock.

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