Living fences in Costa Rican agriculture*

JONATHAN D. SAUER**

COMPENDIO

El uso de árboles como postes vivos para cercas se ha convertido en una técnica de amplia difusión en varias zonas ecológicas de Costa Rica. Alrededor de casi todos los cultivos agropecuarios pueden observarse cercos vivos, pero la mayoría de ellos se ven en las orillas de cafetales, pastos y cañales. El número de especies utilizado para cercas vivas es impresionante: durante una encuesta de campo de seis meses, 57 especies fueron identificadas que son regularmente plantadas como componentes de cercas.

Las 26 especies más importantes son descritas individualmente en orden sistemático. Las consideraciones finales sobre los orígenes de esta técnica de cercas demuestran claramente que la diversidad de las especies ha sido reducida durante los últimos años, más que todo por la apertura y ensanchamiento de carreteras y debido a la aparición en el mercado de postes tratados con preservativos, que tienden a sustituir las técnicas tradicionales.

Introduction

LIVING fences are used in many tropical regions (5, 6, 13) but rarely with such consistency and virtuosity as in Costa Rica. Fencerows on some Costa Rican farms are messy mixtures of volunteer trees and weeds. Living fences on most farms are composed of carefully chosen species, evenly planted and neatly maintained. They may be simple rows of single species or they may be compound rows and layers of species selected for multiple functions. There are many local and regional variations in structure and function. In the aggregate, the living fences are largely responsible for the pleasant character of the Costa Rican countryside.

The reconnaissance reported here was conducted along main roads and byways accessible by 4 wheel drive and front-wheel drive vehicle. Data were gathered during June to Agust, 1972 and April to June, 1976. Wherever the character of the roadside or transverse changed, details of structure and species present were recorded for sample sectors. Farmers and passerby were usually very willing to discuss the science and art of fence planting, obviously regarding it as a significant topic. The area traversed is only a fraction of the country (Figure 1) but includes much cultural and physical diversity. Land use includes subsistence farming, commercial planting on various scales of sugar cane, bananas, and coffee, and pasturing of beef and dairy cattle. Both long settled and recently colonized regions are represented. Many of the sites studies are on Pliocene to Holocene pyroclastics and other volcanics and on mudflows and alluvium derived from them. Many others are on Paleocene to Pleistocene marine sedimentaries. Some sites in the Península de

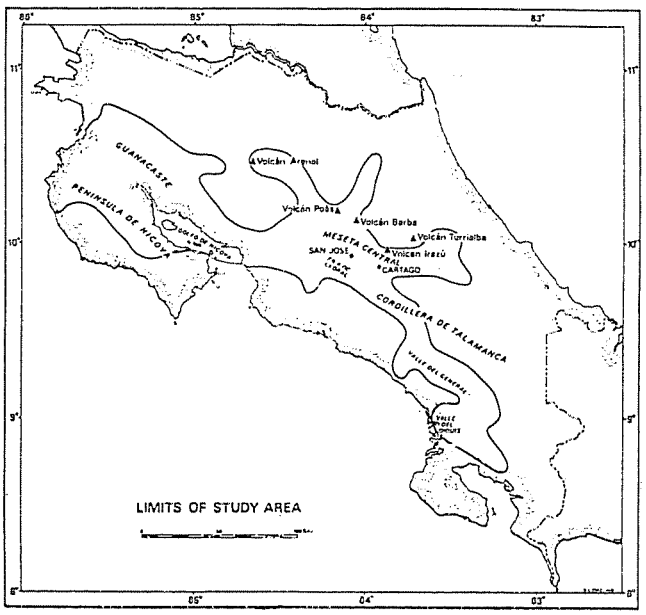

Fig. 1.—*Limits of study area in Costa Rica.*

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** Professor of Geography at University of California, Bunche Hall 1255, Los Angeles, California 90024, U.S.A.

Nicoya are on older, Mesozoic sedimentaries and volcanics (2). Sites range from sea level to over 3,000 m in elevation and have mean annual rainfall ranging from less than 1500 mm to over 4000 mm (3, 4). In this paper, lowlands are defined as lying below 500 m, highlands above 1500 m, with middle elevations between; drier zones are defined as having less than 2000 mm mean annual rainfall, wetter zones with over 3000 mm, with mesic zones between.

Dominant Species

The total flora of Costa Rican fencerows includes hundreds of species of weedy herbs and vines, pioneer shrubs and trees, and epiphytes. Excluding uninvited volunteers, 57 species were encountered as regularly planted components of fences in the sutdy area (Table 1). Of these, the 26 most important dominants will be considered individually in systematic order; most of them are native to Central America; homelands will be noted specifically only for the introduced exotic species.

Cupressus lusitanica was first recorded historically in cultivation in Portugal in the 17th Century but it is probably native to the highlands of Mexico (7). It it the only conifer commonly planted as a fence tree in Costa Rica. At high elevations, massive rows of this cypress (Figure 2) dominate much of the landscape in

Fig. 2.—Cupressus lusitanica *hedge concealing rock wall around pasture, 1900 m elevation, south slopes of Volcán Barba.*

all moisture zones. They extend to the upper limits of living fences on the volcanoes. On Irazú, where they are planted up to 2700 m elevation, they survived heavy volcanic ash falls in 1964 and 1965. Cypress fences are less important at middle elevations and absent in the lowlands. Cypresses are occasionally planted around *cafetales* but mostly they surround pastures of Kikuyu grass *(Pennisetum clandestinum)* (Figure 3). The trees are started as seedlings, usually along a barbed wire fence strung on dead posts. Eventually, the wire may be nailed to the cypress trunks, but dead fence posts do not rot quickly in the higlands and the cypresses are planted more for ornament than utility. Little value is

Table 1.—Systematic List of Species Encountered in Study Area as Regularly Planted Components of Fences.

¢ preceding a species name indicate it is propagated vegetatively by cuttings.
Common names of species are given within quotation marks. These are in local use; they are not copied from the literature.
Probable source regions of introduced exotics are given in parentheses; other species are believed to be natives.
Code letters after species name indicate its use for fences within elevation and rainfall zones, as follows:

L: below 500 m elevation; M: 500-1500 m; H: above 1500 m.
d: less than 2000 mm mean annual rainfall; i: 2000-3000 mm; w: more than 3000 mm.

Cupressaceae--Cypress family
Cupressus lusitanica Mill. "ciprés" (México?) *Mdi Hdiw*
Gramineae--grass family
¢ *Phyllostachys bambusioides* Sieb. & Zucc. "bambú" (East Asia) Mi.
Bromeliaceae--bromelia family
¢ *Bromelia pinguin* L. "piñuela" *Ld Miw*
Liliaceae--lily family
¢ *Agave spp.* (México?) Li Md.
¢ *Dracaena fragrans* Ker.-Gawl. (West Africa) *Li Miw.*
¢ *Yucca elephantipes* Regel "itavo" Li *Mdiw Hiw.*
Casuarinaceae--beefwood family
Casuarina equisetifolia L. "pino" (Southwest Pacific) *Md.*
Salicaceae--willow family
¢ *Salix humboldtiana* Willd. "sauce" Md. Hi.
Moraceae--fig family
Chlorophora tinctoria (L.) Benth. "palo de mora" Ldw
¢ *Ficus goldmanii* Standl. "matapalo" Ld
¢ *Ficus pertusa* L. f. "matapalo" Hiw.
¢ *Ficus sp. "matapalo"* Miw.
Proteaceae--silkoak family
Grevillea robusta A. Cunn. (Australia) Mdi
Magnoliaceae--magnolia family
¢ *Drimys winteri* Forst. "chile, quiebramuelas" Hw.
Lauraceae--avocado family
Persea sp. "aguacatillo" Lw
Leguminosae--legume family
Caesalpinia eriostachys Benth. "saíno" Ldi.
Cassia grandis L.f. "sandal" Ldiw.
¢ *Diphysa robinoides* Benth. "guachapilín" Lw Mw.
¢ *Erythrina berteroana* Urban, *E. glauca* Willd., *E. globocalyx* Porsch & Cufod. "poró" Ldw Mdiw *Hdiw.*
¢ *Erythrina peoppigiana* (Walpers) O. F. Cook "poró extranjero" (South America) *Mdiw.*
¢ *Gliricidia sepium* (Jacq.) Steud. "madero, madera negra" Ldiw Miw.
Inga spectabilis (Vahl) Willd. "guaba" Mw.
Pithecolobium longifolium (Humb. & Bonpl.) Standley "soto" *Mw.*
Burseraceae--torchwood family
¢ *Bursera simaruba* (L.) Sarg. "jiñote, jiñocuave, indio pelado" Ldiw Mdiw.
Meliaceae--mahogany family
Cedrela odorata L. "cedro" Ld
Malpighiaceae--Barbados cherry family
Byrsonima crassifolia (L.) H.B.K. "nance" Liw.
Euphorbiaceae-poinsettia family
¢ *Codiaeum variegatum* (L.) Blume (Southwest Pacific) Md.
Croton niveus Jacq. "copalchí". Miw.
¢ *Euphorbia cotinifolia* L. "barrabas, jacalillo, lechilla" Hi.
¢ *Euphorbia milii* Ch. des Moulinns (Madagascar) Mdiw.
¢ *Pedilanthus tithymaloides* (L.) Poit. "bítamo" Md.
¢ *Synadenium grantii* Hook. f. "bijarro" (West Africa) Md.

Table 1 (continued)

Anacardiaceae--sumac family
Anacardium occidentale L. "marañon, espavel" (Brazil)
Mangifera indica L. "mango" (India) Ld. Ldi.
¢ *Spondias mombin* L. "jobó" Liw
¢ *Spondias purpurea* L. "jocote, ciruelo" Ldiw Mdiw.
Bombacaceae--kapok family
¢ *Bombacopsis quinata* (Jacq.) Dugand "pochote" Ldi.
Bixaceae--anatto family
Bixa orellana L. "achiote" Mdi.
Cochlospermum vitifolium (Willd.) Spreng. "poroporo" Mi.
Flacourtiaceae--kei apple family
Xylosma velutina Triana & Karst. "pejipute" Md.
Elaeagnaceae--oleaster family
¢ *Elaeagnus umbellata* Thunb. "ua" (Japan) Hw
Myrtaceae--eucalypt family
¢ *Syzygium jambos* L. "manzana rosa" (Southeast Asia) Mdiw.
Psidium guajava L. "guayabo" Li Miw.
Oleaceae--privet family
Ligustrum lucidum Ait. f. "trueno" (East Asia) Mi.
Ligustrum vulgare L. "olivo" (Mediterranean) Miw.
Boraginaceae--heliotrope family
Cordia alba (Jacq.) Roem. & Schult. "tiguilote" Ld.
Verbenaceae--lantana family
Cornutia pyramidata L. "azulita, pavilla" Lw.
¢ *Stachytarpheta frantzii* Polak "rabo de gato" Mdi.
Tectona grandis L. f. "teca" (Southeast Asia) Ld.
Solanaceae--tomato family
Acnistus arborescens (L.) Schlecht. "güitite" Mdiw.
Datura candida (Pers.) Safford "reina de la noche" (Peru) Mdi.
Bignoniaceae--jacaranda family
Jacaranda acutifolia Humb. & Bonpl. (Brazil) Mi.
Tabebuia rosea (Bertol.) D.C. "roble" Ldi Miw.
Rubiaceae--coffee family
Hamelia nodosa Mart. & Gal. "coloradito" Lw.
Randia karstenii Polak "crucilla, horquetilla" Md.

attached to the wood, despite its increasing commercial value.

Bromelia pinguin, a coarse relative of the pineapple, is commonly planted as a hedge, usually beneath a row of trees bearing barbed wire. In spite of its formidable sword-like leaves, by itself the species is ineffective as a cattle barrier; its does discourage human trespass. In the mesic and wetter zones at middle elevations of the Meseta Central, it is planted around canefields and *cafetales* and usually kept under control by hacking with a machete. Around gardens in the drier lowlands of Nicoya, it is allowed to grow, by spreading sucker shoots, into a thick wall. The fruits and tender core of the plant are edible but of trivial food value.

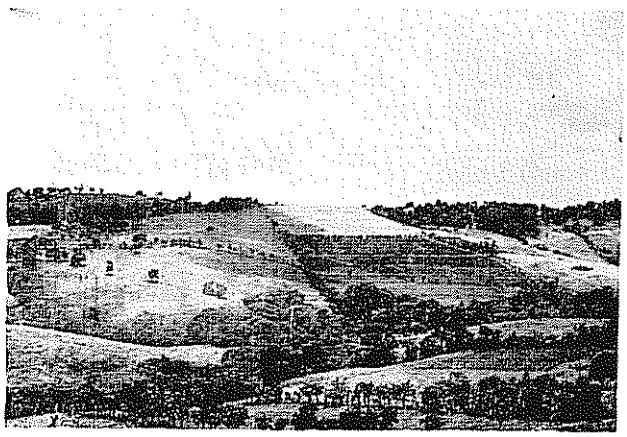

Fig. 3.—Cupressus *hedges and barbed wire fences on living* Erythrina *posts around dairy cattle pastures. 1600 m elevation, southwest side of Volcán Poás.*

Dracaena fragrans, a tall stemmed lily with striped foliage, was introduced from West Africa. It is much used for living fence posts, alone or alternating with *Gliricidia sepium,* a woody legume. In the Meseta Central and Valle del General, the *Dracaena* is planted around many *cafetales,* gardens, and pastures in both mesic and weter zones. It is admired as an ornamental and appreciated as being extremely easy to propagate from stem cuttings.

Yucca elephantipes, a massive relative of the Joshua tree, is also easily propagated from cuttings. It is occasionally planted near houses in all elevation zones but is most common at middle elevations in the Meseta Central and Valle del General. There it is much used in all moisture zones, especially around *cafetales,* canefields, and gardens, less around pastures. Planted closely spaced as a palisade, it is a favorite for holding the soil above road cuts and other steep banks (Figure 4). Some old yuccas are 10 m tall and have trunks more than a meter in diameter. The inflorescences are often peddled along the roadside by children, the blossoms being eaten as a delicacy.

Fig. 4.—*On right,* Yucca elephantipes *palisade around sugarcane plantation; on left,* Syzygiumjambos *trees bearing barbed wire fence around banana plantation; 1500 m elevation, southwest slopes of Volcán Barba.*

A graceful willow, *Salix humboldtiana,* is a dominant fence tree near Cartago, especially around pastures in alluvial valleys. The willows are mostly pollarded, their trunks eventually becoming huge.

Evergreen figs, *Ficus pertusa* and another unidentified species, are planted as living posts by sticking branches in the ground and they also become established

in fence lines as strangling epiphytes on other fence trees. They dominate fences around some pastures and potato fields in mesic and wetter zones on the flanks of Volcán Irazú, where *Ficus pertusa* is planted up to 2700 m elevation. In the drier lowlands of Guanacaste, another strangling fig, *Ficus goldmanii*, is planted around rough pastures; the trunks bear barbed wire and the dense crowns give constant shade for the cattle.

The legume family includes several outstandingly important fence trees, all with compound, deciduous leaves and attractive flowers. In wetter zones at both low and middle elevations, *Gliricidia sepium* is used more than all other kinds of living fence posts combined. In mesic zones at the same elevations, it is less ubiquitous but still the most important single species. *Gliricidia* fences like most other fences are usually started by planting unpeeled poles about 2 m long; these are tall enough so the sprouting foliage at the top is out of reach of livestock (Figure 5); cattle do not nibble the bitter bark. In drier zones at low and

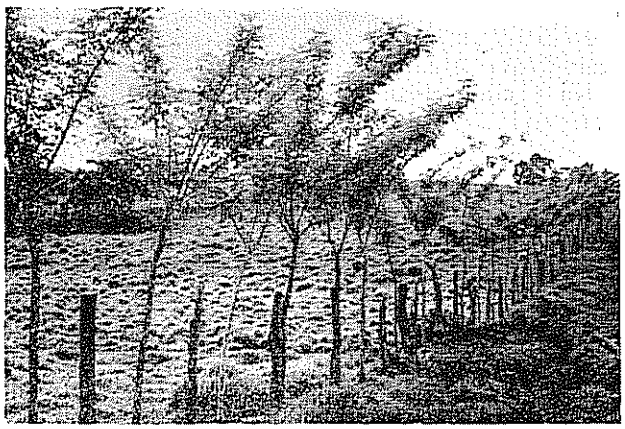

Fig. 5.—*Sprouting* Gliricidia sepium *poles that will bear the barbed wire when the dead posts rot, new transverse fence in pasture, 600 m elevation, Valle del General*

middle elevations, the poles root poorly and the species is used in only a desultory way, usually by planting seed. At higher elevations, *Gliricidia* is entirely absent. Where it grows well, *Gliricidia* is the favorite species for fencing *cafetales*, pastures, canefields, banana plantations, and lime and cacao orchards. Until about 70 years ago, it was a favorite tree for shading coffee and cacao but that function has now been taken over by other legume trees, mainly species of *Inga*, which are as good as *Gliricidia* for nitrogen fixation and give better shade during the dry season (1). Seen from above, most Costa Rican *cafetales* are a forest of *Inga* with a rim of *Gliricidia*. Well kept *Gliricidia* fences are pollarded about every three years (Figure 6). The lopped branches are valued as posts and firewood.

Other legumes important as living posts are the brilliant flowered coral trees belonging to the genus *Erythrina*. Three native species and one introduced from South America are involved, but the genus will be discussed here as a unit. *Erythrina* is planted and

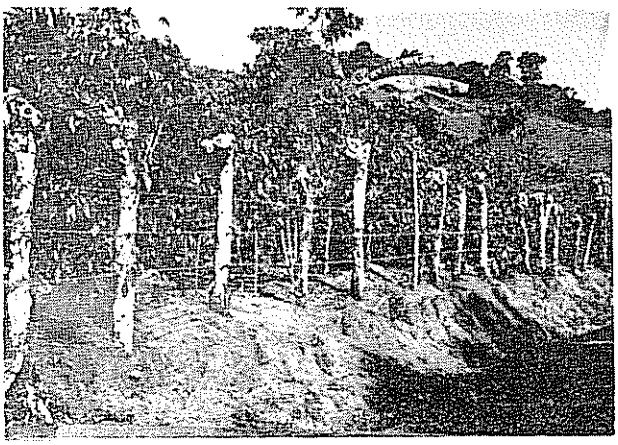

Fig. 6.—Gliricidia sepium *fence, which has not yet resprouted after being pollarded surrounding cafetal shaded by* Inga *trees and bananas, 800 m elevation, northwest end of Valle del General*

pollarded much like *Gliricidia* but the lopped branches have no value as wood. In the lowlands, *Erythrina* is important in fences only in the wetter zones, where it is planted around pastures as a distant second to *Gliricidia*. At middle elevations, *Erythrina* is used around many pastures and *cafetales* and a few canefields; at those elevations it is second to *Gliricidia* in the mesic and wetter zones and is the commonest of all fence trees in the drier zones. In the higlands, *Erythrina* and *Cupressus* trees dominate *cafetal* and pasture fences (Figure 3) in all moisture zones. Above 2000 m, *Erythrina* trunks and branches become blanketed with epiphytes (Figure 7) and the trees are obviously stunted. They are planted up to 2400 m on Volcán Irazú, where they have survived heavy ash falls.

Two other legumes are important fence trees around lowland pastures: *Diphysa robinioides* in the wet Valle del General and Valle del Diquís, *Caesalpinia eriostachys* in the mesic and drier lowlands of Nicoya. Unlike *Gliricidia* and *Erythrina*, both of these species are allowed to grow unpollarded into tall trees. *Diphysa* timber

Fig. 7.—*Barbed wire of pasture fence borne partly by dead posts, partly by old* Erythrina *trees, which are blanketed with epiphytic bromeliads, orchids, and ferns; cypress hedges in background, 2200 m elevation, west side of Volcán Barba.*

Fig 8.—*New pasture fence with sprouting* Bursera simaruba *poles already bearing barbed wire between widely spaced dead posts, fourth post from the right is a volunteer tree.* Crescentia cujete; *200 m elevation, Guanacaste*

is used for cabinetry and is also valued for its rot resistance. Wood of the *Caesalpinia* is not exploited; the species is valued mainly for shade and is established along fence lines by planting seed at wide intervals with sawn posts between.

Bursera simaruba, a deciduous tree with smooth red bark, dominates many fences around pastures, milpas, and *cafetales* at low and middle elevations (Figure 8). In mesic and drier zones, pure *Bursera* fences are common; in the wetter zones, *Bursera* is usually mixed with other species. The living posts are usually kept pollarded at about 2 m height, the lopped branches being left to rot unless needed for new living posts. *Bursera* posts strike root more reliably in the drier zones than *Gliricidia* posts and where pastures are burned *Bursera* posts survive relatively well. However, *Bursera* posts do not hold barbed wire very firmly and gum exudes from wounds where the wire is attached. The gum has minor medicinal and other uses.

Three ornamental shrubs in the poinsettia family are commonly planted asdense hedges: *Croton niveus, Euphorbia cotinifolia,* and *Synadenium grantii.* They are usually combined with an overstory of *Erythrina* or some other tree bearing barbed wire. The *Croton* is said to have medicinal uses but is mainly planted for its silvery foliage. Started as closely spaced seedlings, it is clipped into neat hedges. It is most common around *cafetales* at middle elevations in mesic and wetter zones. The *Euphorbia* is commonly planted around pastures, canefields, and *cafetales* at middle elevations in all moisture zones. Its red foliage makes a colorful border and its blinding, poisonous latex repels human intruders and browsing cattle. The even more toxic *Synadenium,* native to West Africa, is a succulent plant easily grown from cuttings. It is much used to guard *cafetales* and gardens, mainly in the dry, middle elevation valleys around Cartago.

Two species of *Spondias* are propagated and pollarded much like *Gliricidia* and *Erythrina* but they differ from those legumes in being evergreen, having inconspicuous flowers, and producing edible, plum-like fruits. *Spondias purpurea* is much planted as a fence tree at low and middle elevations in all moisture zones. In drier areas, it is a favorite pasture fence because it gives the cattle shade and juicy fruits during the dry season (Figure 9). In mesic and wetter areas, it is planted not only around pastures but also *cafetales,* banana plantations, canefields, and gardens. It would be more popular if the trunk did not bleed unsightly gum wherever barbed wire is attached. *Spondias mombin* is less important but is used for fences in the mesic and wetter lowlands, mostly around gardens near farm houses, occasionally around pastures and banana plantations.

Fig 9.—*On right, first fence tree is* Spondias purpurea, *the rest are* Bombacopsis quinata; *on left fence trees are* Gliricidia sepium; *rough pastures cleared from seasonal forest, 200 m elevation, Guanacaste*

The spiny-trunked, deciduous *Bombacopsis quinata,* a relative of the *Ceiba,* is locally important in the drier lowlands along the Golfo de Nicoya, especially around pastures on light soils (Figure 9). It is usually started from seed and allowed to grow freely into a tall tree that is highly valued for hardwood timber.

The southeast Asian rose-apple, *Syzygium jambos,* is occasionally planted around *cafetales,* banana plantations, and gardens (Figure 4). It is most common in mesic and wetter zones of the Meseta Central and Valle del General. Started from seed, the species is usually allowed to grow freely into tall, evergreen trees producing abundant fragrant, white flowers and crisp fruits.

Two shrubby nigthshades with fragrant flowers, *Acnistus arborescens* and *Datura candida,* are common in fences on the Meseta Central, especially around farmyards, gardens, and *cafetales.* They come up as volunteer seedlings, tolerated as ornamentals in fences dominated by *Erythrina* or other trees; both species are also occasionally planted deliberately for living posts. The *Datura* was presumably introduced from Peru in the early colonial period; it was one of the first New World ornamental plants introduced to Europe. It was grown in the gardens of King Philip II of Spain in the

16th Century, the Viceroy of Perú having deemed it worthy of being sent to a king (10).

Tabebuia rosea, a tall, deciduous tree with showy, pink flowers, is much planted for pasture fences in the lowlands of the Golfo de Nicoya (Figure 10). Like *Bombacopsis,* seedlings are allowed to grow tall without being pollarded and develop into valuable hardwood timber trees.

Fig. 10.—*Fence trees are deciduous* Tabebuia rosea, *pasture cleared of nearly all trees except palms, 50 m elevation, east of Golfo de Nicoya*

The remaining 31 species (Table 1) will not be discussed separately. They are planted rather idiosyncratically. Most are ornamental or useful species that are grown more commonly in gardens and houseyards than for agricultural fences.

Genesis of the Fencing Patterns

The cast of characters of plants used in Costa Rican living fences is made up mostly of species native to the general region. As a rule, they were originally pioneers of naturally open habitats, particularly cliffs, streambanks, and coastal beach ridges, and had very broad ranges in such habitats before being taken into cultivation. The *Gliricidia, Bursera,* and several other major fence species are still dominant pioneers of coastal and riverine successions in Costa Rica and the New World tropics in general (9, 11). Such plants were preadapted to occupy agricultural clearings and must have been readily available to prehistoric American Indian farmers. At the time of the Spanish Conquest, Indian peoples of Central America were planting *Gliricidia* for hedges and to shade their cacao groves (11). The only recognizable Indian group surviving within my study area is the Boruca, occupying territory between the Valle del General and Valle del Diquis. The Boruca formerly fenced gardens and milpas with living posts of *Cochlospermum vitifolium* (12) but they no longer make much use of hedge plants. A less acculturated Central American group, the Chorti-speaking people of the Guatemala-Honduran border commonly plant hedges of *Bromelia pinguin, Yuca elephantipes, Gliricidia sepium, Erythrina spp,* and *Spondias purpurea,* all species important in modern Costa Rican fences; they also plant hedges of cacti, which are not important in Costa Rica (15). Hedges of cacti, *Agave,* and other spiny succulents are common around milpas in many other regions of Central America and Mexico (13). Presumably, they are a pre-Conquest tradition that became more imporant after the introduction of Spanish livestock and before the invention of barbed wire. It is recorded in Cuba that planting of spiny and thorny hedges expanded with the rise of cattle ranching in the 18th Century (5). In Costa Rica in the late 19th Century, even after barbed wire was available, the Meseta Central still had many hedges of spiny succulents, including *Agave, Yucca, Bromelia,* and cacti, and of thorny woody plants, including *Randia* and roses (8, 14). As late as 1910, thorn hedges of *Xylosma* remained more important than they are now and were combined with deep ditches as barriers around fields (1). There are surviving remmants of the old hedge types, especially *Yucca* palisades, but most of the present fencing pattern is not a heritage from past centuries. Rather it was probably developed by 20th Century Costa Rican farmers following the adoption of barbed wire.

Throughout the country, construction of a fence ordinarily begins with stringing of barbed wire on stout, non-living posts, just as in regions where living fences are not used. In some climatic zones of Costa Rica, that may be the whole story. In the cloudforests of the Cordillera de Talamanca and the higher volcanoes, pastures cleared for dairy herds mostly have conventional non-living fences. Some posts, especially those cut from *Drimys winteri,* take root and grow but they are not much appreciated. In these cool highlands, a dead oak post lasts for 30 years or so and oak is in surplus supply from wholesale forest clearing. At the other extreme, in the Guanacaste lowlands, which are hot dry most of the year, a dead *Gliricidia* post lasts 20 years or so and living posts are hard to establish. Here trees that give shade and fodder to the cattle are a valued element in the fence rows but the basic function of bearing barbed wire is borne by dead posts. In the bulk of the country, dead posts rot quickly and are only expected to last until living posts can take over.* The species that will form the backbone of the living fence are chosen from the roster of those known to be easily rooted and resistent to cattle. Among these, choice depends somewhat on byproducts but more on aesthetic considerations. Costa Ricans are famous for surrounding their houses with a variety of ornamental and curious plants. Non-utilitarian devotion to growing plants is quite apparent in many farm fences. The older settled Meseta Central had developed the most complex fencing pattern with great farm to farm diversity. This diversity has been greatly reduced in the last five years by wholesale road widening pro-

* In recent years it has been observed however that many landowners prefer the use of dead posts which have been treated against decay by the use of different chemical compounds.

jects. Along both major roads and side roads, miles of fine old hedges and galleries of trees are gone. They are being carefully replaced with new living fences, set farther back, but these are relatively simple and uniform and rarely use anything other than *Erythrina, Gliricidia, or Bursera* posts. I hope this standardization is only temporary and that the farmers' individualistic experimentation with fence planting will soon take effect again.

Summary

The use of living trees and shrubs as posts for fences has become a widely diffused technique in various ecological zones of Costa Rica. Many agricultural crops are protected by living fences, though the majority of them may be seen along the edges of coffee plantations, pastures and sugar cane fields. The number of species used for live fence posts is impressive: during a six months of field survey 57 species were identified as being regularly planted as components of fences. Of these the 26 most important are described individually in systematic order.

An analisis of the evolution of the fencing patterns shows clearly that the species diversity has been reduced during the last four years, mainly through road-widening projects and because posts treated with preservatives are being used as a substitutes to this traditional technique.

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Notas y Comentarios

Sesiones de carteles en reuniones científicas

En reuniones anuales de sociedades científicas de los Estados Unidos se han utilizado cada vez más las llamadas "sesiones de carteles" como un modo alterno de presentar los resultados de investigaciones. El nuevo método ha despertado entusiasmo entre los participantes porque alivia en gran parte la congestión de trabajos que tienen que ser presentados en tiempos muy estrechos para poder cumplir el programa del certamen.

En lugar de hacer una presentación oral formal ante un público numeroso, el autor, en una sesión de carteles, monta un compendio de su presentación y los datos pertinentes e ilustraciones en un tablero, generalmente de 1,22 metros de alto por 2,44 de largo (4 por 8 pies). El montaje se hace una hora antes del tiempo fijado para la presentación. En ese lapso, los autores y coautores deben estar en sus espacios asignados para discutir el trabajo y responder preguntas. Los carteles de la mañana deben ser despegados a medio día y los de la tarde, a las 4:30 p.m.

Según los autores y públicos que han asistido a esas sesiones de carteles *(Food Technology,* September 1978, p. 66), las ventajas son las siguientes:

— En contraste con las presentaciones formales que permiten poco o ningún tiempo para preguntas, las sesiones de carteles permiten un tiempo adecuado para solicitar al autor detalles sobre sus métodos y resultados.

— Es posible entablar diálogos individuales y discusiones informales con pequeños grupos de científicos interesados.

— Se pueden presentar en el espacio disponible numerosos gráficos, tablas, diagramas, fotografías y otras ilustraciones.

— Los carteles con ilustraciones también dan a los participantes tiempo adicional para estudiar aquellas que puedan ser altamente técnicas o muy complicadas.

— Los oradores que pueden estar nerviosos cuando van a dirigirse a públicos grandes, y los oradores que tienen un dominio limitado del inglés, acogen la atmósfera informal y amistosa de la sesión de carteles.

Las sociedades de horticultura, fitopatología y tecnología de alimentos, entre otras, han programado sendas sesiones de carteles para sus reuniones de 1979.

Café sintético

Un espectro está acosando al mundo cafetalero: el café artificial. A mediados de 1979, el precio del grano se elevó 20 por ciento en una sola semana, debido al pánico sobre heladas en Brasil. Pero, alerta productores y especuladores: las grandes firmas manufacturadoras de café, como la General Foods, podrían fabricar café artificial, que no contenga ni un solo grano de café.

Un obstáculo importante es que no podría ser vendido legalmente como café. También, el consumo del producto real se ha recuperado pronto desde las grandes alzas de precios en 1977. Pero el sabor del café artificial no es necesario que sea tan malo como suena a los oídos. Si se prepara correctamente, puede tener mejor sabor que el café típico de restaurante, el que ha perdido por ebullición sus productos volátiles, que le dan su aroma a un buen café; incluso, se podría acercar a la calidad del café soluble que representa el 90 por ciento de las ventas al menudeo en la Gran Bretaña *(The Economist,* 23 de junio de 1979, p. 107).

Los sabores artificiales a café, se usan ampliamente en productos que llevan la etiqueta "con sabor a café". Están disponibles para la venta irrestricta en firmas especializadas en sabores, tales como Givandan e Internacional Flavours and Fragances (ambos con sede en Ginebra), que ofrecen sabor a café Mocca, sabor de café de Kenia, café muy tostado, de bajo tostado, y muchos otros sabores.

Estos sabores son caros ahora, porque son usados en pequeñas cantidades y porque las firmas de sabores cobran un alto sobreprecio por sus conocimientos tecnológicos. Pero los pueden hacer a bajo costo a partir de levaduras, las que, fermentadas en gran escala, están comenzando a volverse competitivas, con la ayuda de los granos de soya, que se venden a una fracción del precio del café.

La levadura es de color pálido. Para darle al café sustituto el color oscuro del producto real, se usa el caramelo. El caramelo comercial, empleado para colorear varios alimentos, es prácticamente sin sabor. Se fabrica hirviendo azúcar con amoníaco. En lo que se refiere a la cafeína, para aquello que lo deseen, puede ser obtenida al descafeinizar cacao, guaraná, kola, té (y también café). Con mayor probalidad podrá ser sintetizado a partir de ingredientes químicos básicos. La cafeína no es sino una molécula, 1, 3, 7, -trimetil-2, 6,- dihidroxipurina, y no muy compleja por cierto.

Las células selladas y la producción de sustancias químicas

Las células vegetales inmovilizadas en píldoras de gelatina de agar pueden llevar a cabo sus procesos metabólicos normales y elaborar mayor cantidad de sus productos naturales que las células libremente suspendidas en el cultivo. P. Brodelius y sus colegas de la Universidad de Lund, en Suecia, y de la Universidad del Ruhr, en Bochum, Alemania Occidental, sugieren que este resultado podría ser aplicado para elaborar muchos productos vegetales naturales, usados en medicina, particularmente alcaloides. Estos incluyen el curare, un relajante muscular usado en cirugía, y la morfina, un aliviador del dolor. Los productos vegetales usados en la industria, tales como las antraquinonas, sobre las que están basados muchos pigmentos usados para teñir, podrían también ser hechos por este método *(FEBS Letters* Vol 103, p. 93).

La extracción de estas sustancias es más fácil si las células están inmovilizadas en un soporte sólido. Las células atrapadas pueden ser integradas en un sistema de flujo continuo que es fácilmente controlable y los sustratos son abastecidos continuamente y sus productos extraídos sin perturbar a las células. Los biotecnólogos utilizan ya sistemas inmovilizados de enzimas y células microbianas, pero no han intentado el hacerlo con células vegetales porque son grandes y tienen paredes de celulosa.

Brodelius y sus colegas pusieron en suspensión las células vegetales aisladas en una solución alginada al 3 por ciento. Agregaron la suspensión al medio de cultivo gota a gota, y observaron la formación de las bolitas de agar alrededor de las células.

Publicaciones

Futurics. La Pergamon Press ha iniciado en 1977 una revista trimestral, *Futurics,* destinada a facilitar la comunicación entre investigadores, escritores y otros interesados en la exploración de alternativas del futuro. Además de artículos, la revista publica reacciones a artículos e ideas, notas cortas sobre asuntos de interés, reseñas de libros, y revisiones de desarrollos sobre la materia.

Cada volumen tendrá 300 a 400 páginas y la dirección es Pergamon Press, Headington Hill Hall, Oxford OX3 OBW, Inglaterra.