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A NEW GRAFTING TECHNIQUE FOR *ERYTHRINA, LEUCAENA,* AND POSSIBLY OTHER NITROGEN FIXING TREE SPECIES

Abstract. A grafting technique known as cleft inarching has been found successful for vegetatively propagating *Erythrina* and *Leucaena* species and hybrids. Preliminary results have yielded 50 percent and 100 percent success rates for *Erythrina* and *Leucaena*, respectively. Cleft inarching may prove to be a major breakthrough in the utilization of clonal improved varieties and hybrids selected for sterility, insect resistance, vigor, and fuel, and for fodder and timber production.

Introduction. Most nitrogen fixing tree species are propagated from seed, although a few such as *Gliricidia sepium* and *Erythrina variagata* are commonly and easily grown from stem cuttings. Previous reports on grafting *Erythrina* species are unknown. However, there are reports of grafting success with *Leucaena* using cleft grafts and whip and tongue grafts (Versace 1982) and bud grafts (Brewbaker 1988).

Despite the reported successes of grafting *Leucaena,* the species is still considered difficult to graft. Brewbaker and Sorenssen (1988) called for the need to adapt vegetative propagation techniques for large-scale use of *Leucaena.* Barnes and Burley (1987) suggest that "quantum leaps in productivity" can be achieved in tropical forest tree improvement that combines breeding and vegetative propagation techniques. As interest in other NFT species increases, grafting technology may prove to be a useful tool to their improvement and utilization without the danger of introducing weedy exotic tree species.

This paper reports on the preliminary results of cleft inarch grafting of *Erythrina* and *Leucaena* species. The author, while working as an extension agent, learned cleft inarch grafting from Thai farmers who use it to propagate mango and sweet tamarind varieties. These same farmers often expressed their need for seedless varieties of *Leucaena* to be used in alley cropping.

Materials and methods. The grafting experiment was conducted at the Waimanalo Research Station, Oahu, Hawaii in November 1991.

Cleft inarching. Cleft inarching is an approach to grafting where the rootstock and scion retain both root and shoot components until a sound union has been formed (Garner 1979). In cleft inarching, the rootstock is decapitated and grafted onto a branch of the scion parent tree. When the graft has healed, the scion branch is cut off from the parent scion tree to produce the grafted seedling that is then ready for planting out. An experienced grafter can graft from 100 to 150 trees per day with greater than 90 percent success using the technique.

Rootstock preparation. Two seedlings of *Erythrina poepiggiana* raised in plastic rectangular containers (13 cm x 5 cm x 5 cm) were used as rootstock. The seedlings were approximately one year old, with a root collar diameter of 8 mm and a height of 30 to 45 cm. The potting container was removed and the root ball was encased in a clear plastic bag that was tied off above the root collar, leaving the stem protruding from the bag.

Table 1. Results of cleft inarching for *Erythrina* and *Leucaena*.

Rootstock	Scion	Percent grafting success
Erythrina poepiggiana	*Erythrina variagata*	50
Leucaena diversifolia (K784)	636 x K838	100

Four seedlings of *L. diversifolia* (K784) raised in dibble tubes (13 cm tall) were used as rootstocks. The seedlings were approximately six months old, with a root collar diameter of 6 to 8 mm and stem height of 30 to 50 cm. The dibble tube of each seedling was enclosed in a plastic bag with sphagnum moss at the bottom. Each bag was tied off on the top of the dibble tube, leaving the seedling stem protruding from the bag.

Scion selection and grafting. A well established tree of *Erythrina variagata* L. cv. Tropic Coral (Rotar et al. 1986) with a height of approximately 25 feet was selected to provide the scion branches. A branch of similar diameter to each rootstock was selected. Starting 10 cm above the root collar, the rootstock was trimmed on one side to produce a wedge 5 cm long. The single upward cut was made on the scion branch 5 cm long through the bark and about 1 mm into the woody tissue to form a cleft. The rootstock wedge was inserted into the scion cleft so that the cambium of the rootstock and scion were lined up. Plastic grafting tape was used to bind the rootstock and scion branch together, and an additional string was used to tie the bagged root ball of the rootstock to the scion branch.

The rootstock remained tied to the scion branch for five weeks. After five weeks the scion branch was cut away from the parent scion tree below the graft to produce the grafted tree with *E. poepiggiana* as the rootstock and *E. variagata* as the scion. The grafted tree was repotted and raised in a nursery for observation before being planted out. Any sprouts from the rootstock that grew following grafting were pinched off to encourage growth of the scion.

The selected scion parent tree for the *Leucaena* grafts was a 25 m tall F1 individual from a cross between *Leucaena leucocephala* (K636) and *L. esculenta* (K838). This triploid hybrid is seedless, has good vigor, is psyllid resistant, and is a high gum yielder (Brewbaker and Sorensson 1988). The grafting procedure for *Leucaena* was identical to that for *Erythrina* explained above.

Results. Evaluation of grafting success was made three months following removal of the grafted rootstocks from the parent scion tree. A graft was recorded successful if the scion was actively growing and healthy in appearance. Findings are reported in Table 1.

Discussion. The results of this preliminary study indicate that cleft inarch grafting is a promising method to vegetatively reproduce both *Erythrina* and *Leucaena* species. Despite the small number of replications, the results are significant, especially in the case of *Leucaena*.

These results also show that asexual tissue compatibility exists between *E. poepiggiana* and *E. variagata* (cv. Tropic Coral), and *L. diversifolia* (K784) and the hybrid (K636 x K838).

Interspecific graft compatibility. A successful graft union between *L. diversifolia* (K784) and the K636 (*L. leucocephala*) x K838 (*L. esculenta*) hybrid suggests that graft compatibility would also exist between *L. diversifolia*, *L. esculenta*, and *L. leucocephala*. Brewbaker and Sorensson (1988) reported that the *Leucaena* genus is highly intercompatible in terms of hybrid production; however, little is known about interspecific graft compatibility. In the search for the optimal rootstock/scion combinations, interspecific crossability could help to predict interspecific graft compatibility. Preliminary results of this experiment indicate that interspecific graft compatibility may parallel interspecific crossability.

Grafting versus cuttings. *E. variagata* (cv. Tropic Coral) is not true to seed (Rotar et al.1986) and is propagated from cuttings for windbreaks; a survival rate of 100 percent is common. The species is used in windbreaks due to its ease of propagation and narrow upright canopy. The long-term objective of grafting *E. variagata* is to determine if larger trees can be produced due the taproot system of a seedling rootstock.

Although *Leucaena* has been successfully propagated from cuttings (Dalton 1980, Hu and Chuh-Cheng 1981, Bristow 1983), it is difficult (Litzow and Shelton 1991). In general, plants grown from cuttings take less time to establish and are genetically identical to the parent plant. Despite these advantages, cuttings are seldom used to produce large trees the size of giant leucaena, and the root system of a tree grown from a cutting is inferior to a seed grown tree and thus prone to damage by wind (Williams et al. 1980). In contrast, grafting can maintain genetic purity and produce a tree with a normal root system; thus its wide use in fruit propagation. Although few non-fruit trees, with the exception of rubber (*Hevea brasiliensis*), are vegetatively reproduced by grafting, if techniques can be developed for NFTs which are simple and time efficient, grafting may become widely used.

Agroforestry implication. Agroforestry systems such as alley cropping could benefit greatly from grafting techniques that would allow sterile hybrids of species such as leucaena to be utilized without the risk of them becoming weedy. Farmers in an alley cropping project in Northern Thailand, for example, were hesitant to use leucaena as a hedge row species for fear that it would become a weed (Brennan 1990).

The commercial production of hybrid seed can be greatly enhanced by the ability to clone one of the parent genotypes (Litzow and Shelton 1991) using cleft inarch grafting.

In addition to exploiting particular genotypes for exceptional aboveground characteristics, cleft grafting could also be used to exploit genotypes with desirable root characteristics such as acid tolerance, nitrogen fixation, disease resistance, and cold tolerance. Grafting gives plant breeders the option of improving above and belowground characteristic independently, since the best of both can be brought together through grafting.

Conclusion. The results confirm that the species studied can be vegetatively propagated by cleft inarching. The findings in this preliminary study justify in-depth replicated experiments on the use of cleft inarching and other grafting techniques for the propagation of *Erythrina* and *Leucaena* species. In addition, further research is needed in the area of grafting other NFTs if they are to be utilized to their full capacity and potential.

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References:

Barnes, R.D., and J. Burley. 1987. Vegetative propagation for improved tropical forest trees. *In* A.J. Abbott and R.K. Atkin (eds), Improving vegetatively propagated crops. Academic Press, London. p. 212-224.

Brennan, E.B. 1990. Using farmers and their ideas for effective extension work. *In* C. Haugen, L. Medema, and C.B. Lantican (eds), Multipurpose tree species research for small farms: Strategies and methods. Winrock International Institute for Agricultural Development and the International Development Research Center of Canada.

Brewbaker, J.L. 1988. Cloning of seedless leucaena for plantation use. Leucaena Res. Reports 9:111-112.

Brewbaker, J.L., and C.T. Sorensson. 1988. New tree crops from interspecific leucaena hybrids. *In* J. Janick and J.E. Simon (eds), Advances in new crops.

Bristow, S. 1983. Propagation of *Leucaena leucocephala* by cuttings. Nitrogen Fixing Tree Res. Reports 1:28-29.

Dalton, 1980. Bare stem method for establishing leucaena. Tropical Grasslands Newsletter (October).

Garner, R.J. 1979. The grafter's handbook. Oxford University Press, New York. p. 140.

Hu, T., and L. Chih-Cheng. 1981. Vegetative propagation of leucaena by leafy cuttings under mist spray. Leucaena Res. Reports 2:50.

Litzow, D.R., and H.M. Shelton. 1991. Establishment of *Leucaena leucocephala* and *Gliricidia sepium* from stem cuttings. Leucaena Res. Reports 12:3-6.

Rotar, P.P., R.J. Joy, and P.R. Weissich. 1986. 'Tropic Coral' tall erythrina. Research Extension Series 072, Hawaii Institute of Tropical Agriculture and Human Resources. p. 10.

Versace, G. 1982. Propagating leucaena by grafting. Leucaena Res. Reports 3:3.

Williams, C.N., W.Y. Chew, and J.A. Rajaratnam. 1980. Tree and field crops of the wetter regions of the tropics. Longman Scientific and Technical, England. p. 28-32.

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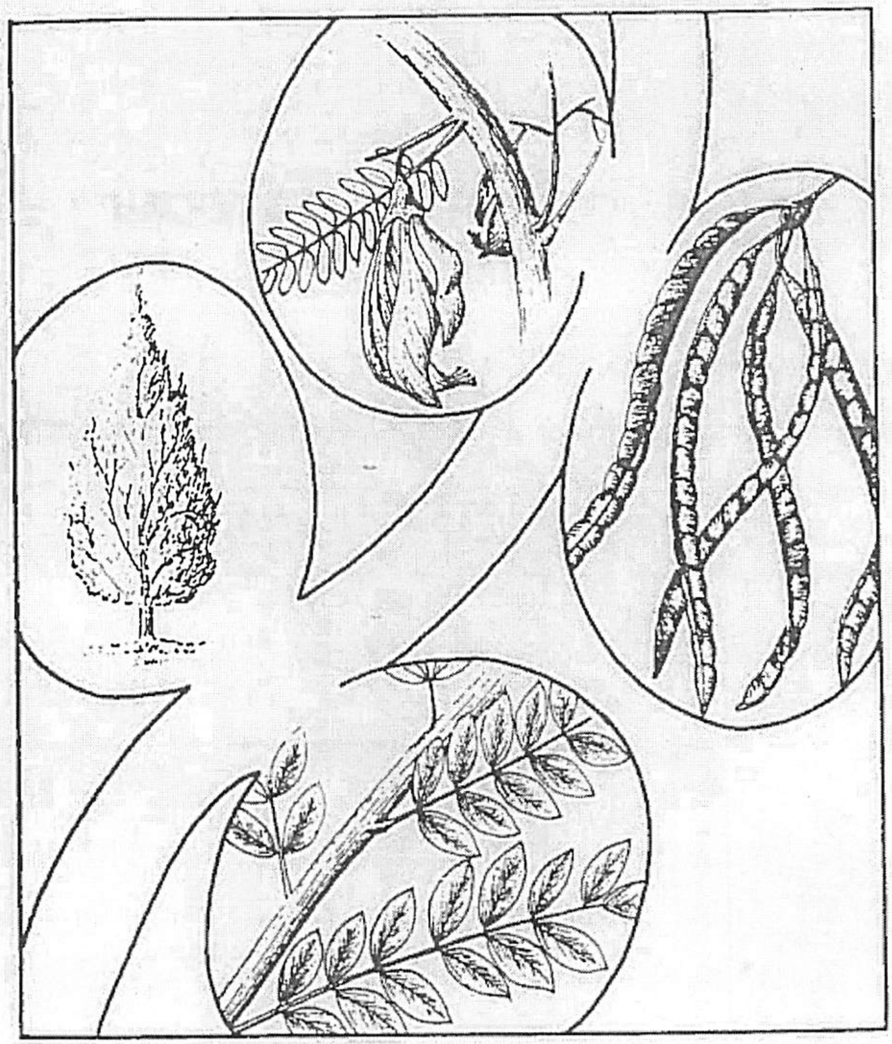

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