



Figure 1. Rooting in a cladode cutting of *Casuarina equisetifolia* dip-smeared with IBA 4000 ppm in talcum powder.

cladode. Treatment with 4000 ppm of IBA elicited 100% rooting response (figure 1). The results show that rooting percentage, number of roots per rooted cladode and average root length are maximal in cladodes treated with 4000 ppm of IBA. All the rooted cladodes were subsequently transplanted in soil and sand (1:1) in polythene bags and placed outside the mist chamber in shade. All the plants are grown normally (100% survival after transplantation).

The present results show that vegetative propagules of *C. equisetifolia* can be produced using cladodes. However, it must be emphasized that the high degree of success obtained in the present study was with cladodes obtained from 15-month-old plants. In many forest plants the vegetative material obtained from older trees fails to root despite hormone treatment². In such plants attempts have been made to induce juvenile shoots in older trees by methods such as coppicing or hedging³. Trees show juvenility gradients, with epicormics, root suckers, stump sprouts and severely pruned trees producing juvenile shoots⁴. In *Eucalyptus*, branch and leafy cuttings taken from older trees fail to root

but coppice sprouts root with a high degree of success⁵. In mature trees of *C. equisetifolia*, bunches of cladodes often arise sporadically on the main stem in the basal region. Root suckering of desired trees can also be stimulated to obtain juvenile cladodes. These cladodes can be rooted to produce new plants. Once a tree with desired characteristics such as better performance under acidic/saline conditions is identified, it can be cut or root suckers can be induced, and the bunches of cladodes rooted using the technique presented to produce a large number of vegetative propagules.

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IMPORTANCE OF CALCIUM AT BREEDING SITES OF FISHES

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Shell strength may be directly proportional to the availability and concentrations of its various components existing in the environment. Zotin¹ attributed shell strength of salmonids to calcium contents of the water at breeding habitats. He also demonstrated that calcium is necessary for the functioning of the hardening enzyme which acts during earlier stages of development, immediately after fertilization. In marine fishes the degree of hardening among eggs depends upon the time the eggs are exposed to sea water² (access to excess calcium). Calcium is necessary for both insegmented and

unfertilized eggs. While comparing the effects of different media, Lonning *et al*² indicated that the responses of eggs to calcium free medium differed. In a medium deficient in calcium, eggs with a soft chorion are produced as compared to those eggs which grow in a medium where calcium is present, thus emphasizing the need for calcium during hardening of eggs. From the present investigations, it is concluded that the egg shell of *Puntius conchoni* is stronger in resisting mechanical stress (which was caused experimentally) as compared to the egg shell of *Aspidoparia morar* and *Xenentodon cancila*. This strength could be related to the relative calcium content of the water during breeding seasons of these fishes, which is maximum during the breeding season of *P. conchoni* (mean 57.46 ppm) less so in the case of *A. morar* (mean 37.7 ppm) and least in the case of *X. cancila* (mean 20.05 ppm). On the basis of the present findings there exists a direct correlation between the calcium content of water and the shell strength of the eggs^{1,2}.

The weaker egg shell of *X. cancila* may be because these eggs mostly develop in water columns, attached to vegetation and which are not demersal. The eggs of both *P. conchoni* and *A. morar* develop when placed on naked shallow sandy troughs and are exposed to turbulences caused by the flowing water when these troughs (breeding sites) are connected with the main stream; or even when disconnected, such turbulences may be caused by wind action in these shallow troughs which lie in the open at breeding sites, particularly in the case of *A. morar*. This condition may have caused the formation of relatively harder egg shells to protect them against mechanical injury through abrasion against sand particles caused by turbulent wind action. Such a condition demands a Ca⁺ rich breeding habitat (mean 37.7 ppm *A. morar* and mean 57.46 ppm in *P. conchoni*) for these fishes that deposit their eggs on sandy substrates. It is interesting to point out that breeding sites of *X. cancila* and *P. conchoni* are precisely the same, though they differ in their breeding times. This temporal difference in the breeding appears to be an adaptation, among other factors, against mechanical stress, because calcium content at the time of breeding of *P. conchoni* is more than twice that of the calcium content at the time of breeding of *X. cancila*. Eggs of *X. cancila* show a relatively higher mortality when compared to those of *P. conchoni* and *A. morar* on exposure to mechanical stress under laboratory conditions³. This indicates a poor

inbuilt strength in the egg shell of *X. cancila* as compared to that of other two fishes.

This poor strength in *X. cancila* is compensated by the development of hooks on the egg shells (an ecological adaptation) enabling the developing eggs to stick to submerged vegetations. This ecological adaptation in the eggs of *X. cancila* enables them to offset the poor strength of their egg shells. This may be an adaptative compensation in fishes like *X. cancila* for breeding in a Ca⁺ deficient habitat (20.05 ppm). Eddy⁴ is of the view that demersal eggs carry stronger shells than pelagic or mesopelagic eggs, because demersal eggs probably need to be strong to withstand the mechanical stress caused by direct contact of the deposited eggs with the bottom and the action of sediment laden flowing water. Therefore, this differential presence of calcium appears to be one of the factors determining the breeding times of fishes at the same breeding site.

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CHANGES IN PHENOLS DURING RHIZOGENESIS IN ROSE (*ROSA BOURBONIANA* DESP)

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PHENOLIC compounds comprising a vast class of compounds, play a vital role in the rooting of plants^{1,2}. Though auxins also play a major role in the formation of adventitious roots, some factors other than auxin which are hormonal or nutritional or both, are necessary for the same. It was later found that these factors are of phenolic nature which act as auxin synergists in root initiation. Differences in rootability between different plant species, and between young and old plants in the same species may be due to differences in the quantity of these phenolic compounds^{3,4}. However, the