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Networking via root grafts - just a whim of nature or a strategy of trees to be more resilient in stressful environments?

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Two of the oldest living trees known on earth, the Pando and the Old Tjikko, are clonal plants. Their longevity has been attributed to the mutual benefit of resource sharing and the accumulation of beneficial somatic mutations. Similar effects are known for mycorrhizal networks and trees connected by grafted roots. Could it be that networking is generally advantageous increasing forest integrity under harsh conditions? Using an ultrasonic Doppler probe, we mapped networks of grafted black mangroves (*Avicennia germinans*) along inundation gradients in Mexico. To analyse their potential role for mitigating drought stress, we investigated (1) the network topography and (2) the influence of tree characteristics, tree constellations, pore water salinity and redox potential, as well as the microtopography and hydroperiod on the occurrence of root grafts. We found that the number of root grafts increases with tree density. Under stressful saline conditions the number of grafted trees in a plot is larger (~ 52%) than under moderate conditions (~ 20%). The probability of root grafting is a sigmoid function increasing with the size of the trees, but its shape is very much influenced by pore water salinity. Under more stressful conditions, the inflection point is earlier (smaller trees graft) and steeper (the maximum number of grafted trees is achieved earlier). In stressful conditions the tree networks are small, with 4 - 5 connected trees in average, and have a more linear structure than in moderate conditions. The latter agrees with evolutionary game theory, which predicts that cooperation flourishes most if organisms are strongly pairwise-tied because the costs (for grafting) are quickly payed-off by the reciprocal benefits (sharing of water, nutrients and other resources). Our findings thus support the recent hypothesis that root grafting is an evolutionary beneficial, and thus adaptive behavior, which improves resource acquisition by trees.

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