

Formation of Adventitious Roots in Decaying Trunks of Old *Persea americana* Mill. Mexican Race

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Summary

Three cases of adventitious roots formation were observed inside the old trunks or of the root base showing advanced process of wood decomposition. Such roots seem to play a salvation role and may be indicative of easy rooting of individual seedling trees. Conditions favoring etiolation of healing bark, contact with decomposing wood, continued presence of leaves, and disequilibrium of root/crown components seem to favor the formation of adventitious roots.

INTRODUCTION

Old solitary trees are seldom sound. They normally die due to the stem or root base rotting. This process liberates a mechanism of adventitious roots formation. In turn, this can be regarded as the salvation process aimed to replace the dying primary root system and to guarantee the future functional, physiological, and statical equilibriums between the above-and underground parts of the tree. Description of cases observed was considered worthwhile because of theoretical and possible practical implications.

MATERIAL AND METHODS

The data include observations, documented with photographs of large avocado trees (*Persea americana* Mexican race), located in Tecamachalco, Puebla State (Fig. 1) and the Valle of Maltrata area of Aquila, Veracruz (Figs. 2, 3). The drawings (Figs. 1, 2, 3) originate from slides and are somewhat simplified. The three trees observed are of the Mexican race. Observations and photographs were made while searching for germplasm resources for further research.

RESULTS AND DISCUSSION

The situations of adventitious root presence in the three cases (Figs. 1, 2, 3) are different, although their initiation and further development could have common features. Comparing the situation found in Figure 2 with those in Figures 1 and 3, one can imagine the following sequence of events.

Figure 2 shows a situation at a relatively early stage of development. Figure 3 shows a younger phase; Figure 1 represents the very advanced stage of restoring the lost root system. I had not until this discovery located a tree with initial stages of adventitious root formation inside the rotting wood of the trunk.

In the first case (Fig. 1), at the time the photograph was made (V 1980) there was no wood decomposing and the roots were already very thick. All roots were deeply rooted in the soil stratum inside the cavity formed at the trunk/root junction. Ramifications present above the soil indicate that roots were developing earlier in the substrate, which was gradually lost. The situation in this particular case represents an advanced stage of rescue of the root system.

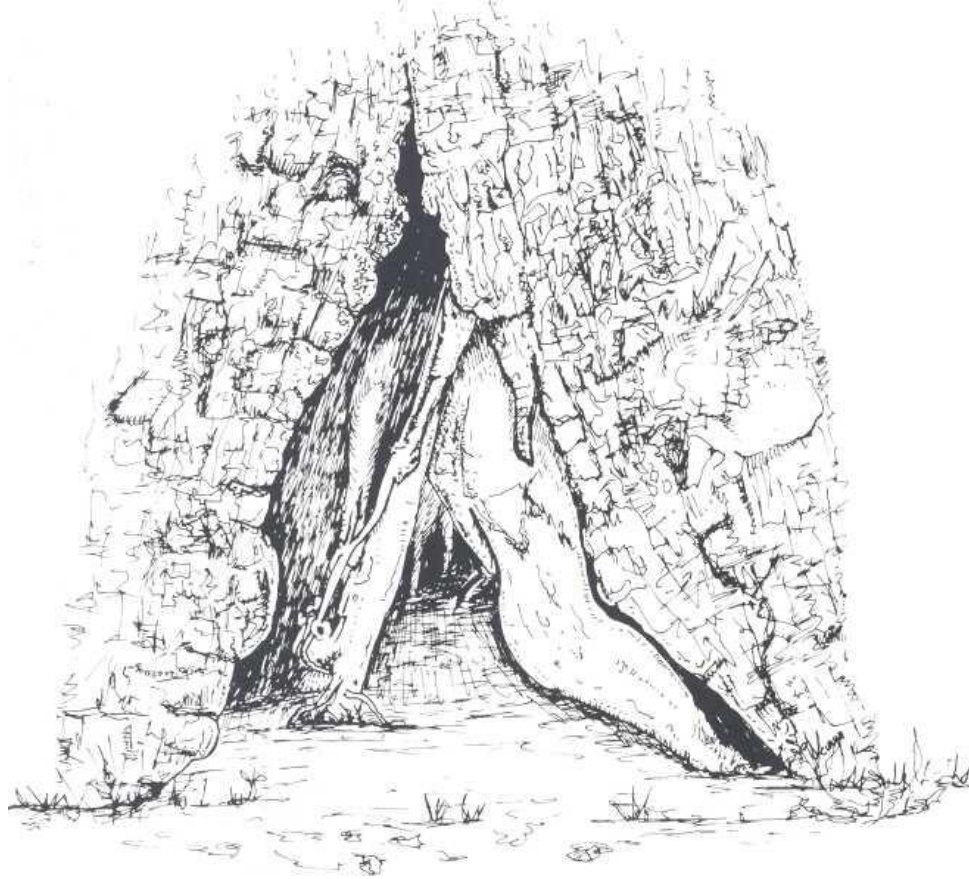


Fig. 1. *[Tecamachalco] Adventitious roots formed at the trunk base. Old, thick, and some thinner roots inside the rotted trunk can be seen. They reached to soil after the trunk/root base decomposed. The adventitious roots are branching inside the soil with vigorous growth in diameter. The roots, although exposed to the diffuse daylight, do not show any sign of adventitious shoot formation.*

The second and third cases (Figs. 2, 3) depict earlier stages of formation of adventitious roots. The roots are relatively thin and long (Fig. 2) to very long: 150-170 cm (Fig. 3). The roots were found at the early stages of wood rotting, when the decomposing matter possibly was still in contact with the healing bark. The downward movement of the stratum of decomposing wood inside the trunk was followed by longitudinal growth of the roots to remain in contact with the litter. The part of the root in contact with decomposing material was branching. Due to losses in the stratum level, those branches appeared above the stratum. In all three cases, roots appeared at the highest levels of the ceiling of the cavity. In Figures 2 and 3, they give the impression of hanging

from the ceiling of the cavity. They could be classified as vertical roots similar in function to the primary root.

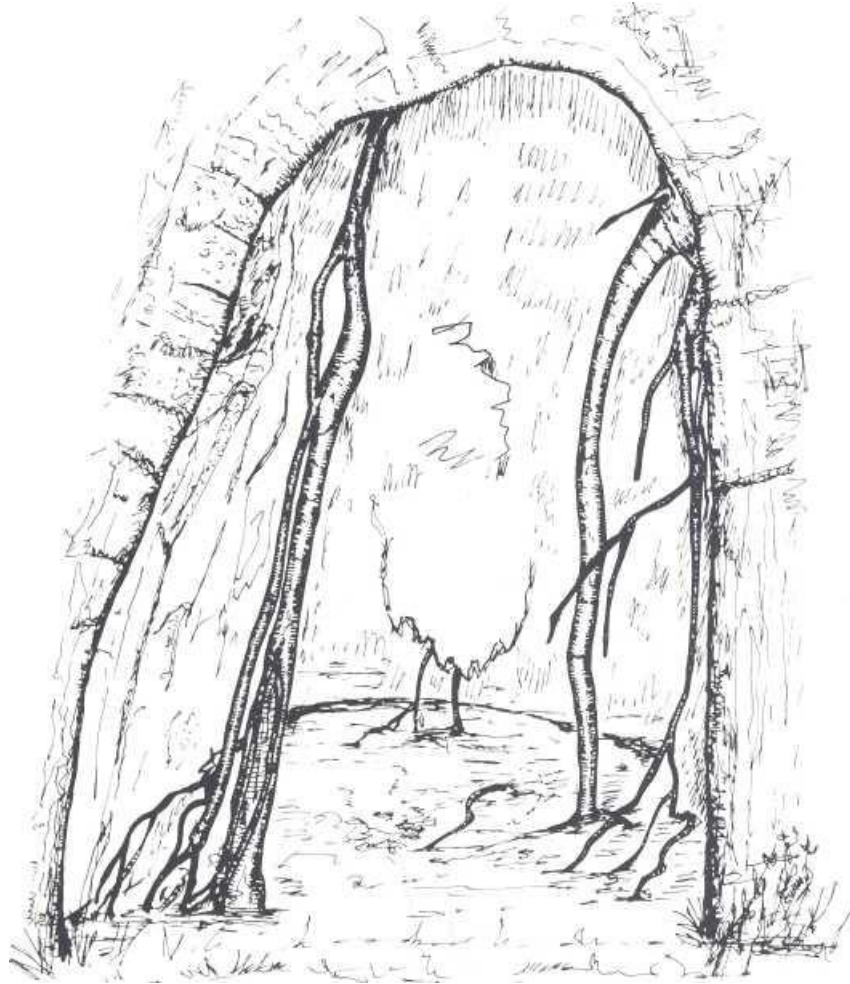


Fig. 2. [Maltrata] Adventitious roots inside the cavity formed in the decaying wood of a trunk. The bottom of the cavity was formed at approximately 1.0 m above the ground level. The branching of roots occurs at the level of decomposing organic matter of the trunk (pulverized humid, brownish matter with large fragments still compacted). Some roots lost their contact with the organic matter and died. The roots seem to follow the lowering layer of trunk wood in the process of decomposition.

Old, solitary trees are seldom healthy. They are gradually dying due to rotting at the stem/root junction or any point of the stem or stem/scaffolds junction. In the latter case, the starting point forms at a wound from a broken or cut scaffold where the healing process is unfinished. Such a wound, especially when occurring at the trunk base, weakens the tree's anchorage, and the tree may fall down.

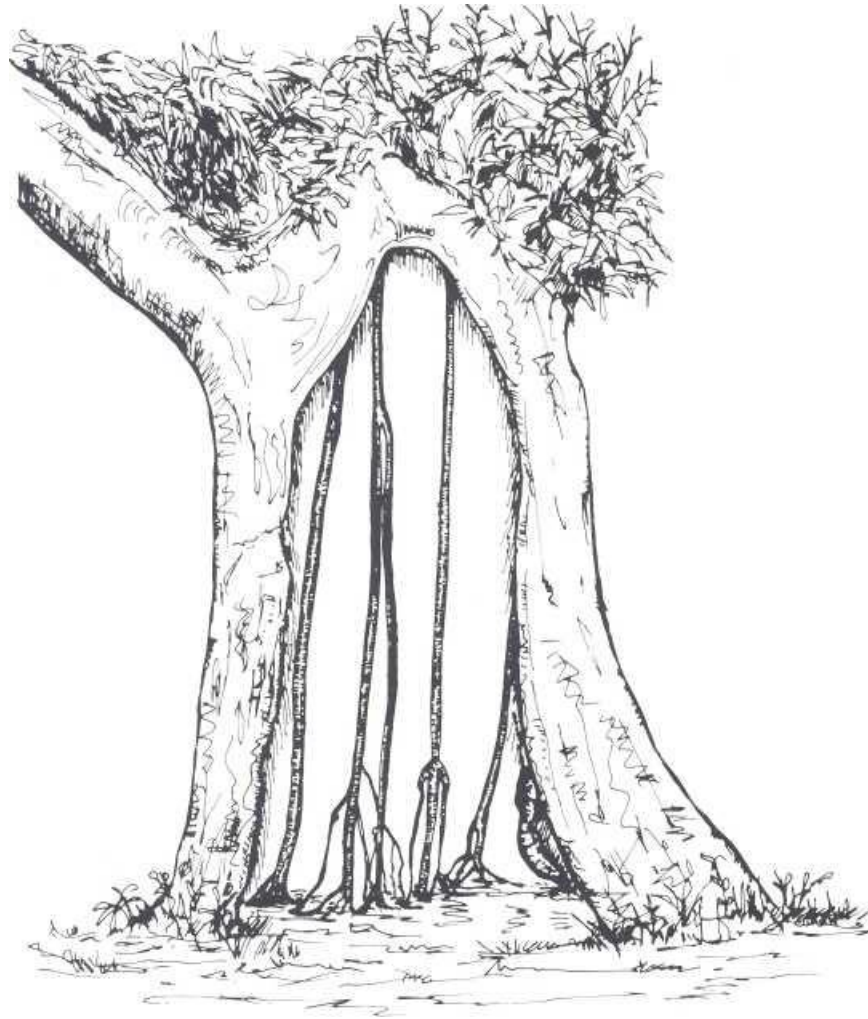


Fig. 3. [Maltrata] Adventitious roots formed inside the cavity of an old tree. The upper pan of the cavity, from which almost all roots originated, is located 17 m above the soil level. All roots are developing in the organic matter and soil inside the former trunk. The roots were following the process of wood decomposition and removal or washing away of organic matter during decomposition, finally reaching the soil surface, the former basal part of a root system.

The formation of wound bark, especially if it functions for many years, may result in disequilibrium of growth regulators in the upper part of the wound (the upper part of the cavity) favoring an increased level of auxins. It is well known from horticultural practice that auxins applied to a wound accelerate the healing process. Roots always initiated inside the trunk, in the ceiling of the cavity in conditions of low light intensity; thus, higher levels of auxins may be the prime cause of adventitious root initiation and growth inside rotting trunks.

The lack, or very low level, of light also should be taken into account as a possible factor favoring rooting. This has been repeatedly documented (Barrientos Priego, *etal.*, 1986; Frolich, 1961; Salazar-Garcia and Borys, 1983). The three cases observed in this study were of the Mexican race which, according to general opinion, roots more easily

than other races. The adventitious roots were initiated in the healing bark exposed to conditions favoring the etiolation process.

The rooting of cuttings is conditioned by continued leaf presence (Reuveni and Raviv, 1981). The leaves of the crown could additionally stimulate adventitious roots formation. On the other hand, the tree of Figure 2, where the roots were exposed to high sunlight, lacks the formation of adventitious shoots. Such shoots are freely formed on roots exposed to the light in *Crataegus pubescens* (H. B. K.) Steud. as early as in the first year (Borys, 1990). Avocado roots seems to be very resistant to such morphogenic action of sun radiation.

Initially, the process of root formation involves continued contact of healing bark with wet wood in the process of decomposition. Microbial activity could add some growth regulators to stimulate further the root development process. From studies of humic acids, present in decomposing organic matter, it is known that stimulation of root development takes place (Niklewski, 1948). The formation of adventitious roots inside decomposing trunks could result from the interaction of increased levels of auxins and formation of humic acids that favor nutritional composition of decayed matter in contact with healing bark.

As shown in Figure 2, the roots are growing in the tree's own decomposing body. One could expect a possible allelopathic influence. The formation of roots and the branching of roots in contact with decaying wood excludes a negative, allelopathic effect. To the contrary, it suggests a positive influence of a type experimentally proved by Niklewski and his students (1948) with root development in other species.

Adventitious roots can be used to reproduce an individual tree by grafting onto it the scions of the same crown or by making root cuttings.

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