

## AN UNUSUAL CASE OF PARASITISM IN AVOCADO

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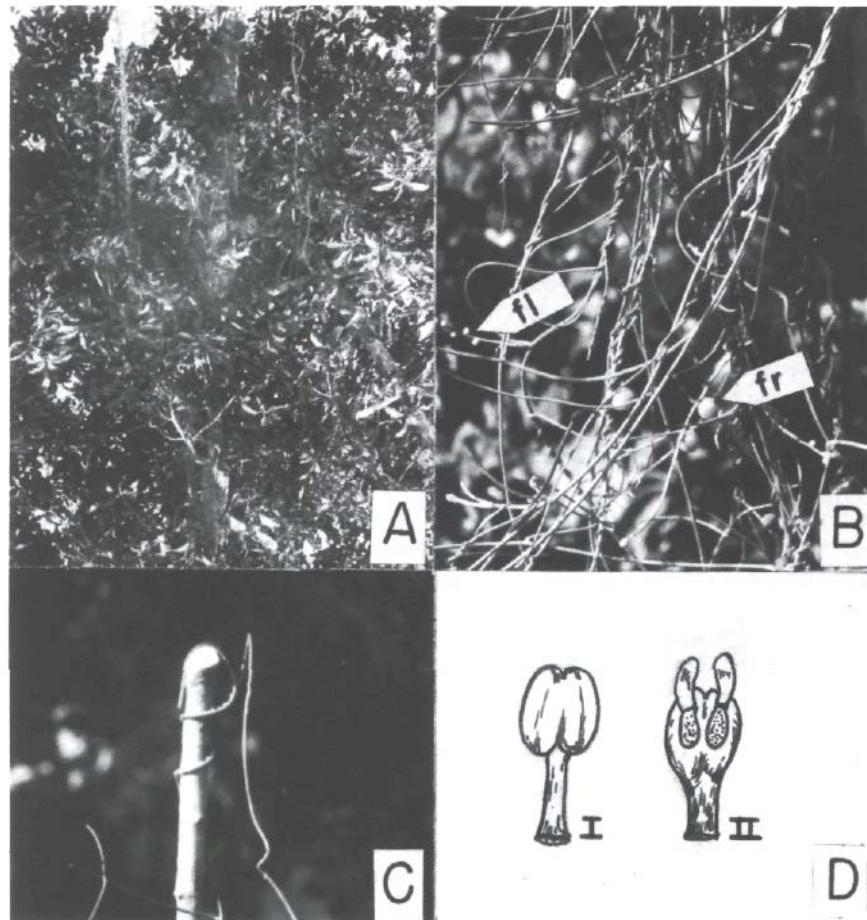
The majority of higher woody plant species maintain themselves through the production of elaborated products, the result of several metabolic sequences associated with the presence of chlorophyll and the reactions during photosynthesis. Evolutionary diversions from this condition of independence have caused some plant groups to become parasitic on other self sufficient plants. These parasitic types generally are smaller in size than their host and contain little or no chlorophyll, thus lack the metabolic mechanisms to support themselves. Many interesting examples can be cited of higher flowering plant species which have become parasitic on various organs of other higher plants. The parasitic relationship of the stem mistletoes, *Viscum* sp., a member of the Loranthaceae family, and the parasitic figworts and broomrapes of the family Scrophulariaceae which lives on the roots of a wide range of host plants, is often described in botanical work (6). Well known stem parasites of the family Loranthaceae produce an exceptionally large and massive vegetative structure which sometimes equals or exceeds the size of the host plant.

Two parasitic species which resemble each other in general morphological characteristics of the plant body are *Cuscuta* species of the family Convolvulaceae and *Cassytha* species of the family Lauraceae (3,10). Both of these genera consist of plants with long vine-like stems of rather uniform size along the entire stem length. The stems have a diameter of 1 to 3mm, and branch profusely as they twine about each other and about the host tissue. The younger branchlets may be greenish in color but eventually may become a bright orange. The fruit structures are round in form and about 5 to 10mm in diameter. The distinguishing features which separate the two genera are found in the floral structures and the morphological aspects of the respective fruits. The flowers of *Cuscuta* are small, about 2mm in diameter and borne singly along the stem. The floral envelope consists of a calyx with five lobes encircling a corolla which is small, bell-shaped and cream colored. The fruit is a dry, spherical, thin-shelled structure containing several small black seed.

The flowers of *Cassytha filiformis* are borne in small panicles. An individual flower is 2mm in diameter and consists of a very small corolla of six lobes surrounding the six cream-colored perianth parts. Within the perianth are nine stamens, each with uplifting valves, arranged in two whorls and six staminodes. The simple single pistil gives rise to a small fleshy berry-like fruit within which is a single spherical seed.

The *Cassytha* vine climbs by twining movements (9). It has no tendrils. Adherence and actual physical connection to the host plant is by means of specialized swellings, the numerous haustoria, in which actually develop an internal anatomical continuity of xylem tissue with that of the host plant (1,2,9). The leaves are reduced to scales. The

stem has a small amount of chlorophyll, hence functions somewhat in photosynthesis reactions, thus relying on the host plant primarily as a source of moisture. This in reality is only a partially parasitic plant in the strict sense. The plant climbs by a twining movement in which the apex circumnutates, that is, it swings around in the air until it strikes the host plant at which time continued length growth is stimulated by contact in a manner that causes the stem to wrap around the host organ.



The woe-vine, *Cassytha filiformis*, a parasite on avocado. A—general cascading habit on West Indian avocado tree. B—closeup of *Cassytha* showing twining stems, flowers (fl) and fruits (fr). C—section of avocado stem with single *Cassytha* stem and haustoria. D—nature of stamens from I—*Cuscuta* (dodder) and II—*Cassytha*. Note uplifting valves in latter.

McLuckie (9) has described the small hard seed within the mucilaginous fruit wall as germinating in the soil into a fleshy primary root with no root hairs. This primary root in short order develops secondary roots with root hairs. Upon contact with the host plant the lower part of the plant dies, hence the remainder of the parasitic stem growth is completely supported by the host tissue. Occasionally the seed will germinate in the mass of intertwined stems of the *Cassytha*. The *Cassytha* plant, a mass of entwined stems, becomes a perennial on perennial hosts in opposition to the comparable plant of *Cuscuta*, which is an annual in habit.

The distinction between *Cuscuta* and *Cassytha* is based primarily on the structural differences of the flowers and the resulting fruits. Species of *Cassytha* are generally tropical in that they seldom extend north of the Tropic of Cancer and south of the Tropic of Capricorn. They are pantropic along the coastal shelves of the tropical areas of Australia, Africa, the American Tropics and India. *Cassytha* is common along the more humid coastal regions of the tropics though it extends inland considerable distances in some instances. *Cuscuta*, on the other hand, is a temperate zone and subtropical species often extending from a coastal environment to that of a desert region.

The host range for both *Cuscuta* and *Cassytha* is extensive in number of species parasitized (4, 8, 11, 12). *Cuscuta*, for example, is a parasite on many fruit and forest trees. It also grows on a large number of exotic ornamental and native plant species in California and many other areas.

*Cassytha* likewise is found on such fruit plants as citrus (*Citrus* sp.), mango (*Mangifera indica*), cloves (*Eugenia aromatica*), nutmeg (*Myristica fragrans*) and avocado (*Persea americana*). It also is common on many other endemic tropical species of lesser economic value.

Because the identity of species in these two genera is not clear in some instances, the respective host ranges are variable and might be questioned. Thus general host records are probably as valid as any. Gaertner (3) does not list any members of Lauraceae among the extensive list of host plants for ten species of *Cuscuta* found in eastern United States. The same study also lists four species of *Convolvulus* and two species of *Ipomea* as hosts within the same botanical family as the parasitic genus *Cuscuta*. McLuckie (9) investigated parasitism in the genus *Cassytha* and listed eighteen plant species of various families other than Lauraceae, though he mentions that *Cassytha* can be found entwined upon itself with the intervention of well developed haustoria, hence dependent upon the supporting vine primarily for moisture sources.

The extensive host list given by Wellman and Woodbury (11) indicates 165 species from 84 families which are parasitized by *Cuscuta* and *Cassytha* in Puerto Rico.

*Cuscuta* has been identified on avocado in Israel (7).

*Cassytha filiformis* attaches itself to the avocado stem by means of haustoria which are comparable to a series of cups that partially encircle the stem in a spiral arrangement at specific points high on the stem. These haustoria are about 2mm in diameter. A series of six to eight haustoria, each spaced 2-3mm apart, provide the attachment mechanism from which can be supported a considerable weight of parasite stem. From the point of attachment on the host stem the branching parasite stem cascades downward, sometimes forming thick mats of thread-like tissue which will cover the lower branches and eventually extend to the soil. Without doubt the presence of a parasitic plant species on an avocado tree will have some effect on the physiology and growth responses of the plant. In all probability under conditions of extensive covering of the tree by the parasite, severe damage may result. Apparently there are no reports of extensive avocado tree damage by the presence of *Cassytha filiformis*.

The appearance of *Cassytha filiformis* as a parasite on many plant species has been observed in many parts of the world such as southern Mexico, Western Australia, South

Africa, Mauritius, New Caledonia, New Hebrides. On a recent visit to Zanzibar *Cassytha* was observed on several fruit trees, including the avocado. The combination of *Cassytha* as a parasite on a host of the same botanical family was observed in the Agricultural Experiment Station at Kizimbani, Zanzibar. This island, of great historical interest, is located just off the coast of Tanzania in East Africa, Zanzibar has been known for many years for its production of spices, particularly that of cloves, which is the major agricultural crop of the island. The climatic and soil conditions support the growth of many species of economic importance, such as cloves, nutmeg and mace, ginger, cardamom, pepper berries from which black or white pepper is made, and several other spices. Many of the tropical crop trees in Zanzibar were planted by the British during the early occupation of the island in the latter part of the 19th century. The avocado on which the *Cassytha* was growing probably was planted not more than fifteen years ago. The tree was about 20 feet tall with a trunk diameter of approximately 10-12 inches. Without doubt this avocado is of the West Indian type, which is common throughout the island. Only West Indian type avocado fruits were observed in the several markets which were visited.

A significant aspect of *Cassytha filiformis* growing on avocado, *Persea americana*, is that both are members of the same botanical family, Lauraceae. *Cassytha* is the only member of the family Lauraceae without leaves and with very little chlorophyll, hence it has evolved as a vine and as a parasitic species depending upon larger, woody host plants for nutrients and physical support. It represents, moreover, a rather unusual situation where a species from a botanical family is parasitic on other members of the same family as well as on species of many other families.

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