

# Some Observations on Root-Parasitism in New Zealand

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## Abstract

It is shown that the endemic genus *Mida* (Santalaceae) is a root-parasite, and this condition is confirmed for New Zealand species of *Euphrasia* and *Exocarpus*.

Root parasites are rare among New Zealand flowering plants. The habit appears to have been recorded definitely for only one species—namely, *Dactylanthus*, a striking monotypic genus of the Balanophoraceae, which is confined to the North Island (Cheeseman, 1914 and 1920). It has been stated frequently in New Zealand botanical literature that the species of *Gastrodia* (Orchidaceae) are parasitic on the roots of other plants, but this is not correct; these orchids are saprophytic.

## EXOCARPUS

Many members of the Santalaceae are known to be parasitic, and this habit has been recorded for *Exocarpus* in Australia (Benson, 1910; Herbert, 1925; Rao, 1942). So far as is known no published report exists of parasitism in the single New Zealand endemic species, *E. bidwillii*. In a recent paper by Aiken (1957), for example, it is stated that no parasitic members of the Santalaceae are known from New Zealand. The following description of the haustoria in that species may therefore be of interest.

The small shrub *Exocarpus bidwillii* is frequent at mid-altitudes on the mountains of the South Island of New Zealand. It attracts attention by its curious appearance: the densely branched erect twigs are reddish-brown and the leaves are reduced to minute scales. The root system is woody and usually runs underground for considerable distances, often among boulders. Sometimes, therefore, it has proved difficult, or impossible, to demonstrate haustoria. However, these have been observed in a sufficient number of cases to warrant the assumption that they are general or even invariable. The haustoria, when they are seen, are found in abundance, and may form such an intricate plexus of connections with several roots that the relations between parasite and host are difficult to interpret. This complexity is due to the finer roots of *Exocarpus* producing a close succession of haustoria when they are appropriately situated in relation to a host root. As in other members of the Santalaceae, young roots will attack large as well as fine host roots, the haustoria being capable of penetrating well developed cork layers.

Sections through haustoria confirm that the tissues of the host are penetrated. A central peg of tissue projects into the host, but union remains superficial, contact being made with the secondary phloem but not, so far as has been observed, with the xylem. In this respect, therefore, the New Zealand species resembles *E. spartea* as described by Herbert (1925) rather than *E. cupressiformis* and *E. aphylla* described by Benson (1910) and Rao (1942) respectively.

Roots of *Exocarpus* have been found with haustoria on *Helichrysum selago*. However, the range of hosts must be wide, as is the case in some other members of the Santalaceae, because *Exocarpus* has not been observed to associate constantly with this *Helichrysum* or with any other species.

## MIDA

The only other members of the Santalaceae occurring in New Zealand are the two species of the endemic genus *Mida*, both of which are confined to the North Island. Formerly this genus was united with *Eucarya* (*Fusanus*), a genus which

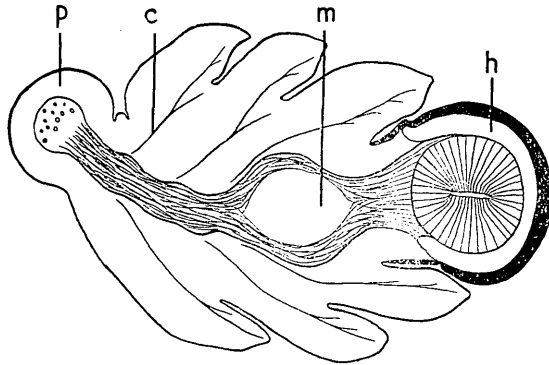


FIG. 1.—*Mida salicifolia*, haustorium in longitudinal section.  $\times 8$ . Between the roots of the parasite (p) and of the host (h) is the haustorium with three cortical folds, each with a layer of collapsed cells (c). Down the centre of the haustorium runs a massive vascular cylinder, which becomes distended by a core of parenchyma (m) before it enters the host root.

has been shown to possess haustorial connections with neighbouring roots (Herbert, 1921, 1925). But Skottsberg (1930) has confirmed that the New Zealand species are not very closely related to any other members of the Santalaceae. It was interesting, therefore, to determine whether the genus *Mida* exhibited parasitism.

Dr. J. A. Rattenbury, of the University of Auckland, very kindly obtained roots of *Mida salicifolia* for me which had developed haustoria in contact with roots which he thought might be kauri (*Agathis australis*). Sections passing through these haustoria (Fig. 1) show a structure similar to those of other Santalaceae figured by Rao (1942). The structure is much more complex than the simple swellings of *Exocarpus bidwillii*, and the contact with the vascular tissue of the host is more complete. The cortex of the larger haustoria is thrown into a series of collars or folds which are traversed by strands which Rao (1942) interprets as collapsed cells caused by differential growth rates in the outer and inner tissues of the haustorium. Towards the host root the vascular cylinder becomes distended by a mass of dense parenchyma cells. This feature was recorded in the material examined by Benson (1910) and Rao (1942).

In the roots examined the parasitic tissue did not extend beyond the outer xylem of the host. It seems probable, however, that if the haustoria persist from one year to the next that they will become more deeply embedded in the xylem.

Anatomical investigation confirmed that the host roots were *Agathis australis*, but it seems probable that *Mida* will prove to resemble many other Santalaceae and parasitise a number of hosts.

#### EUPHRASIA

Species of the genus *Euphrasia* have long been known to be partial root-parasites in other parts of the world (Heinricher, 1897, 1898). It seems probable that several New Zealand botanists will have confirmed for themselves that our species of *Euphrasia* are also parasitic, but this does not appear to have been stated categorically in print. Cockayne was well aware of parasitism in *Euphrasia*, and it is to be expected that he confirmed this in New Zealand. His statement in *New Zealand*

*Plants and Their Story* (1910, and all later editions) is not positive, and has not been taken up by later writers. Other authors refer to the parasitic habit, in their general accounts of the genus, and some (e.g., Richards, 1949) have commented on the likelihood of the native species sharing this habit. On the other hand, in the most recent editions of Laing and Blackwell (1957) and Martin (1947) it is stated that this has not been confirmed. It would seem, therefore, that Cockayne's early statement has not been accepted as based on New Zealand evidence. In view of the fact that in a recent article (Aiken, 1957) no reference is made to the possibility of parasitism in New Zealand *Euphrasias*, and because conflicting opinions on the situation in that genus have been given to me verbally by New Zealand botanists, I have thought it worth while to record the following observations.

Three of the species of this genus which occur in the vicinity of the Mountain Biological Station of the University of Canterbury at Cass—namely, *E. revoluta*, *E. cockayniana*, and *E. zealandica*, have all proved to possess haustorial connections with the roots of adjacent plants whenever they have been examined. These haustoria consist of small bead-like swellings to one side of the fine roots. Their connections with the roots of the host is very fragile, so that roots which have been cleared of soil frequently show numerous haustoria without any host root attached. However, with care junctions may always be found.

Transverse sections through the haustoria have confirmed that penetration of the tissues of the host root occurs. The structure of the haustoria is similar to that of other members of the Rhinanthoideae, especially to that of *Melampyrum pratense* as figured by Leclerc du Sablon (1887). The cells of the cortex multiply to form the mass of the haustorium; within this the cells opposite one of the phloem groups of the parasite root elongate radially. Root hairs form a collar around the base of the haustorium. The actual absorptive cells are few in number, and enter the host tissues rather in the manner of fungal mycelia.

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