Chapter (non-refereed)

Mason, P.A.. 1981 Toadstools and trees. In: Last, F.T.; Gardiner, A.S., (eds.) *Forest and woodland ecology: an account of research being done in ITE.* Cambridge, NERC/Institute of Terrestrial Ecology, 82-84. (ITE Symposium, 8).

18. TOADSTOOLS AND TREES

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Unlike those of annual and biennial plants, many of the smaller roots of coniferous and broadleaved trees are, as a result of colonization by mycorrhizal fungi, short and stubby. The identity of the different fungi would be difficult to determine if it were not for the production of conspicuous and characteristic fruitbodies, mostly toadstool-like, in the autumn. Having planted a plot of birch in July 1971, attempts have been made to analyse some of the factors influencing the production of (ecto-) mycorrhizal toadstools in succeeding years. The plot of ground at the Bush Estate (lat. 55°52'N) was divided into 3 replicate blocks each planted at 3 x 3 m spacings with 20 saplings (8 x *Betula pubescens* Ehrh.; 12 x *B. pendula* Roth) whose seed sources ranged from 66°30'N (Sweden) in the north to 50°40'N (S. Germany) in the south. 1974 the number of trees, out of 60, with toadstools increased from 13 to 38. At the same time mean numbers of toadstools per tree were twice as large around *B. pendula* as compared with *B. pubescens,* with a clear indication that more were associated with trees of southern than of northern origin. By 1975, the overall number of toadstool-producing fungi had increased to 5 but more importantly some had very distinctive patterns of distribution. For this reason it was decided to take the co-ordinates of all toadstools appearing during the autumns of ensuing years, hoping that their occurrence above ground may accurately reflect the development of mycorrhizas below ground (Figure 38). Observations made by Dr J.H. Warcup suggested that this was likely to be so but much more evidence is needed before the relation can be expressed quantitatively (Plate 12).

From 1975-1977, the annual production of sporophores increased steeply to more than 19,000 (Table 28) with the effects of seed origin becoming

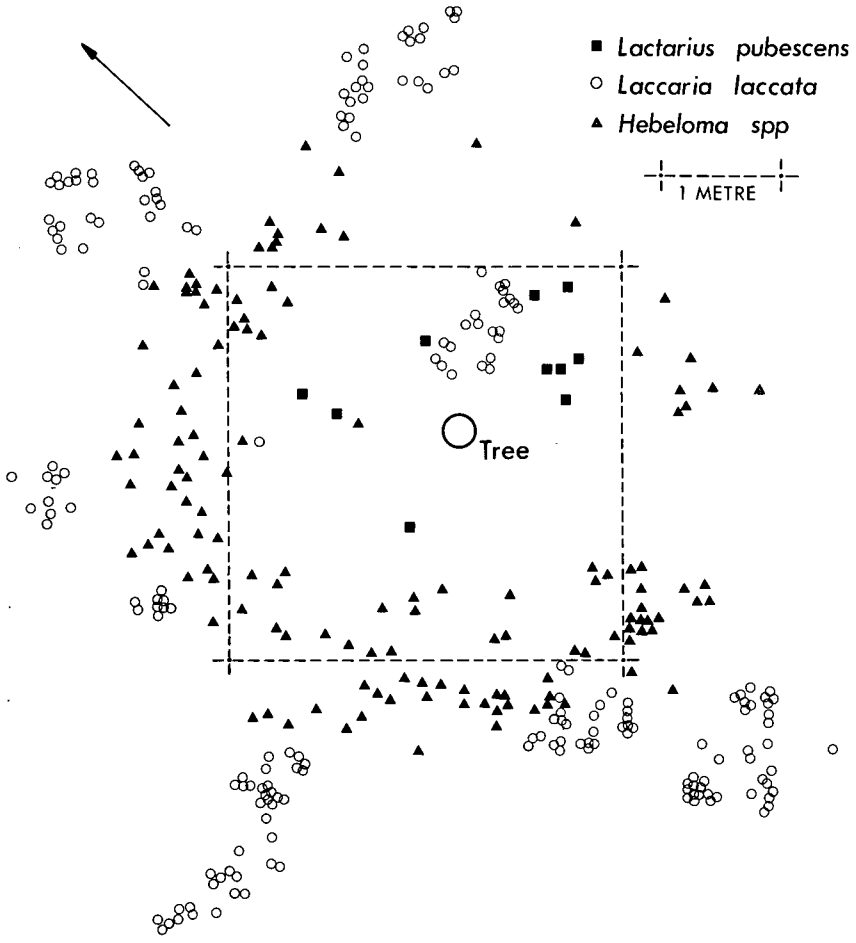

Fig. 38 *The distribution of mycorrhizal fungi around a sapling of* Betula pendula, *4 years after planting.*

A few toadstools of 2 species of fungi, known to form mycorrhizas with birch (Trappe, 1962), were observed near the saplings in 1973 with those of *Hebeloma crustuliniforme* (Bull. ex Saint Amans) Quélet being the more numerous. From 1973 to conspicuous. Eighty-one, 150 and 766 sporophores were produced per tree of southern origin (lat. 50°40'N) in 1975, 1976 and 1977 respectively, while only zero, zero and 3 were associated with those from the most northerly location. As leaves

TABLE 28 Changing populations of toadstools in an ageing stand of *Betula pubescens* and *B. pendula* planted in 1971 at the Bush Estate, near Edinburgh.

Observations made in	No. of trees (of 60) with toadstools	Nos. of fungal species	Annual production of toadstools	Mean nos. of toadstools/tree
1973	13	2	170	13
1974	38	3	680	18
1975	47	5	4900	140
1976	52	12	8500	160
1977	59	22	19000	320

Footnote: counts restricted to fungi known to form mycorrhizas with Betula spp.

of trees from northerly locations yellowed sooner than those from elsewhere, it seems that there is a link between the amounts of persistent foliage and toadstool production (Meyer, 1974).

In 1976 and 1977 numbers of different toadstool species associated with the plot of birch increased sharply to 12 and 22 respectively with as many as 9 being associated with individual trees. In addition to 7 species of *Hebeloma,* 3 species of *Leccinum,* 2 of *Laccaria* and one of *Lactarius* have been recorded. Interestingly, analyses of their location indicated that the spaces currently filled by toadstools had not been occupied in previous years by toadstools of the same or different species. This observation suggests that each fungus has its own particular niche in space and time which may be a product of competition between different species and/or dictated by the effects of the host and its environment. In the period from planting to the end of 1977, the mean distances of sporophores of *Hebeloma crustuliniforme* and *Lactarius pubescens,* from their tree 'hosts', had appreciably increased, but the 'rings' of the former were becoming increasingly fragmented. The significance of these changes and their relation to the occurrence of mycorrhizas in different parts of a root system is being further analysed. However, in the meantime, the effects, already mentioned, of foliage on the production of toadstools were confirmed when another batch of trees was artificially defoliated in 1978– sporophore production being interrupted more or less immediately. Whereas 'mycorrhizal toadstools' (6 or more per tree) were associated with 40 of 64 trees during August, only 2 in total developed in September after defoliation on 22 August, with none at all in October and November (Figure 39). When another batch of trees was defoliated on 25 July there was the same immediate response, but, in this instance, a new flush of leaves developed towards the end of September and, with it, a new crop of toadstools (Plate 13).

Bearing in mind the intimate contact between tree roots and mycorrhizal fungi it is not surprising that there is a degree of interdependence. It has been possible to identify a succession starting with *Hebeloma crustuliniforme,* followed successively by *Laccaria laccata, Lactarius pubescens* and *Inocybe* spp, then other *Hebeloma* spp and *Leccinum* spp. Should note be taken of this array of fungi in considering the choice of species when making artificial inoculations? Should *Hebeloma crustuliniforme,* the first in succession, be used or can the choice be widened? Is the succession attributable to the effects of earlier colonisers or is it, in the main, a reflection of the host's changing metabolism? Should we be thinking of a root system as a single entity or do different sections of it differentially favour the growth of the assortment of mycorrhizal fungi? We already have evidence to suggest that, when planted in the same soil, different seedlings of the same birch seed-lot may be selecting different mycorrhizal associates.

References

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Trappe, J.M. 1962. Fungus associates of ectotrophic mycorrhizae. *Bot. Rev.,* **28,** 538-606.

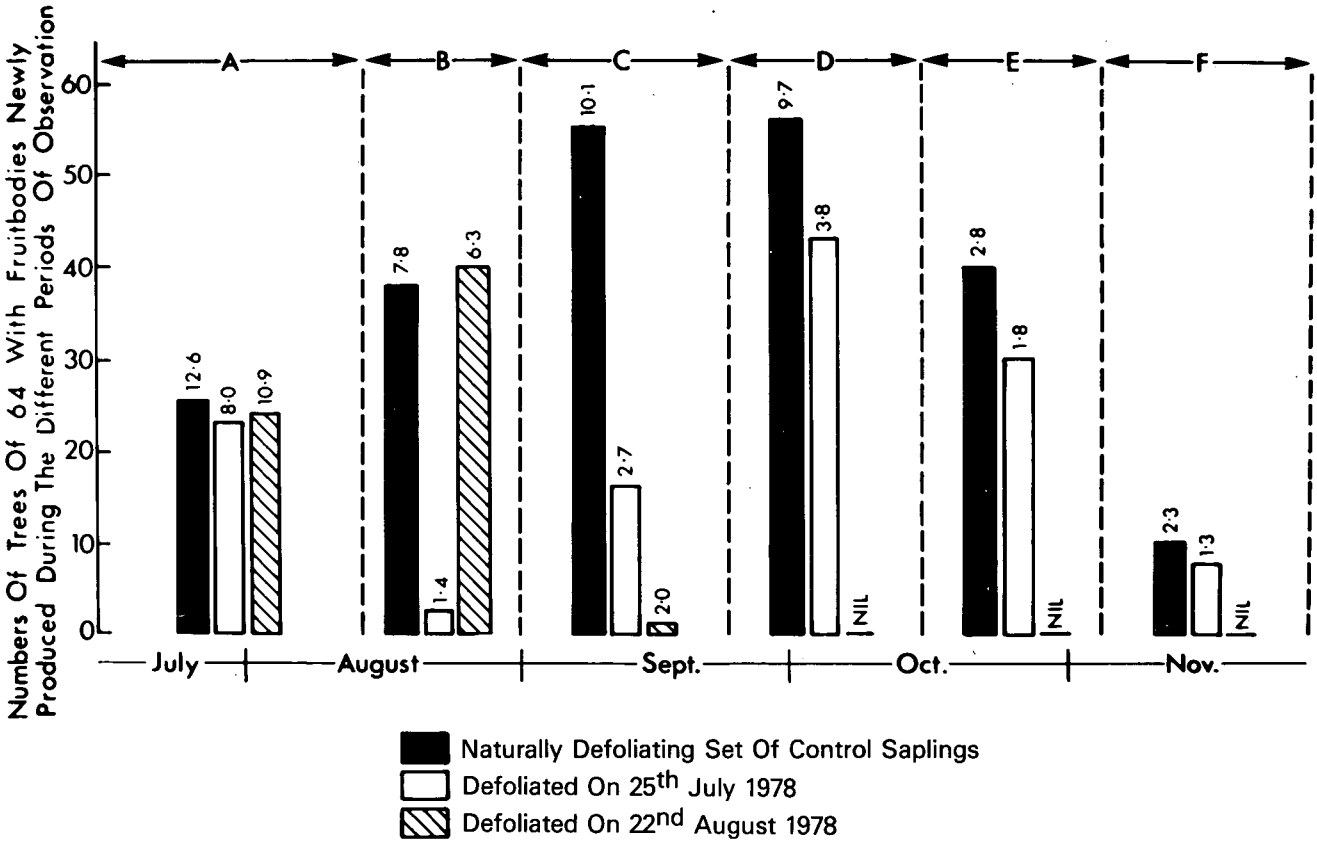

Fig. 39 *Mean effects of defoliating* Betula *spp on either 25 July or 22 August 1978 on numbers of replicate trees with fruitbodies of associated mycorrhizal fungi newly produced within the different periods of observation. (Figures at tops of columns are mean numbers of fruitbodies per tree produced during each period; they were calculated from replicates producing at least one new fruitbody during the relevant period.).*