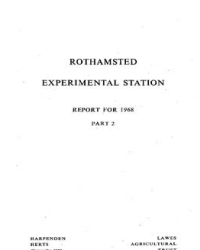


Thank you for using eradoc, a platform to publish electronic copies of the Rothamsted Documents. Your requested document has been scanned from original documents. If you find this document is not readable, or you suspect there are some problems, please let us know and we will correct that.



ROTHAMSTED
RESEARCH

Rothamsted Experimental Station Report for 1968 - Part 2



[Full Table of Content](#)

Rhizosphere and Rhizoplane Fungi

Judith Etheridge

Judith Etheridge (1969) *Rhizosphere and Rhizoplane Fungi* ; Rothamsted Experimental Station Report For 1968 - Part 2, pp 181 - 183 - DOI: <https://doi.org/10.23637/ERADOC-1-2>

MICROBIOLOGY OF BROADBALK SOILS

Medicago lupulina (black medick) is the commonest leguminous weed on the plots sampled, but its nodule bacteria is the rarest of the four species. Black medick is most frequent in plots 3 and 5, much less frequent on plot 16 and rarely occurs on plot 8, which also contains fewer *R. meliloti* than other plots. Herbicides have decreased numbers of *M. lupulina* in most years (see p. 197) but this has had no effect on the numbers of its nodule bacteria in the different sections.

The natural hosts of *R. leguminosarum* found in Broadbalk are common vetch (*Vicia sativa*) and meadow vetchling (*Lathyrus pratensis*), *Vicia sativa* being most frequent, particularly in certain years on plots 3, 5 and 18. *Lathyrus pratensis* occurs rarely and sporadically and very few of either legume occur on plot 16 and none on plot 8. There is no significant difference in numbers of *R. leguminosarum* between plots or between sections treated with herbicides and those not treated, in spite of the effect of herbicides in diminishing populations of *V. sativa* on all plots where it occurs.

Although *Rhizobium trifolii* is more widely distributed on Broadbalk and more abundant than *R. lupini* or *R. meliloti*, its natural host plants, the clovers, occur very rarely and not at all in most years.

No known host plant of *R. lupini* has been recorded on Broadbalk so that the occurrence of this species of *Rhizobium* cannot be related to weed history.

Numbers of *Rhizobium* in Rothamsted soil under leguminous crops are larger by several orders of magnitude than those found in Broadbalk. For example in Sawyers field (limed plots) under *Medicago lupulina*, tick beans and red clover, the average number of the specific rhizobia for these legumes were respectively 500 000, >2 000 000 and 700 000 per g/dry soil (Nutman, 1963). In the long term fallow experiment in Highfield the total *Rhizobium* population is small, but, as on Broadbalk, the clover and bean nodule bacteria are nevertheless more abundant than the lotus and medick bacteria. This suggests that the nodule bacteria found in Broadbalk are unlikely to have multiplied in the rhizospheres of the relatively few leguminous weeds but more likely to have been brought in from neighbouring fields.

Rhizosphere and Rhizoplane Fungi

By JUDITH ETHERIDGE

Take-all, caused by *Ophiobolus graminis*, is usually less severe on wheat on Broadbalk than on wheat grown successively in other fields at Rothamsted. In 1960 the fungi of the rhizosphere and rhizoplane of wheat from Broadbalk were compared with those from other fields in an attempt to identify any organism that might inhibit the development of take-all on Broadbalk. The rhizosphere fungi were studied by the dilution plate method using a glucose peptone medium (Johnson *et al.*, 1959) with 30 mg aureomycin per litre. After the rhizosphere soil had been washed away, the roots were washed in only two changes of sterile water, then cut into 0.5 cm

ROTHAMSTED REPORT FOR 1968, PART 2

TABLE 9-6
Frequency of fungi in rhizosphere and rhizoplane of Broadbalk wheat, 1960

| Species | Plot 3 (4th crop after fallow) | | Plot 7 (4th crop after fallow) | | | |
|-------------------------------|-------------------------------------|-----------------------------|--------------------------------|-----------------------------|---------------------|-----------------------------|
| | Rhizoplane | Rhizosphere | Rhizoplane | Rhizosphere | | |
| | % root pieces colonised (all dates) | No. of dates when isolated* | % total (all dates) | No. of dates when isolated* | % total (all dates) | No. of dates when isolated* |
| Aspergillus spp. | 0.1 | 2 | 0 | 0 | 0 | 0 |
| Aureobasidium spp. | 3.2 | 7 | 0 | 0 | 0 | 0 |
| Beauveria bassiana | 0.05 | 1 | 0 | 0 | 0 | 0 |
| Botrytis cinerea | 0.8 | 5 | 0.04 | 1 | 0.5 | 6 |
| Cephalosporium spp. | 2.5 | 10 | 3.6 | 9 | 2.9 | 9 |
| Geomyces vulgaris | 0.6 | 7 | 6.7 | 11 | 5.4 | 11 |
| Gliocladium roseum | 1.8 | 11 | 0.5 | 5 | 1.3 | 3 |
| Paecilomyces carneus | 0.2 | 2 | 0.6 | 4 | 0.2 | 2 |
| Penicillium spp. | 40.6 | 11 | 30.3 | 11 | 20.4 | 11 |
| Sporotrichum carnis | 0.05 | 1 | 0.2 | 1 | 0.9 | 3 |
| Tilachlidium sp. | 0.1 | 3 | 0.4 | 4 | 0.6 | 3 |
| Verticillium spp. | 0.2 | 4 | 0.1 | 2 | 0.6 | 4 |
| Trichoderma spp. | 4.0 | 11 | 0.8 | 8 | 2.2 | 9 |
| Graphium sp. | 0.05 | 1 | 0.1 | 1 | 0 | 0 |
| Truncatella truncata | 0.05 | 1 | 0.2 | 2 | 0.2 | 2 |
| Alternaria spp. | 0.9 | 7 | 0 | 0 | 0.04 | 1 |
| Cladosporium herbarum | 26.2 | 11 | 26.7 | 11 | 35.9 | 11 |
| Periconia spp. | 2.0 | 5 | 0.8 | 2 | 0.1 | 1 |
| Stachybotrys sp. | 0 | 0 | 0.1 | 2 | 0 | 0 |
| Trichosporium cerealis | 0 | 0 | 0 | 0 | 0.2 | 2 |
| Cylindrocarpum spp. | 0.5 | 7 | 0.4 | 4 | 0.4 | 4 |
| Epicoccum nigrum | 0 | 0 | 0.05 | 1 | 0 | 0 |
| Fusarium avenaceum | 3.3 | 10 | 0.6 | 3 | 0.3 | 3 |
| F. chlamydosporum | 0.4 | 4 | 0.2 | 1 | 0.2 | 1 |
| F. culmorum | 0.5 | 6 | 0.2 | 2 | 0.4 | 3 |
| F. dimerum | 0.1 | 1 | 0 | 0 | 0 | 0 |
| F. merismoides | 0.1 | 2 | 2.1 | 4 | 0.2 | 2 |
| F. poae | 0.3 | 4 | 0 | 0 | 0 | 0 |
| F. sambucinum | 0.3 | 2 | 0 | 0 | 0 | 0 |
| F. solani | 0.05 | 1 | 0 | 0 | 0 | 0 |
| Myrothecium sp. | 2.3 | 9 | 2.3 | 7 | 0.1 | 1 |
| Coniothyrium spp. | 0.05 | 1 | 0.1 | 2 | 0 | 0 |
| Diplodia sp. | 0.8 | 8 | 1.0 | 8 | 0.4 | 3 |
| Phoma spp. | 1.3 | 5 | 0.6 | 5 | 0.4 | 3 |
| Absidia glauca | 0.7 | 7 | 0 | 0 | 0.2 | 3 |
| Mortierella and other similar | | | | | | |
| Phycomycetous fungi | 42.5 | 11 | 8.0 | 11 | 9.0 | 11 |
| Mucor spp. | 7.0 | 11 | 1.9 | 11 | 2.1 | 8 |
| Rhizopus sp. | 0.05 | 1 | 0 | 0 | 0 | 0 |
| Yeasts | 1.1 | 5 | 1.0 | 3 | 0.6 | 3 |
| Chaetomium indicum | 0 | 0 | 0.1 | 1 | 0 | 0 |
| Ophiobolus graminis | 0.1 | 1 | 0 | 0 | 0 | 0 |
| Mycelia sterila, dark | 10.0 | 11 | 6.6 | 11 | 11.0 | 11 |
| Mycelia sterila, light | 5.4 | 11 | 2.6 | 8 | 3.6 | 7 |

* Of 11 sampling dates from January to July.

lengths and 20 pieces were plated at each sampling date. The 'rhizoplane' population of fungi counted by this method are not the same as the 'root surface' fungi obtained by Harley and Waid's method (1955) which employs a more thorough washing technique. Within the limits imposed by these methods (which greatly favour the isolation of fungi present as spores)

MICROBIOLOGY OF BROADBALK SOILS

no consistent differences were found between Broadbalk and other fields. Non-rhizosphere soils were not studied, and this account describes results from Broadbalk only.

The 4th wheat crop after a one-year fallow on plot 3 (no manure) and plot 7 (N₂PKNaMg) was sampled at intervals from January to July. Table 9·6 lists the fungi identified. In addition to these spore-producing species, several sterile fungi were isolated, of which the most frequent has a fast-growing aerial mycelium, pinkish-fawn at first, but becoming dark-grey to black within four days. Twenty-four of the 32 rhizosphere fungi identified occurred on both plots. *Penicillium* spp., *Cladosporium* spp., *Geomyces vulgaris* and the *Mortierella*-type group were the most abundant species. On each of the 11 sampling dates these four groups constituted more than 33% of the total number of fungi and from May to July at least 65%. *Penicillium* spp. were most abundant at the earlier samplings, and *Cladosporium* became dominant later in the growing season.

Actinomycetes in Broadbalk soils. Actinomycetes in rhizosphere and non-rhizosphere soils from plot 7 were counted in May and June 1962, 1963 and 1964 using the dilution plate method (Table 9·7). The rhizosphere/non-rhizosphere ratios (R/S) were small in all 3 years, and the counts showed no evidence that actinomycetes were stimulated in the rhizosphere.

TABLE 9·7
Count of actinomycetes in rhizosphere and non-rhizosphere soils from Broadbalk plot 7 at a dilution of approx 1/40000, 1962-64

| Year | Crop | Medium used | Date of sampling | Number actinomycetes millions per g dry soil | | R/S |
|------|------------------|--------------------------------|------------------|--|----------------------|------|
| | | | | Rhizo-sphere (R) | Non rhizo-sphere (S) | |
| 1962 | 4th after fallow | Chitin ¹ | 16 May | 0·67 | 0·59 | 1·14 |
| | | | 6 June | 0·67 | 0·69 | 0·98 |
| | | | 28 June | 0·96 | 0·90 | 1·07 |
| 1963 | 2nd after fallow | Chitin | 8 May | 1·25 | 2·13 | 0·59 |
| | | | 29 May | 0·32 | 2·30 | 0·14 |
| | | | 26 June | 0·85 | 0·85 | 1·00 |
| 1964 | 3rd after fallow | Soil extract agar ² | 26 May | 1·71 | 1·73 | 0·99 |
| | | | 16 June | 1·85 | 2·12 | 0·87 |

¹ Lingappa & Lockwood, 1962.

² Flentje, 1956.

The Vesicular-arbuscular Mycorrhizal Fungi

By BARBARA MOSSE

Three plots on Broadbalk were surveyed for spores of *Endogone*, a mycorrhizal fungus, in 1961/2 and 1966 (Mosse & Bowen, 1968a, b), and four plots in 1968 (Hayman, unpublished). Each survey showed spores of four types, designated respectively as yellow vacuolate, laminate, bulbous reticulate and white reticulate, and that they occurred in different proportions in different plots. The unmanured plot contained more spores than the others

ROTHAMSTED REPORT FOR 1968, PART 2

and was especially rich in reticulate spores. Yellow vacuolate spores were most abundant in the FYM plot. Of the four types, laminate spores were fewest, whereas in the nearby field, Little Knott, they were the only ones found and were numerous in some plots, especially those not given nitrogen.

Acknowledgement

We thank G. J. S. Ross for the statistical analyses.

REFERENCES

- ASHBY, S. F. (1907) Some observations on the assimilation of atmospheric nitrogen by a free living organism—*Azotobacter chroococcum* of Beijerinck. *J. agric. Sci., Camb.* **2**, 35–51.
- BARROW, N. J. & JENKINSON, D. S. (1962) The effect of water-logging on fixation of nitrogen by soil incubated with straw. *Pl. Soil* **16**, 258–262.
- BRISTOL ROACH, B. M. (1927) On the algae of some normal English soils. *J. agric. Sci., Camb.* **17**, 563–588.
- BROWN, M. E., BURLINGHAM, S. K. & JACKSON, R. M. (1962) Studies on *Azotobacter* species on soil. I. Comparison of media and techniques for counting *Azotobacter* in soil. *Pl. Soil* **17**, 308–319.
- BURLINGHAM, S. H. (1960) Unpublished results.
- CRUMP, L. M. (1920) Numbers of Protozoa in certain Rothamsted soils. *J. agric. Sci., Camb.* **10**, 182–198.
- CUTLER, D. W. & CRUMP, L. M. (1920) Daily periodicity in the numbers of active soil flagellates; with a brief note on the relation of trophic amoebae and bacterial numbers. *Ann. appl. Biol.* **7**, 11–24.
- ETHERIDGE, J. (1960) Unpublished results.
- ETHERIDGE, J. (1964) Unpublished results.
- FLENTJE, N. J. (1956) Studies on *Pellicularia filamentosa* (Pat) Rogers. I Formation of the perfect stage. *Trans. Br. mycol. Soc.* **39**, 343–356.
- HARLEY, J. L. & WAID, J. S. (1955) A method of studying active mycelia on living roots and other surfaces in the soil. *Trans. Br. mycol. Soc.* **38**, 104–118.
- HAYMAN, D. (1968) Unpublished results.
- HUTCHINSON, H. B. & CLAYTON, J. (1919) On the decomposition of cellulose by an aerobic organism (*Spirochatea cytophaga* n.sp.). *J. agric. Sci., Camb.* **9**, 143–173.
- JOHNSON, L. F. *et al.* (1959) *Methods for studying soil microflora—plant disease relationships*. Minneapolis; Burgess Publishing Co.
- LINGAPPA, Y. & LOCKWOOD, J. L. (1962) Chitin media for selective isolation and culture of actinomycetes. *Phytopathology* **52**, 317–323.
- MARTIN, C. H. & LEWIN, K. R. (1915) Notes on some methods for the estimation of soil protozoa. *J. agric. Sci.* **7**, 106–119.
- MEIKLEJOHN, J. (1949) Isolation of *Nitrosomonas* from Rothamsted soil. *Nature, Lond.* **164**, 667.
- MEIKLEJOHN, J. (1956) Preliminary notes on numbers of nitrogen fixers on Broadbalk field. *Proc. 6th int. Cong. Soil Sci., Paris, C*, 243–248.
- MEIKLEJOHN, J. (1962) Unpublished results.
- MEIKLEJOHN, J. (1965) *Azotobacter* numbers on Broadbalk field, Rothamsted. *Pl. Soil* **23**, 227–235.
- MOSSE, B. & BOWEN, G. D. (1968a) A key to the recognition of some *Endogone* spore types. *Trans. Br. mycol. Soc.* **51**, 469.
- MOSSE, B. & BOWEN, G. D. (1968b) The distribution of *Endogone* spores in some Australian and New Zealand soils, and in an experimental field soil at Rothamsted. *Trans. Br. mycol. Soc.* **51**, 485.
- NUTMAN, P. S. (1963) *Rep. Rothamsted exp. Stn for 1962*, 80, 81.
- NUTMAN, P. S. (1968) Unpublished results.
- RUSSELL, E. J. & APPLEYARD, A. (1917) The influence of soil conditions on the decomposition of organic matter in the soil. *J. agric. Sci.* **8**, 385–417.
- RUSSELL, E. J. & HUTCHINSON, H. B. (1913) The effect of partial sterilisation of soil on the production of plant food. II. The limitation of bacterial numbers in normal soils and its consequences. *J. Agric. Sci., Camb.*, **5**, 152–221.

MICROBIOLOGY OF BROADBALK SOILS

- SINGH, J. (1937) Soil fungi and actinomycetes in relation to manurial treatment, season and crop. *Ann. appl. Biol.* **24**, 154-168.
- SINGH, B. N. (1946) A method of estimating the numbers of soil protozoa, especially amoebae, based on their differential feeding on bacteria. *Ann. appl. Biol.* **33**, 112-119.
- SINGH, B. N. (1947a) Myxobacteria in soils and composts, their distribution, number and lytic action on bacteria. *J. gen. Microbiol.* **1**, 1-10.
- SINGH, B. N. (1947b) Studies on soil Acrasidae. 1. Distribution of species of *Dictyostelium* in soils of Great Britain, and the effect of bacteria on their development. *J. gen. Microbiol.* **1**, 11-21.
- SINGH, B. N. (1948) Studies on giant amoeboid organisms. 1. The distribution of *Leptomyxa reticulata* Goodey in soils of Great Britain, and the effect of bacterial food on growth and cyst formation. *J. gen. Microbiol.* **2**, 8-14.
- SINGH, B. N. (1949) The effect of artificial fertilizers and dung on the numbers of amoebae in Rothamsted soils. *J. gen. Microbiol.* **3**, 204-210.
- SKINNER, F. A. (1951) A method for distinguishing between viable spores and mycelial fragments of actinomycetes in soils. *J. gen. Microbiol.* **5**, 159-166.
- SKINNER, F. A., JONES, P. C. T. & MOLLISON, J. E. (1952) A comparison of a direct and a plate-counting technique for the quantitative estimation of soil micro-organisms. *J. gen. Microbiol.* **6**, 261-271.
- THORNTON, H. G. & CRUMP, L. M. (1953) Micro-predators in soil. *Rep. Rothamsted exp. Stn for 1952*, 164-172.
- ZIEMIECKA, J. (1932) The *Azotobacter* test of soil fertility applied to the classical fields at Rothamsted. *J. agric. Sci., Camb.*, **22**, 797-810.