Rothamsted Experimental Station Report for 1968 - Part 2


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Rhizosphere and Rhizoplane Fungi

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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

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TABLE 9·6

Frequency of fungi in rhizosphere and rhizoplane of Broadbalk wheat, 1960

	Plot 3 (4th crop after fallow)				Plot 7 (4th crop after fallow)	
	Rhizoplane		Rhizosphere		Rhizosphere	
Species	% root pieces colonised (all dates)	No. of dates when iso-lated*	% total (all dates)	No. of dates when iso-lated*	% total (all dates)	No. of dates when iso-lated*
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
Cylindrocarpon 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)

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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 (N_2PKNaMg) 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

				Number actinomycetes millions per g dry soil		
Year	Crop	Medium used	Date of sampling	Rhizo-sphere (R)	Non rhizo-sphere (S)	R/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

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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.

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