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BROADBALK DISEASES: TAKE-ALL 1958-67

Take-all on Broadbalk Wheat, 1958-1967

By JUDITH ETHERIDGE

Since 1958 the incidence of take-all on Broadbalk has been estimated each year on plot 7 (N₂PKNaMg). Diagnosis was by a more sensitive method than previously, so some increase in the recorded incidence of take-all is to be expected. Despite this, amounts found in the first seven years (1958-64) were small, even in years when take-all was prevalent and severe in nearby fields. Seasonal variations in the incidence of take-all on Broadbalk were also small, smaller than the difference between sections in any one year. However, from 1965 to 1967 take-all was much more prevalent during spring and summer on all sections except that after fallow (Table 6.17) and infected plants had a larger proportion of roots infected. This

TABLE 6.17

The incidence of take-all on Broadbalk wheat, plot 7, in the years 1958-67

	Years after fallow				Continuous wheat (Section IA)
	1	2	3	4	
<i>7 years, 1958-64</i>					
% plants infected in May	1	4	10	8	14
% straws* infected in July	0	8	15	12	13
<i>3 years, 1965-67</i>					
% plants infected in May	4	14	37	28	31
% plants* infected in July	4	37	69	78	68

* In wheat after wheat, mean straws per plant, 1965-67 = 1.1.

sudden increase is unexplained but as take-all was not unusually prevalent in other fields in these years, it is unlikely that the increase was caused by especially favourable weather. Nor is it easy to ascribe the increase to changes in the husbandry of Broadbalk. Since 1964 herbicides have been used on all sections except VA, but the incidence of take-all was no less on VA than on sprayed sections. Moreover, herbicides have been used on section IA since 1957, but take-all did not become prevalent until 1965. Equally puzzling is the fact that the greater prevalence of take-all was not associated with smaller yields. The mean yields for 1965-67 were as large as in the previous seven years, whereas in other experiments where take-all was prevalent, yields were closely correlated with its incidence. Although the amount of fertiliser applied to plot 7 is generous, the grain yields were small, much less than the potential of Squarehead's Master at Rothamsted, so it is likely that factors other than take-all limited yield on Broadbalk.

Effect of fertilisers. In three years (1965-67) take-all was estimated on eight plots of section IA (continuous wheat since 1952) (Table 6.18). The

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incidence of take-all differed considerably with different fertiliser treatments, but was less on plots 3 (unmanured) and 5 (PKNaMg) than on plot 7 (N₂PKNaMg). This conflicts with the generally accepted and well documented idea that take-all is most prevalent when nutrients, especially

TABLE 6-18
*The percentage plants with take-all in July in Broadbalk wheat,
Section IA (continuous wheat), 1965-67*

Plot number	Treatment	Total infection	Moderate + severe infection
3	None	45	16
5	P K Na Mg	52	18
7	N ₂ P K Na Mg	63	33
10	N ₂	64	25
11	N ₂ P	36	11
13	N ₂ P K	58	27
16	N ₂ * P K Na Mg	72	32
20	N ₂ K Na Mg	62	27

N Nitrogen as ammonium salts.

N* Nitrogen as sodium nitrate.

nitrogen, are deficient. We cannot explain this, but it is further evidence that the epidemiology of take-all on Broadbalk wheat is unusual.

Development of take-all. The small incidence of take-all on Broadbalk before 1965 led us to postulate the presence of a factor inhibitory to *O. graminis* in Broadbalk soil, possibly produced by the continual cropping with wheat only (Glynne, Salt & Slope, 1956; Cox, 1963). This idea was supported by earlier observations on the Continuous Wheat experiment at Woburn (Glynne, 1935) and, more recently, by results from short-term experiments at Rothamsted (Slope & Cox, 1964; Cox, 1965). Elsewhere in this account of the Broadbalk experiment (p. 181) we report on an unsuccessful attempt to identify micro-organisms inhibitory to *O. graminis* in the rhizosphere or rhizoplane microflora of Broadbalk wheat. In an effort to define more exactly the occurrence of inhibition, plants of Cappelle wheat with two seminal roots naturally infected with *O. graminis* were transplanted from Highfield into small plots on Broadbalk (headland of plot 7) on May 10, 1963. On May 23, June 7, June 27 and July 10 these plants had 5, 15, 35 and 58% crown roots infected, whereas plants uninfected when transplanted remained largely uninfected. These amounts of infection were very similar to those in a drilled wheat crop on Great Field, but were much greater than in the drilled crop on Broadbalk (2nd after fallow). Hence any factor inhibitory to take-all on Broadbalk is either destroyed by the process of transplanting or is not effective in preventing further development on already infected plants.

From 1960 to 1965 the development of take-all was studied in detail in the third or fourth wheat crop on plot 7 and compared with the development on plots in an experiment on Great Field I (Table 6-19). In 1960 to 1963 development on Broadbalk was checked in late May and June

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TABLE 6-19

Development of take-all on plants and crown roots in spring and summer:
Broadbalk wheat (BB) plot 7 (N₂PKNaMg) and Great Field I (GF)
wheat plots, 1960-65

Year	Crop	April	Early May	Late May or early June	Mid June	July
% plants with take-all						
1960	BB 4th	—	—	30	—	28*
	GF 4th	59	—	72	—	73*
1961	BB 4th	—	11	37	36	21
	GF 4th	16	47	60	—	93
1962	BB 4th	3	10	24	—	13
	GF 4th	50	41	69	—	67
1963	BB 3rd	0	1	4	5	9
	GF 4th	2	37	57	57	75
1964	BB 3rd	7	11	22	59	50
	GF 4th	1	21	39	67	64
1965	BB 4th	20	43	56	77	94
	GF 4th	36	60	78	93	98

* % straws with take-all in 1960.

— = not sampled.

% crown roots infected on infected plants						
1960	BB 4th	0	0	31	27	40
	GF 4th	2	0	31	58	75
1961	BB 4th	—	18	7	10	18
	GF 4th	—	8	20	33	39
1962	BB 4th	0	0	3	—	2
	GF 4th	0	0	8	—	12
1963	BB 3rd	0	0	6	2	3
	GF 4th	0	1	6	24	38
1964	BB 3rd	0	3	9	21	28
	GF 4th	0	0	3	9	20
1965	BB 4th	0	4	11	13	31
	GF 4th	0	4	9	14	37

(Cox, 1963) but in 1964 and 1965 its progress did not differ appreciably from that on Great Field, suggesting that in some years *O. graminis* is inhibited on Broadbalk wheat but not in others.

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