Table 1. Estimates of the Relative Frequency of Male-Steriles (Q %) and the Selection Coefficient (x)*

Generation	CC XIV Q	CC XIV x_a	CC XIV x_b	CC XV Q	CC XV x_a	CC XV x_b
F_2	26·38			26·07		
		0·634	0·278		0·848	0·680
F_3	28·36			24·06		
		0·450	0·750		0·549	0·680
F_5	18·69			16·40		
		0·194	0·070		0·243	0·253
F_6	28·33			21·25		
		0·514	0·920		0·410	0·800
F_{10}	5·16			6·19		
		0·385	0·368			
F_{13}	6·17					
		0·770	0·891			
F_{14}	2·08					
		1·000	1·000			
F_{16}	Less than 1·00					

* Selection coefficients were estimated for each time interval between various generations so as to give the best fit to the observed frequencies.

Table 2. Some Theoretical Values of Q, t' and H at Equilibrium

	kt = 0·42		kt = 1·00	
Q	t'	H	t'	H
5·0	0·040	0·038	0·069	0·065
10·0	0·060	0·056	0·118	0·106
20·0	0·100	0·091	0·216	0·178

Wright[8], the panmictic index $(1-F)=\frac{2t'}{1+t'}$, and at equilibrium the expected amount of heterozygosity (H) at a locus with gene frequencies (p, q) is simply given by $H=2pq(1-F)$. Table 2 gives numerical examples of this relationship among Q, t' and H for two different values of kt (0·42 and 1·00) and $p=q=0·5$, $t=0·02$. Thus, for Q as large as 10·0–20·0 the amount of increase in outbreeding as well as in the levels of heterozygosity is large enough to be of adaptive significance, as postulated by Jain[4], and this contribution is proportional to k, the probability of outcrossing on male-steriles. The population genetics of such devices controlling the breeding system of a species is indeed likely to direct attention of many more investigators handling natural as well as experimental populations of inbreeding species. The adaptive maintenance of an outbreeding factor in such species has important bearing also on their controlled breeding methods.

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[1] Drayner, J. M., *Nature*, **176**, 489 (1956).
[2] Rowlands, D. G., *Heredity*, **12**, 113 (1958).
[3] Grant, V., *Cold Spring Harbor Symp. Quant. Biol.*, **23**, 337 (1958).
[4] Jain, S. K., *Genetics*, **46**, 1237 (1961).
[5] Lewis, D., *New Phytol.*, **40**, 50 (1941).
[6] Suneson, C. A., *Agronomy J.*, **43**, 234 (1951).
[7] Jain, S. K., and Allard, R. W., *Proc. U.S. Nat. Acad. Sci.*, **46**, 1371 (1960).
[8] Wright, S., *Ann. Eugenics*, **15**, 323 (1951).

SOIL SCIENCE

Relationships between Mycostasis and Free Monosaccharides in Soils

Investigations of the mycostatic factor in British soils[1] have shown that mycostasis is reduced and finally masked by the addition of increasing concentrations of glucose to the soil. It has further been shown[2] that seasonal variation in mycostatic activity in British soils could be closely correlated to the level of reducing substances present: a high level of mycostatic activity corresponding to a low level of reducing substances while an increase in the level of reducing substances resulted in a low level of mycostasis.

Reducing substances were estimated as glucose equivalents on water extracts of pine forest humus layer (A horizon) from North Wales obtained by bubbling oxygen-free nitrogen gas through a soil/water mixture. After centrifugation, substances other than sugars were precipitated from the supernatant with neutral lead acetate, after which sugars were estimated by Wager's[3] modification of the Shaffer–Hartman method and measured photometrically on a Spekker absorptiometer at 580μ, using Nelson's[4] arsenomolybdate chromogenic reagent.

Qualitative analysis of the sugars present in the soil extracts was carried out chromatographically. 1-kg samples of soil from the A horizon in pine forest in North Wales were sieved through a B.S. 10 mesh and extracted:

(a) By stirring with 0·5 N sodium hydroxide for 48 h; the supernatant siphoned off and acidified with hydrochloric acid to precipitate the humic acids. The solution was passed through animal charcoal, previously treated with 0·1 hydrochloric acid, and the eluate concentrated under reduced pressure at 50° C. The residue was extracted twice with ethanol and finally reduced to dryness under vacuum. The residue was made up in 50 ml. of double distilled water passed through 'Zeo-Karb 225' and 'Deacidite FF' and further concentrated to 2 ml.

(b) By bubbling oxygen-free nitrogen gas through a soil/water mixture for 5 h, followed by centrifugation at 3,000 r.p.m. for 20 min. The supernatant was Seitz-filtered, and the tannins present were precipitated with saturated neutral lead acetate and the solution filtered through Whatman No. 50 filter paper on to sodium oxalate. The precipitated lead oxalate was filtered off and the filtrate concentrated under reduced pressure to 50 ml., after which it was passed through 'Zeo-Karb' and 'Deacidite FF' and finally concentrated to 2 ml.

Chromatograms of the two solutions obtained from (a) and (b) were run on Whatman No. 1 paper against standardized solutions of known monosaccharides in butanol/pyridine/water (6 : 4 : 3) for 48 h at 25° C. The chromatograms were dried, dipped into a solution of silver nitrate in acetone, further dried and sprayed with alcoholic sodium hydroxide. The developed chromatograms were dipped into 2 N ammonia and finally rinsed in sodium thiosulphate/sodium metabisulphite solution.

Chromatograms of the solutions (a) and (b) above showed the presence of ribose, sorbose and galactose together with an unidentified spot of high molecular weight. Similar chromatograms from the extract after hydrolysis with N sulphuric acid showed a decrease in concentration at this spot accompanied by an increase in size and intensity of the spots for ribose and galactose, indicating hydrolysis of an unidentified polysaccharide. Autoclaved soil gave much larger spots for the same three sugars with the addition of a spot with the same R_F value as xylose.

The absence of glucose in the soil solution confirms the findings of Hinson[5], who showed that glucose added to forest soils disappeared very rapidly over the course of a few days, probably due to its utilization by the soil microflora.

Recent work by Nagar[6] has shown that free monosaccharides also occur in American and Brazilian soils, and work is now in progress to establish whether or not free sugars occur in the highly mycostatic soils of Malaya[7].

Our thanks are due to the Forestry Commission for a grant to one of us (D. A. G.) which enabled this work to be carried out.

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[1] Dobbs, C. G., Bywater, J., and Griffiths, D. A., *Rep. For. Res. 1959*, 94 (1960).
[2] Dobbs, C. G., and Griffiths, D. A., *Rep. For. Res. 1960*, 87 (1961).
[3] Wager, H. G., *Analyst*, **79** (934), 34 (1954).
[4] Nelson, N., *J. Biol. Chem.*, **153**, 375 (1944).
[5] Hinson, W. H., Ph.D. thesis, Univ. Wales (1954).
[6] Nagar, B. R., *Nature*, **194**, 896 (1962).
[7] Griffiths, D. A. (in preparation).