to be the case with foot-and-mouth disease virus, as the addition of *p*-fluorophenylalanine (1,000 μM), even immediately before the maturation stage, leads to complete inhibition of infective virus and viral nucleic acid synthesis within 20 min. (Fig. 1). Even for natural amino-acids it has been reported that 15 min. is required for 75 per cent penetration[9], so 20 min. probably represents the time required for *p*-fluorophenylalanine to reach its site of inhibition.

It appears, therefore, that the synthesis of the infective nucleic acid of foot-and-mouth disease virus, like that of Western equine encephalomyelitis virus[4], is intimately related to the continuous synthesis of protein. This might be due to the need for the continuous synthesis of induced enzymes or to the fact that ribonucleic acid and protein synthesis are intimately coupled, as has often been postulated[10].

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Leaf Curl Virus and the Flavonoid Content of Resistant and Susceptible Strains of Cotton

Massey and Andrews[1] reported finding larger amounts of unidentified 'brown' pigments in aqueous extracts obtained from healthy cotton leaves than in those obtained from leaves infected with cotton leaf curl. By means of the known chemical tests I ascertained that the pigments are in fact anthocyanins. The work described here is a study of the changes in the amounts of various flavonoids in leaves of resistant and susceptible strains of cotton, in the course of infection.

Top leaves from two strains of Domains Sakel were used, *BAR* 14/25 as a highly susceptible strain and *X*17/30 *A* as a strain resistant to leaf curl virus. Both strains were grown in the same plot and were cultivated under identical conditions. It was observed that virus infection appeared in the susceptible strain (*BAR* 14/25) thirty days after sowing and 100 per cent infection had occurred 115 days after sowing. Infection started in the resistant strain (*X*17/30 *A*) 70 days after sowing and only 40 per cent infection was observed 120 days after sowing.

Leaf extraction and methods of determining total phenols, anthocyanins, leuco-anthocyanins, and flavanols were those used by Swain and Hillis[2].

The results (Table 1) show that the percentages of total phenols, leuco-anthocyanins and flavanols are higher in the resistant than in the susceptible strain throughout the season. Infection with the virus caused a rise in the amounts of total phenols, leuco-anthocyanins and flavanols in both strains, followed in all cases by a gradual decrease in these amounts.

Table 1. Phenolic Compounds in Cotton Leaves in the Course of Infection with Leaf Curl Virus
(Percentage on dry weight basis)

Days after sowing	Total phenols		Anthocyanins		Leucoanthocyanins		Flavanols	
	H	I	H	I	H	I	H	I
	BAR 14/25 (Susceptible)							
40	7·01	8·74	1·22	1·34	0·03	0·06	0·16	0·20
60	5·14	6·97	0·93	1·24	0·03	0·05	0·17	0·21
80	6·54	4·56	0·68	0·72	0·08	0·05	0·30	0·23
100	5·61	3·32	0·55	0·52	0·07	0·04	0·28	0·21
	X 17/30 *A* (Resistant)							
40	10·06	—	1·66	—	0·08	—	0·24	—
60	9·22	—	1·42	—	0·09	—	0·30	—
80	7·26	10·47	1·23	0·91	0·19	0·75	0·43	1·55
100	7·83	4·26	0·89	0·41	0·27	0·09	0·56	0·22
120	6·56	1·89	0·83	0·23	0·23	0·09	0·43	0·29

H, healthy; I, infected

The anthocyanins behaved in the same manner in the susceptible strain, that is, there was a sharp rise in the amounts following infection, then a gradual decrease, but in the resistant strain these amounts actually decreased rapidly after infection had occurred.

The results obtained in this work suggest that there might be some connexion between the flavonoid content of the leaves and the resistance of cotton plants to leaf curl virus. A study of the flavonoid content may act as a guide in spotting resistant strains in the course of breeding for resistance towards this disease.

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SOIL SCIENCE

Isolation of Anthraquinone from Humus

It is now generally accepted that the skeletal part of humic acids consists of heteropolycondensates of various aromatic nuclei. This concept, however, has been deduced rather indirectly from physico-chemical data such as X-ray analysis, and benzene seems to be the sole aromatic ring identified by the method of organic chemistry[1]. Recently we found anthraquinone in the decarboxylation products of the water-soluble acid fraction obtained by the alkaline permanganate oxidation of humic acids.

The humic acids used in this work belonged to so-called *A* type[2], and were obtained from a volcanic ash soil at the foot of Mt. Fuji, and from a muck soil presumably formed under the influence of volcanic ash showers on low-moor peat at Tanemori, Akita Prefecture, both soils being treated with 0·5 per cent sodium hydroxide at 100° C. for 30 min.

The sample, dissolved in *N* potassium hydroxide, was heated at about 90° C. and oxidized by adding potassium permanganate powder in small portions, until the permanganate to humic acid ratio became 4·0. The mixture was cooled, filtered to remove the precipitated manganese dioxide, and washed