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## Report 1918-20 With the Supplement to the Guide to the Experimental Plots Containing the Yields per Acre Etc.



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### Physical Conditions

#### Rothamsted Research

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The distribution at the various depths is shown in the following table of percentages of the total in each group:—

	0-1"	1"-3"	3"-5"	5"-7"	7"-9"
INSECTS :					
Manured Plot . . .	51.5	27.2	10.9	6.4	3.8
Untreated Plot . . .	25.3	25.0	33.0	11.1	5.5
ACARI :					
Manured Plot . . .	48.3	25.3	20.2	5.0	1.2
Untreated Plot . . .	59.3	23.4	14.0	3.1	--
EARTHWORMS :					
Manured Plot . . .	23.3	37.0	22.0	10.6	7.0
Untreated Plot . . .	23.5	41.0	18.3	11.0	5.8

The vast majority of soil organisms were found at a depth not exceeding 3 inches. Wireworms are exceptional in that they attain their maximum numbers at a depth of 5 inches to 7 inches. Manuring increases the total number of soil organisms to the extent of about 200%, but exercises no very appreciable influence upon the number of wireworms present.

#### THE POSSIBILITY OF THE CONTROL OF THE SOIL POPULATION.

Previous investigations have shown that heating the soil or treatment with certain poisons not only rids it of pests but actually improves its productiveness, increasing the amount of bacterial activity. This has been applied in glasshouse practice in the Lea Valley. Steaming has proved effective and so have certain chemicals, but their action is complicated by the fact that some poisons such as phenol, cresol, naphthalene, etc., are destroyed in the soil before they have been able to kill those organisms to which they are fatal. It is found that certain soil bacteria have the power of attacking or feeding on these particular poisons: they are being further studied in the bacteriological laboratory. The introduction of a chlorine atom stabilises the poison and the further introduction of a nitro-group adds considerably to its toxicity (p. 58). Much work has been done to find a suitable agent for the control of wireworms (p. 43).

#### INVESTIGATIONS ON THE WEED FLORA.

The accumulated data on the weed flora of arable and grass land has been worked up by Dr. Brechley and published in book form. Connections have been traced between various groups of weeds on the one hand and soils and crops on the other, and in some cases slight changes in manurial or cultural treatment may prove efficacious in the reduction of bad weed pests. Arrangements are being made for gathering together more information from different parts of the country in order to extend the practical application of the work.

#### THE PHYSICAL CONDITIONS OF THE SOIL.

Much of the agricultural value of the soil depends on physical conditions, such as the ease of cultivation, the supply of air and moisture, temperature, etc. These factors, which largely determine its suitability for the growth of crops and micro-organisms,

are being investigated in the Soil Physics Department under Mr. B. A. Keen.

The factors are very complex, and closely inter-related: under field conditions alteration in any one almost always produces variation in most of the others.

Soil cultivation was developed into an art when animals were the motive power on the farm. The change to mechanical power is a fundamental one, and it is by no means certain that the implements designed for horse traction will prove most suitable for mechanical traction. The study of the methods and effects on the soil of tractor cultivation has already begun at Rothamsted. The various factors contributing to the resistance offered by the soil to the plough are being analyzed in order to disentangle those due to soil conditions and those inherent in the design of the plough.

For purposes of this work it is necessary to obtain field data on soil cultivation, and on the moisture and temperature relations in the soil, from a diversity of soil types and under varying climatic conditions. The co-operation of various educational institutions situated in the country has been invited for the collection of the required information, and arrangements have been made for teachers to visit Rothamsted in order that they may become familiar with the methods of observation.

Over much of England loss of water by evaporation from the soil represents a serious source of loss to farmers. Investigations on this subject have been made and are now being extended to different soil types and varying manurial treatment. The percentage of clay in the soil has a preponderating influence on the rate of evaporation, while the manurial treatment is responsible for minor differences in the rate.

Other studies deal with the surface effects associated with clay particles, the method used being the absorption of certain dyes from their solutions; the effect of the clay fraction on various physical properties of soils; and the behaviour of the soil colloids when in contact with different liquids. It has also been shown that the experimental results obtained in America on the depression of the freezing point of soil solution measured *in situ*, are capable of quantitative investigation; a definite relation holds over a wide range of moisture content between the "free" and "unfree" water.

These results, together with earlier work in the laboratory, have formed the basis of a general review of the relations existing between the soil and its water content, which was published in 1920, and they were incorporated, together with other material, in a series of lectures on Soil Physics delivered in the University of London, and now being expanded into a Monograph (p. 59).

A detailed examination of the meteorological data collected at Rothamsted and their effect on the temperature of the soil has been published (p. 47). Material is at present being collected for a discussion of percolation and evaporation under field conditions and their relation to meteorological influences.

The investigation of soil acidity by physico-chemical methods which was started by Mr. E. A. Fisher (see p. 48) is being continued by Mr. E. M. Crowther. A hydrogen electrode and potenti-

ometer apparatus—the gift of Robert Mond, Esq.—is now being set up, and the sources of error eliminated preparatory to a general investigation of the nature of soil acidity.

Many farms in the country are short of lime, but agricultural advisers are often in the difficulty that they cannot tell a farmer exactly how much lime the soil needs: often, indeed, they can only say that he should apply between 10 cwts. and 2 tons per acre. Of course, if farming were independent of cost, this vagueness would not matter, but the delicate financial balance under which agriculture has to be conducted leaves no margin for indecision between 10 cwts. and 2 tons. It is hoped that one result of these investigations will be to enable experts to give more definite advice than is now possible.

During the period under review, two voluntary workers have assisted in the work of the department—Mr. V. A. Tamhane, Soil Physicist to the Bombay Presidency, and Mr. H. Raczkowski, of the Palestine Experimental Station.

#### SPECIAL ENTOMOLOGICAL INVESTIGATIONS.

In addition to the important investigations on the insect and other invertebrate fauna of the soil already dealt with on p. 20, the Entomological Laboratory has undertaken the following work:—

(1) A study of the biological phenomena of Aphides. The results are set out on p. 49.

(2) *Chemotropism*. Dr. A. D. Imms, in conjunction with Mr. H. M. Morris, has extended his previous work (p. 48) on the responses of insects to chemical stimuli. This property opens up the possibility of controlling certain injurious insects which cannot satisfactorily be dealt with by insecticides. The method of experiment is to expose uniform amounts of various chemical substances in a series of traps for a constant length of time and to identify the species and the sex of the insects that respond.

(3) Wireworm investigations have been carried out by Mr. A. W. Rymer Roberts on the biological side, and in conjunction with Mr. Tattersfield on the chemical side (p. 43).

(4) In view of the urgent necessity for systematising the subject, Dr. A. D. Imms is preparing an advanced text book of entomology for the use of research students, which it is hoped to complete during the present year. A beginning has also been made towards the formation of insect collections which will be essential for purposes of identification and research.

(5) *Insecticides*. By common consent the subject of insecticides is not well advanced, and efforts will be made to obtain much needed fundamental knowledge. On the chemical side, Messrs. Tattersfield and Roach have investigated Tuba root (*Derris elliptica*) from which they have extracted two crystalline substances, some resins, an oil and an amorphous substance, apparently a saponin. Of these the resins and one crystalline substance are toxic. Methods have been devised for comparing the toxicities of these products, and also of different consignments of the root. In addition a chemical method for evaluating the root has been elaborated.