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Farming will never be a success unless the farmer had more voice in the disposal of his produce.—P. Morrel.

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ON SOIL HUMUS

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The importance of humus or organic matter for the fertility of the soil cannot be overstated. It has been at the bottom of all our agricultural methods and practice. The presence of organic matter rectified most of the physical defects of the soil producing proper tilth and right conditions of acidity and temperature. It increases the capacity of the soil for retaining moisture, a point of very great value to hot and dry tracts that are so common in India. Besides itself offering plant nutrients in an available form, it provides the necessary food and energy to the countless soil micro-organisms which bring about nitrification and other useful changes essential for the growth of the crop. The nature and the decomposition of soil organic matter is of primary importance to the Indian ryot since in his climate it disappears far more quickly than under milder climatic conditions. Most of the Indian soils are notorious indeed for their lack of organic matter.

Considerable quantities of organic matter of plant and animal origin are added to the soil year after year. The most important source is the farmyard manure. The Agricultural Department has, therefore, been carrying on widespread propaganda on improved methods of preserving and utilising it. It is an all-round manure; besides performing the ordinary functions of organic manures, it is said to supply also auximones which are as essential to plant growth as vitamins are to animals. Of almost equal importance as a source of supply of organic matter, are green manures, and much has been done to improve the quality and quantity of these. A third source which is slowly assuming greater and greater importance is the utilisation of plant waste materials and night-soil. A mixture of these two after storing for a suitable time, offer an excellent supply of manure to the soil

Though the importance of soil organic matter was realised from the very early days of agriculture, the scientific study of the subject has not yet passed the stage of infancy. The main cause is its complicated nature and the great difficulties which hamper the progress of any investigation. It is known that the organic matter added to the soil, undergoes decomposition by two main processes depending upon the conditions prevalent. The more important of the two which is characteristic of arid soils with free access to air, is the so-called decay or aerobic decomposition. By this means, most of the carbon goes off as carbon-dioxide and the nitrogen is converted into nitrates. On the other hand, under water-logged conditions as are prevalent in paddy fields, the organic matter undergoes fermentation or anaerobic decomposition. This is a comparatively slow process and the decomposition is incomplete. Various organic acids, ammonia, methane and hydrogen besides some carbon-dioxide are produced. These decompositions take place with greater or less rapidity depending upon the nature of the organic matter. Waxy and resinous coatings render plant remains very resistant as also the presence of lignified and fibrous tissues which remain undecomposed in the soil for a considerable time. Hence, some time after adding organic manure, it gives rise to various intermediate products of decomposition which are found along with the more resistant remains of the original materials. Besides these, there come in the products arising out of the synthetic activity of bacteria and fungi present in the soil. The role of these organisms may be expressed as below :

Provided the right conditions of moisture, air and light are existent, most organic materials in the world have a tendency to decompose. This process is enormously accelerated by countless invisible micro-organisms existing in the soil. They live on the humus and multiply at an enormous rate. They derive their energy from the decomposing organic matter, build up new tissues from the products of decomposition and, as they die, their cells are left behind to decay in their turn. The first result of the transformation of the naturally occurring organic matter added to the soil is the rapid disappearance of carbon, bringing about the narrowing of the C : N ratio. In the original materials it varies between 80 and 25 : 1, and as a direct result of the activities of the micro-organisms in the soil, it is narrowed down to somewhere about 10–12 : 1. It is only when this has been brought about or when the large excess of available energy over the nitrogen has been used up, that the nitrogen can be liberated in the soil in the form of ammonia, rapidly changing to nitrates, a process which determines largely the growth of the higher plants in the soil. Nitrogen is usually the limiting factor in the decomposition of fresh organic matter. When the green manure contains about 1·7 per cent. nitrogen or more, the decomposition process will be rapidly accompanied by the liberation of nitrogen as ammonia, which is soon changed to nitrate. When the nitrogen content is, however, less than 1·7 per cent, considerable time will elapse before some of the nitrogen will be liberated in a form available to higher plants. These observations explain the frequent occurrence of nitrogen starvation and the consequent ill effects on crops grown in soil which has received a fresh supply of green manure. A way out of the difficulty lies in the suitable addition of nitrogenous fertilisers so as to bring the nitrogen percentage to 1·7. Even without this treatment, the injurious effect disappears as the decomposition of the manure has proceeded far enough to narrow down the C: N ratio of the soil. The above results are very

interesting in connection with the utilisation of organic residues and manures as sources of nitrogen to plants.

A review of past work in characterising soil organic matter indicates an entire lack of systematic knowledge. The presence of a number of organic compounds have been more or less definitely established in soil humus. Besides waxes and fats, organic acids such as acetic, propionic, malic, laevulinic, oxalic, succinic and hydroxy stearic acids, carbohydrates and alcohols such as pectin, pentosan, phytosterol, ergosterol and cholesterol and nitrogenous compounds such as xanthin, cytosin, histidine, arginine, leucine, isoleucine and other protein-split products along with plant and animal nucleins and chitin have been found. However, an imperfect knowledge of the organic constituents of even our common cultivated and uncultivated plants and a still more meagre knowledge of the composition of microbial cell and the nature of the products resulting from their growth and decomposition account for our ignorance of the origin of many of these organic compounds in the soil.

A GENERAL STUDY OF FLUCTUATIONS IN INSECT PEST DAMAGE

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A detailed study of the variations in the degree of insect damage under varying conditions may not only enable us to assess the value of the present state of knowledge in economic entomology, but also possibly enable us to get glimpses into new vistas of possibilities of pest-control. The rapid strides that are being made in plant-breeding to achieve results of economic importance may, for instance, lead to practical results if the entomologist were to indicate to the plant-breeder the lines on which he could help in the solution of problems of entomological interest.

Wherever a large number of varieties of a crop is under experimentation, one frequently notices much variation in the degree of insect attack. In certain cases, it may possibly be by chance that a particular variety consistently shows the same degree of damage. It is important to ascertain whether the degree of infestation exhibited is really due to any definite inherent characters by the careful elimination of external factors that sometimes bring about insect attack. It is the object of this article to indicate briefly some of the external factors that have to be taken into consideration before one can assess the true value of the powers of resistance shown by any variety, and to examine some of the inherent characters to see how far they are helpful in the repellency of attack by insect pests. In this connection it may be noted that it is no easy matter to compare varieties as regards their differences in the degree of susceptibility to insect attack, as the hatchlings do not usually confine themselves to the strips on which the eggs may happen to be laid, but get themselves distributed with little regard to the object of the observations in view.

Among the external factors, the ' time of planting ' occupies a prominent place not only because of the fact that a late-planted crop forms an attraction to pests by reason of its tenderness, but also because the delay in