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.

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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

planting does not give the crop the time necessary for it to recoup after the attack is overcome. It is a matter of common observation that a late-planted paddy crop generally suffers from pests like *kodu* (silvershoots) (*Pachydiplosis oryzae*) and leaf-folding caterpillars (*Cnaphalocrocis medinalis*). In the case of tobacco, the nature of damage by aphids in a late-planted crop is quite different from that in the early-planted one. In the latter, the growth requisite for harvest is completed by the leaves before aphids make their appearance, and the damage is restricted to a lowering of the quality of the leaf by the development of sooty-mould that follows in the wake of aphis attack. In a late-planted crop, on the other hand, the growth of the leaf remains incomplete by the time aphids start their damage and the attack results in the quality as well as the quantity of the leaf being affected at harvest time. As regards sugarcane, there is an indication that fields planted at the time of the approach of the South-West Monsoon have a light attack by borer (*Argyria sticticraspis*), as compared with those planted earlier in the season.

The situation of a plot also appears to have some influence in governing damage by pests. Nearness to a ratoon crop may favour some pests, the ratoons not only perpetuating internal trouble but also transmitting it to neighbouring fields. Apart from the factor of ratooning, the occurrence of previous infestation in a field may serve to shelter the pest to the detriment of the succeeding crop. Conditions like bad drainage may contribute their share to the outbreak of pests like the paddy case-worm (*Nymphula depunctalis*).

The general condition of the crop also influences damage by the pests, especially borers. As a general rule, borers appear to prefer a thin crop to a thick one. The damaged tillers, besides forming a high number for a unit of space, contribute to a rise in the percentage on account of the thin condition of the crop. It has been ascertained in the case of chillies that a certain amount of vigour created by cultural as well as by manurial operations, helps the crop a good deal in tiding over an attack by thrips.

In the case of certain crops like sugarcane and turmeric, the planting material used has also to be taken into consideration. Cane sets taken from a field badly infested with mealy-bugs favour the development of the pest in the new plantation. There is a similar danger in using scale-infested rhizomes of turmeric for planting purposes.

It is also a matter of common observation that the presence of a strong light near a field may favour the development of pests like the Paddy Stem-borer (*Schœnobius incertellus*), the moths attracted to the light laying their eggs in numbers in the fields roundabout.

With these preliminary observations on the subject of environmental factors influencing the incidence of insect attack, one may examine some of the inherent characters of varieties to see how far they can secure for them freedom from damage by insects and if this knowledge can be used to achieve results of economic importance.

1. *The Relative Duration of Varieties.*—In the case of the Paddy Stem-borer (*Schœnobius incertellus*), the early varieties escape damage in the Northern Circars, whereas the late ones suffer a good deal. This difference appears to be due to the fact that the numbers of the pest are greatly cut short during the summer months and it takes some time for the insect to

multiply sufficiently to turn out serious, whereas the short duration varieties come into flower before this can happen. Even among the late varieties, it is only those whose earing period coincides with the main emergence of moths that suffer most. The period of main emergence of moths varies from year to year, and cannot be definitely predicted so as to adjust the flowering time and thus enable the crop to escape damage by borer. In the case of *Dalwa*, the second crop of paddy in the Circars, a certain amount of reduction in stem-borer damage can be expected, if it were possible to shorten the growing period and thus create a definitely long gap between *Dalwa* and *Saruva* ; for, then the interval thus created would function as a natural check on the continuous breeding of the pest. In the case of the Mango, early flowering varieties like *Swarnarekha* show a high percentage of damage by hoppers, as the flowering comes in during a period when moist weather is prevalent, which would serve to encourage the development of the hopper (*Idiocerus spp.*)

2. *Tillering and Spreading Habit.*—Varieties that tiller freely and cover up the field, do not suffer so much from borers as those that present a thin condition. In the case of certain pests like the Paddy Grasshopper (*Hieroglyphus* sp.), on the other hand, the effect is quite otherwise, as the insect invariably prefers patches of thick growth. In certain places where the pest is bad, the ryots not only give up fertilising their fields, but even go to the extent of topping their paddy crop to get temporary relief from the pest. In one locality it was reported that G. E. B. 24, which presents a thin condition in unmanured plots, escapes serious damage from the grasshopper pest.

3. *Softness of the Stem.*—Soft and thick canes are worse attacked by borer (*Argyria sticticraspis*) than hard varieties, not only as regards tunnels in internodes, but in the matter of the causation of deadhearts in the early stages of the crop. Similarly there is a good deal of varietal difference in paddy in its susceptibility to stem-borer attack.

4. *Character of the Leaf.*—The character of the leaves is also often of much importance. Cane Aleurodids are said to prefer varieties with broad thin leaves.

5 *The General Vigour of the Plant.*—In the case of damage to tillers, the power of response evinced by the production of fresh shoots that can readily take the place of the damaged ones is a desirable quality in a variety. Again, in the case of certain pests such as thrips, it looks as if the possession of a certain amount of vigour on the part of the plant enables it to resist their onslaughts.

While these are some of the general characters that are likely to affect the degree of damage by insect pests, the conditions under which, and the manner in which, their study is likely to be rewarded, may next be considered.

It is common knowledge that certain insects have very specialised tastes, their food being restricted only to certain particular plants. As an example, one may cite the case of the Paddy Stem-borer (*Schœnobius incertellus*), which breeds only in paddy—wild or cultivated. There are on the other hand, other insects which are cosmopolitan in their tastes, having numerous host plants—wild as well as cultivated. In the former case, it is no good attempting to evolve a variety low in the scale of susceptibility, as such a variety, though showing comparative immunity in varietal experimental plots, may perhaps show itself to be subject to heavy attack when

grown by itself, since the pest has no other host plant to turn its attention to. The latter case, too, presents a similar limitation with the reservation that the selection made should be such as would continue to show a low degree in the scale of infestation, when compared either with the existing alternative crops or wild hosts. Under these conditions the inherent characters of a plant may have to be examined subject to the limitations indicated. The time of flowering and the duration of a crop, on the other hand, are factors of a different character, since they seem to permit a certain amount of judicious handling so as to steer clear of periods of maximum damage. The factor of natural vigour in a plant, investing it with a capacity to withstand damage, would appear to hold out promise of a great future in regard to combating certain pests, and the characters that are associated with vigour, therefore, deserve critical study.

G. E. B. 24 IN PALGHAT

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'The which if you with patient ears attend,
What here shall miss, our toil shall strive to mend.'

General.—'What have Government to do with the actual processes of Agriculture?'—'How could these Government officers expect to help us?'—are questions still put by ryots to Agricultural officers. As often the questions have been asked, so often the answers have been given. Instances of the methods by which Agricultural officers have been hitherto able to assist ryots in different localities, have already been quoted and can still be multiplied. The object of this paper is to furnish one particular instance of how the department has helped the ryots with the strain of Paddy known as G. E. B. 24 in Palghat Taluk.

In Palghat Taluk, whose total area is about 4½ lakhs of acres, paddy claims about 2 lakhs of acres. From this it is seen of what great importance paddy is to Palghat, which has been aptly described as the 'Granary of Malabar.' Of the two lakhs of acres under paddy, about 120,000 acres will be single crop and the rest double crop area. The main paddy varieties used in the first crop season are *Chemban* (4½ months), *Chornali* (5 months), *Tavalakannan* (5½ months) and *Arikiri* (6½ months). The important second crop varieties are *Chetteni* (5 months) and *Anakomban* (6 months). It is important to note that *Chetteni* alone occupies more than half the second crop area in Palghat, i.e., over 40,000 acres.

Excepting in some places favoured with *Aeries* or tanks, the second crop paddy cultivation in this Taluk seems to be a gamble with the North-East Monsoon. Anakomban, the 6-months variety, is cultivated under *Aeries* or tanks in preference to short-duration varieties because of the assured water-supply; but, *Chetteni* is grown in lands entirely at the mercy of the North-East Monsoon. It has been the common experience of the ryots that the North-East Monsoon, more often than not, fails to give enough rain to mature even a short-duration crop like *Chetteni*. The vagaries of this monsoon mean disaster to the second crop.

Cultivation aspect.—G. E. B. 24 is well adapted to the conditions obtaining in Palghat. The introduction of G. E. B. 24 and its spread in