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Manuring in relation to insect pests

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It is a matter of common knowledge that only a fertile soil can ensure a vigorous growth of crops and produce bumper yields. A number of factors like soil texture, mineral elements etc., go to make up this fertility but by far the most important of these is the presence of the requisite quantity of organic matter, which in other words is known as humus. In nature, this precious materal is added to the soil by the gradual accumulation of plant and animal residues which are in turn converted into humus by certain natural agencies.

Under intensive agriculture, this plant food is rapidly consumed by the crops grown and its depletion has been compensated from time immemorial by the application of organic manures like green leaves, cattle dung etc., etc. But the demand has always been disproportionately higher than the supply, the latter being inadequate owing to the small quantities available and the imperfect methods of gathering and preservation of what little could be produced. This situation has indirectly served as a potent incentive for the large-scale advent of several forms of synthetic fertilisers. The general experience has been that the application of manures, either organic or synthetic, has a profound effect in increasing crop production.

The main theme of the paper being the influence of manuring on insect pests, it has first to be admitted that very little work has been done in India and much less in this State on this aspect, except for the solitary instance where Andrews (1) tackled the problem of the tea mosquito in North India from various angles, of which manuring was one. This paper is only a compilation of the outstanding lines of research conducted elsewhere.

Before proceeding further, a resume of the available information on the influence of the nature of the soil itself on the incidence of insect pests may cover a certain amount of the preliminary ground for the discussion. Williams (33) has recorded that the pea thrips — *Kakothrips robustus* Uzel, was less prevalent in untilled clayey soils than on light tilled soils, the probable reason being that the adults are unable to emerge from their underground pupae in hard soils. Nougaret and Lapham (26) have concluded that grape-vine suffers less from the root aphis — *Phylloxera vastatrix* Planch, in loose-textured soils, while the vines grown on heavy soils are infested to a more severe extent. This is due to the fact that the bugs are able to lurk under the cracks and crevices common in hard soils, while they get exposed and perish in friable lands. While investigating the incidence of pests on sugarcane, like spittle insects, frog hoppers, etc., Turner (32) mentions that the blighted fields show an appreciable deficiency in calcium carbonate and are markedly acidic, and that the blight-free fields are either alkaline or slightly acidic. Dwight Iseley (7) concludes that wire worms — *Hornistonotus uhleri* Hon., and the Melolonthid grub — *Macrodactylus subspinosus* F., thrive better in sandy light soils and that the apple woolly aphis — *Eriosoma lanigera* H., gets the upper hand in heavier soils. Coming nearer home, Andrews (1)

mentions that a water-logged condition in heavy soils increases the susceptibility of the bushes to the tea mosquito — *Helopeltis antonii* Sign. He also mentions that such a condition promotes acidity of the soil and that the presence of sufficient quantities of potash in the soil is closely connected with resistance to insect damage. Apart from these factors, soil moisture also, as shown by Cook (5) has some bearing on the incidence of the cut worm — *Lycopholia margaritosa* Haw.

Another aspect worth mentioning here is the relationship between the physiological condition of the plant and insect incidence. Evans (8) and Less (19) mention that the reproduction of aphids is positively correlated with the nitrogen and protein contents of the plant. Andrews (1) concludes that the relative proportions of potash and phosphoric acid fluctuate in the tea leaf during the season and that the infestation by *Helopeltis* is parallel to these fluctuations. The work of Greenslade, Massee and Roach (12) indicate that resistance to woolly aphis is associated with an alcohol-insoluble, but ether-soluble material present in the host tissue. In the case of the Colorado beetle — *Leptinotarsa decemlineata* Say, the preference of the beetle was due to certain attractive principles which appear to be nitrogenous compounds contained in the potato leaves (Raucourt and Trouvelot (29)). The presence of higher tanning matter increases the resistance of the African cacao to the larva of *Ephestia elutella* Hb. (Molz (23)). Prell (28) attributes the immunity of certain pines from the damage by the Nun moth (*Lymantria monacha* L.) to the small quantities of turpentine contained in the needles. Oshima (27) has recorded that the immunity of teak and cypress to termites is due to the presence of a sesquiterpene alcohol.

Coming to the subject matter of the paper, the thought-provoking theory of Howard (15) in his book "The Agricultural Testament" is worth mentioning here. The author, who has spent over 40 years in India, is strongly of opinion that the application of humus which is highly favourable for the mycorrhizal development, is probably the only panacea for all complaints. He expounds that insects and fungi are not the real causes of plant diseases and that they attack only unsuitable varieties of crops grown imperfectly. His theory is that Nature has provided a marvellous piece of machinery for conferring disease-resistance in crops. This machinery is active in soils rich in humus and inactive or absent in infertile land. The fuel needed to keep the machinery in motion is a regular supply of freshly prepared humus. The debatable point in his argument, however, is his confirmed prejudice against artificial manures which he says are the very bane of good soil husbandry. Lady Eve Balfour (18), another ardent votary of the humus school, lends enthusiastic support to Howard's theory in her book "The Living Soil". Apart from attributing innumerable virtues to humus, she mentions, in one context, that the presence of this material encourages the development of over 50 varieties of parasitic fungi which control eel worms. Hopkins (14), making a critical review of the opinion of these two workers, mentions as follows: Humus is an important part of the plant diet and a sufficiency of the same is necessary for them to be virile. There is however, very little evidence to prove that pest incidence increases with the application of fertilisers, as the experience has even been contrary in certain cases. Malnutrition may lower the resistance but the primary reasons for epidemics are to be linked with several other factors unconnected with the nutrition.

Quoting a few examples where insect pests are reported to have been controlled by manuring, Frew (9) has concluded that the application of certain fertilisers especially superphosphates has a marked beneficial effect in reducing the infestation by the Barley Gout Fly — *Chlorops taeniopus* Meig. The resistance appears to be effected by stimulating the growth of the earlier internode and the maturity of the earhead. McCollach and Salmon (22) have concluded that silica applied in the form of sodium silicate wards off the Hessian fly — *Mayetiola destructor* Say, on wheat. Hawkins (13) states that fertilisers, when used judiciously, stimulate the growth of sweet corn resulting in heavier yield, though the population of the wire worm — *Agriotus mancus* Say — ran into thousands. One of the general conclusions at the Rothamsted Research Station (Hubert Martin (16)) is that increased nitrogenous manuring leads to an increased liability for diseases and that plots not manured with potash are the first to succumb to insect pests. According to Andrews (1) potash manure affords indications of its value in allaying *Helopeltis* damage and the effect of adding superphosphate has been harmful. He concludes that nitrogenous manures should be used with caution. Gepson and Gadd (10) have shown that the machanical damage caused by the teak shot-hole borer — *Xyleborus fornicatus* Eich., heals up quickly with nitrogenous manuring.

Another line of control which is probably of academic interest is the addition of Selenium in the form of Sodium selenate in culture solution. The absorption of this poisonous chemical up to a concentration of 45 parts in a million was highly toxic to aphids and mites (Neiswander and Morse (25).) But the presence of the salts in the plants is supposed to be highly toxic to animals consuming these. Gnadinger (11) has also recorded that selenates are poisonous to red spiders. The chemical is reported to be specific in action without any marked insecticidal properties. Mason and Phillis (21) report that the inclusion of selenium in the nutrient solution for cotton grown in sand culture, rendered it free from insect attack.

In this connection the novel method of applying the chemicals direct to the root is worth mentioning. Andrews (1) claims that a direct feeding of a 1% solution of potassium chloride to the roots of tea bushes conferred complete freedom from attack by *Helopeltis*.

A certain amount of work has also been done in the control of insects by the injection of certain chemicals into the plant tissue which in its turn renders the plant sap distasteful to the insects. Dementiev (6) has found that the injection of barium chloride into an infested apple tree caused the disappearance of the woolly aphis — *Eriosoma lanigera*, in about ten days. Muller (24) records similar results by injecting pyridine and aluminium sulphate. Other examples of relief obtained by injection consist of the treatment with potassium cyanide against the fluted scale — *Icerya purchasi*, Mask. (Sanford (30)) and against boring insects on elms (Shattuck (31).

The possibility of the influence of trace elements in the relationship between the host and the pest is another factor. Brenchley and Thornton (4) found that the presence of boron is necessary for the symbiotic development of bacteria in Leguminosae. The small quantities of essential oils in the rind of citrus fruits have been found to deter the Mediterranean fruit fly — *Ceratitus capitata* Wied. (Back and Pemberton (2)).

Several instances of relief obtained against soil insects by the applications of chemicals, like carbon disulphide, paradichlorobenzene, carbolic acid, calcium sulphide etc., are on record but a discussion on these does not come under the purview of this paper.

Coming to a few examples of the cursory work done in this line in this State, the application of ammonium sulphate to paddy crops infested by the stem borer — *Schoenobius incertellus* W., and the root grub — *Echinocnemus oryzae* Marshall, and farmyard manure against the sorghum fly — *Atherigona indica* M., has afforded some relief against the respective pests. Krishna Iyer (17) has also recorded that the application of ammonium sulphate reduces the susceptibility of plants to the root-knot eelworm. It should also be mentioned here that most of these treatments have exerted little or no control over the pests themselves but have served only as stimulants to invigorate the growth of the crops which have had a set-back due to the insect damage. It has also been recorded by Balasubramaniam and Kesava Iyengar (3) that application of groundnut cake and cattle manure has increased incidence of the cotton jassid — *Empoasca devastens* D., though the variations were not significant.

Conclusion: Though the matter reviewed above can, by no means, claim to be complete, yet from an overall survey of the information on hand, there is little doubt that a judicious and balanced manuring will ensure the production of good crops. But experimental evidence regarding the efficacy of manuring as a measure of pest control is lacking except in a few cases, and even here, it appears to be effected more by the reaction on the plant tissue than on the insect itself. When there is a severe outbreak of an insect pest, the farmer wants immediate relief and that relief can be afforded only by insecticidal means. With the recent advent of synthetic chemicals like B H C. and D D T., the solution of many an insect problem is in sight and the outlook, on the whole, is quite bright.

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