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Recent Developments in the Chemical Method of Pest Control

by

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Introduction: It is a well-known fact that on an average about ten percent of the produce is lost by the cultivators every year due to depredations of crop pests. Intensive research has been in progress in the Madras State for the past four decades on insecticidal methods of pest control. Based on the results obtained so far, an attempt is made in this paper to give an account of the pesticides that can be adopted in plant protection, their peculiarities and adverse effects, dosages and concentration, etc., for the benefit of agriculturists and horticulturists.

Older Insecticides: A certain amount of basic knowledge on the habits of insects is necessary for the judicious application of these pesticides. Calcium arsenate and lead arsenate come under the category of stomach poisons and are in use even at the present day against insects which, while remaining outside, bite and feed on different parts of the plants. These are applied as sprays at the rate of half an ounce of the chemical mixed with one ounce of air-slaked lime in a gallon of water. Calcium arsenate is also used as a dust after mixing one pound of the chemical with four pounds of lime. Generally soap and sulphur combinations are not compatible with the arsenates. The contact insecticides in vogue against aphids, jassids, thrips, etc., include crude oil emulsion and Fish oil rosin soap which are used at a concentration of one pound in six to eight gallons of water. The latter formulation is effective even against hairy caterpillars. Tobacco, which is also a contact insecticide, is used either as a water extract with the addition of some soft soap at the rate of half an ounce per gallon of the spray fluid or dust and is a specific against aphids and thrips.

Synthetic Insecticides: These chemicals (organic compounds), synthesised soon after World War II, come under two broad categories—Chlorinated hydrocarbons and Organophosphates. An interesting feature about these formulations is that they show a combination of contact as well as stomach action. To a certain extent a few of them also possess a fumigant action.

I. **Chlorinated Hydrocarbons:** (a) *DDT (Dichloro diphenyl trichloro ethane):* This chemical has a high residual action and is a specific against certain categories of insects viz., jassids and cutworms. DDT is comparatively slower in action and a distinct reduction in the pest population will be perceptible only in the course of 48 hours after treatment. This insecticide has only a feeble action against grasshoppers

and is ineffective inert against plant lice, coccids and mites. DDT has been found to stimulate plant growth in the case of brinjal, cruciferous vegetables, sugarcane, groundnut, tobacco and cotton.

There are also instances where an indiscriminate use of this chemical has brought in its wake a secondary infestation of mites, aphids and coccids. This phenomenon is due to the lethal action of the chemical against the parasites and predators of crop pests. A certain amount of foliage injury has also been noted on curcurbitaceous plants as a result of application of DDT. Particular care has to be taken in the treatment of fruit trees like limes, lemons, etc., where there is the risk of a greater absorption of the chemical by the oil present in the outer peel of the fruits.

The standard concentrations in use in plant protection (available under various trade names such as 'Guesarol', 'Didimic', 'Hexamar DDT' etc.) are the 5 and 10% dusts and 50% wettable powder. The dusts are applied as such while the spray fluid is prepared by mixing one ounce of 50% wettable powder in three gallons of water.

(b) *Technical BHC (Benzene hexachloride):* This chemical has got a quicker knockdown effect than DDT. To a certain extent it has a fumigant action also. The vapour pressure of BHC is considerably higher than that of DDT and as such the residual action of the former chemical is of a shorter duration. BHC has proved quite effective against a variety of crop pests which are external feeders. Repeated applications have also given a certain degree of relief against tissue borers. This chemical has a few advantages over DDT. The chronic toxicity of BHC is much less than that of DDT and even from the point of view of the persistence of insecticidal residues the former is safer as the highly toxic 'gamma isomer' is reported to disintegrate rapidly.

The injudicious use of this chemical has been noted to bring about a phytocidal action by way of leaf-scorching or stunted growth. The plants belonging to the family *Curcurbitaceae* are highly sensitive to this chemical and as such it would be safer to avoid its use in this case. Another serious disadvantage with technical BHC is that the taint of the chemical is imparted to the produce of the treated plants, especially fruits, vegetables and tuber crops. These adverse effects have been attributed to the *alpha* and *beta isomers* and the impurities present in technical BHC. As a soil insecticide at higher concentrations it affects the germination of seedlings.

As in the case of DDT, this chemical (available under trade names such as 'Gammexane', 'Benexide', 'Klortex', 'Hexamar BHC', "Lethal rock BHC', etc.) is used as a dust at 5 and 10% concentrations. The dilution of the spray fluid in this instance is generally based on the gamma isomer contents, the strength of 50% wettable powder being 6·5% gamma. On this basis it has been worked out that 1¼ oz. of the chemical in one

gallon of water will give 0·05% (gamma) spray. Higher concentrations of the dusts and spray may be used against hardy insects.

(c) *Lindane:* This product is a purified preparation of technical BHC built up with pure gamma isomers. The insecticidal efficacy of this preparation is on a par with that of technical BHC. The advantage in this chemical is that it may be applied even against pests of fruits and vegetables without fear of ruining the palatability of the produce. The formulation can also be applied judiciously against cucurbits. Lindane is available as dusts and wettable powders, the standard ones in use being 0·64 and 1·3% dusts and 6·5% wettable powder. The dusts can be applied as such while the spray fluid is prepared on the lines indicated against technical BHC.

(d) *Toxaphene (Chlorinated camphene):* It has the quicker knockdown effect of BHC but shows residual action for a considerable time as in the case of DDT. It possesses a combination of the insecticidal action of both the chemicals and may, therefore, be used to act on behalf of the two pesticides. In the case of a combined infestation of aphids, jassids, thrips and caterpillars which is a common feature in cotton, this pesticide has given very convincing results. Toxaphene is highly toxic to cucurbits but does not interfere with the viability of the seed material when used as a soil insecticide. The chemical is available as dust at 10% and 20% and in wettable forms also. The spray fluid may be applied at 0·1% concentration (i. e. one ounce of cent per cent Toxaphene in 6¼ gallons of water).

(e) The other formulations coming under this category which are still in the experimental stage in this State are Chlordane, Aldrin, Dieldrin, Endrin and Isodrin. The first chemical is highly phytotoxic against cucurbits and there appears to be nothing spectacular even as regards its insecticidal efficacy. The other formulations have a high insecticidal action besides being free of phytotoxic hazards, even against cucurbits when applied as a spray.

II. **Organophosphates:** These formulations are highly posionous and have to be handled with the utmost care. An account of the more important pesticides coming under this category is furnished below. It is also a strange coincidence that these chemicals are effective against those groups of insects for which the Chlorinated hydrocarbons are not of much avail.

(a) *Hexa-ethyl-tetra-phosphate (HETP):* As a spray at 0·1% concentrations (i. e. one ounce in 6¼ gallons of water) this chemical is particularly effective against aphids and thrips. In the case of hardier types of insects like mealy bugs and coccids a higher concentration of 0·2% may be necessary. It rapidly hydrolyses to non-insecticidal compounds and can, therefore, be used without fear of toxic hazards even in the case of vegetables. It is compatible with lime and Bordeaux mixture.

(b) *Tetra ethyl pyrophosphate (TEPP):* This is the main active insecticidal principle in HETP also. TEPP has a longer residual action and research on the adaptability of this chemical is still in progressl Malathion is yet another product coming under this category which is stil· in the experimental stage.

(c) *Parathion (Diethy-nitrophenyl thiophosphate):* This is a formulation much more powerful than HETP and is dosigned to give a greater persistence on the treated plants. It is used at a concentration of 0·025% (i. e. one ounce of 20% Parathion in five gallons of water—available under trade names such as 'Ekatox-20', Folidol E. 605, etc.) and has a contact as well as fumigant action. The chemical is effective against hairy caterpillars and coccids. Encouraging results have been obtained even against the paddy stem borer — *Schoenobius incertellus W.* This chemical is not compatible with alkalies and Bordeaux mixture. The application of the chemical may be stopped a month prior to harvest.

Another interesting development in pest control is the synthesis of what are known as '*Systemic insecticides*'. When applied either to the soil or on the plants, these formulations are absorbed and translocated to the different parts of the plants along the cell sap rendering the latter toxic to certain groups of insects. Further they are retained by the plants for a considerable time (about four to five weeks under Indian conditions) and do not exhibit any lethal action on the natural enemies of these pests. These chemicals also come under the category of organophosphates (represented by Schradan, Sytam and Tetrax). A few other formulations represented by B.F.P.O. and Isopestox come under the category of Fluorohydrins. The investigations so far conducted have indicated their usefulness only against aphids, mites and a few species of mealy bugs when applied at a concentration of 0·075%.

Rodenticides: Zinc phosphide baits have given spectacular results against rodents. The bait is prepared by mixing one part of the poison with 49 parts of a suitable base like popped rice with the addition of a few bits of onions to render the bait more attractive. It would be advantageous to expose the unpoisoned food for a couple of days and follow it up with poisoned baits. As the chemical is highly poisonous to human beings and domestic animals, great care should be taken in its use. The latest rodenticide – Warfarin (Dethmor) has also given encouraging results against migrating rats and investigations on the baiting technique are in progress.

Acaricides: The incidence of mites is fairly common on horticultural and agricultural crops. Application of sulphur either as a dust or spray (at one pound of the wettable powder in 20 gallons of water — available under trade names, viz., "Sofril", "Thiovit", etc.) has been found to give considerable relief.

Conclusion: Before concluding the account on the developments in the insecticidal methods of pest control, it has to be mentioned that notwithstanding the synthesis of some of the more potent insecticides, the problem of the control of tissue borers still remains unsolved. There is a need for an effective insecticide which will get into the texture of the plants and cause the death of these internal feeders without in any way proving detrimental to the human beings or domestic animals consuming the produce of the treated plants.

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The Condition Factor for Paddy and the Irrigation Facilities available in certain Districts of Madras State during the last Fifty Years

by

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Introduction: The estimate of output of any crop for each district in a given year is the product of three factors, namely (1) the area under the crop in that year, (2) the normal yield per acre and (3) the condition factor for that year. The area under the crop is compiled every year by village officers based on the actual area sown to that crop in each holding. So far as the normal yield per acre for paddy is concerned, this was worked out by the Director of Agriculture, Madras in the year 1919 for each district. This figure is continued to be adopted since then and upto 1949 – '50. The condition factor (or the seasonal factor as it is also called) is the percentage of the normal yield estimated to be obtained each year. If the season is normal in any year, the normal yield can be expected and therefore the condition factor for that year is expressed as 100. Conditions of drought, floods, incidence of pests etc., affect the yields. The village officers furnish every year their estimates of what percentage of the normal yield is expected from their villages. Based on these estimates and the area under the crop in each village, the average condition factor is calculated for each district. According to the Season and Crop Report for Madras State for the year 1951 – '52, the total