PLATE - 1

Our vegetable crops and pesticides


Metacid 50
mecron

INTRODUCTION

Only four short decades ago, the control of insect pests by means of chemicals was in its early infancy. The pioneers in the area consisted largely of a group of dedicated applied entemologists, working to the best of their abilities with a very limited arsenal of chemicals that included inorganics (arsenicals, fluorides etc.), some botanicals (nicotine, pyrethrum, rotenoides), and a few synthetic organics (dinitro-o-cresol, organothiocyanates). Much of the early research work was devoted to solving practical problems associated with the formulation and application of new existing chemicals, and although the discovery of new types of insecticidal chemicals was undoubtedly a pipe dream in the minds of some, little or no basic research effort was expanded in this direction.

The beginning of the invention of pesticides was started long back before the dawn of civilization and has continued without cessation to the present time and will continue, no doubt, as long as human race endures. In this context few lines from an ancient Egyptian Manuscript which possibly evoke the use of pesticides are : "Worms have destroyed half the wheat, and the hippopotami have eaten the rest; there are swarms of rats in the fields; the grass hoppers alight there; the cattle devour, the little birds pilfer; and if the farmer loses sight for an instant of wheat remains on the ground, it is carried off by robbers."

Since then people were thought of some or the other material which can control such enmies. The old records (3000 to 4000 years ago) of experiences in this respect in Egypt, Greece, China and some other

civilized areas are available (Mayer, 1959), in which the methods of protecting crops and stores are described. These being mainly limited to the use of inorganic materials like lime, aresenic, wood ashes etc. besides organic mixtures such as asphalt, tannins, vinegar, paris green an arsenic compound were used in 1865 against Colarado potato beetle followed by lead aresenate in 1885 used as an orchard-spray (Gangawane and Deshpande, 1985). The use of principal pesticides such as sulphur, arsenicals, plant products like nicotine, pyrethrum, oils and resins etc. came into existance during 1890 to 1920. From 1920s to the early 40s the above mentioned pesticides with improved preparations were in use (Boyce, 1976).

The discovery of insecticidal properties of DDT by Paul Muller in 1939 has to be viewed as the event which marked the birth of modern insecticide chemistry and which has served as the corner-stone for its subsequent development. DDT clearly demonstrated for the first time the dramatic potential of synthetic organic chemicals for insect control and provided the initial stimulus which has caused insecticidal chemistry to become a field not only of immense agricultural and public health importance but also one that has had remarkable and unforseeable repercussions in broad areas of the physical, biological and social sciences.

This was soon followed by the discovery of BHC. Schrader's discovery of organophosphorus, materials of which become available after World War II, and chlorinated hydrocarbons by Diels-Alder reaction greatly stimulated chemical methods of pest control. Gradually other groups of pesticides were developed for commercial use and newer products are

continually appearing in the market. The relatively stable, long lasting, broad spectrum organochlorine pesticides were most effective, but have several disadvantages with respect to deleterious effects on the environment and brought most of them into disfavour and hence partly replaced by organophosphorus and carbamate pesticides.

In the course of time human population increased steadily but the amount of arable land is decreased with the encroachment of towns and cities. In order to meet the needs of human population most of the land has been utilized to accommodate them which has resulted in agricultural set back.

This set back has been improved by the introduction of new high yielding hybrid varieties of crop plants. However, unfortunately most of them have proved to be very susceptible to different types of pests. Now to control these pests pesticides are the only weapons in the farmers task force of defence and hence use of pesticides has become customary.

According to Wood et al. (1969) the problems of pest control have been thrust on us in a new and much more difficult way than in the past. This is because some pesticides have proved to be poisonous to humans and warm blooded animals (Duggan and Duggan, 1974) and have caused many deaths usually through improper or cereless use. There have been many epidemics of poisoning by pesticides in food. About 21 incidents from 1952-69 were given in Mrak Report (1969). Out of these, eleven were ascribed to spillage during transportation or storage; five resulted from eating formulated chemical; four were due to improper

application and two to other reasons. In USA in 1970 there were about 275 accidents during aerial spraying of pesticides involving 30 deaths (Green et al., 1987).

In the developing countries, particularly the illiterate rural people use pesticides indiscriminately, unmindful of the concept of time (time of harvest), space (quantity/acre) and quality. This has posed a great danger to humanity. According to the report of Central Bureau of Investigation (CBI), Govt. of India, 4536 persons died in 1965 alone on account of carelessness in handling poisonous substances (Visweswaraiah et al.,1975). Shinde (1979) has also reported 104 deaths in Kerala occured due to the consumption of organophosphorus contaminated wheat by spillage. The people suffered from retching and vomiting on consumption of food on banana leaves sprayed with copper sulfate in Kerala (Shinde, 1979) and an outbreak of epilepsy among over 150 people (The Hindu, 1976) in Sitapur, Lakshmipur, Kheri and Hardoi districts of U.P. due to eating wheat mixed with BHC has been reported. Apart from this, though irrefutable evidences of damage to humans caused by residues of DDT picked up from commercial foods, appear still to be lacking, there are clear indications that DDT will pass placental barrier and appear in new born children (Wassermann et al., 1967). The greatest human tragedy has occured due to leakage of methyl isocynate from storage tank of Union Carbide Company, Bhopal (India) causing more than 3000 fatalities and blindness to number of people (Gopalkrishnan and Kavi, 1984). Of course this accident was not due to consumption of pesticide but due to carelessness of pesticide manufacturing company.

Another problem caused due to pesticides is contamination of total environment by the entry of pesticides into a variety of cycles in soil, air, water and food. It is obviously clear that only a minute fraction of the pesticide applied is required for suppression of the target pests. The remainder 99.9% is essentially wasted and enters in environment in a variety of ways. The possible ways of entering pesticides into these cycles is shown in Fig. 1.

Another serious problem has been the development of resistance in pest population to pesticides and the rapid resurgence to other pests after chemical treatment. These problems combined with the distruction of vast number of valuable parasites, predators, pollinators and other useful arthropods by pesticides, made it clear that the time has come to face the threats posed by excessive use of pesticides. According to Hussey and Scoopes (1985), leaf miners, aphids and white flies possess genes conferring resistance to the wide range of chemicals applied to control them. Inconveniently such new 'strains' appearing more rapidly than man's ingenuinity can develop new compounds.

Apart from the possible danger of synthetic organic pesticides, when used properly have been of tremendous benefit to man and his environment, but when misused they cause considerable harm. They have saved millions of lives through control of disease carrying insects. They have minimised catastrophic crop damage by insects, weeds, plant diseases, rodents and other pests, preserved valuable forests and park lands from insect destruction and protected house holds against damaging

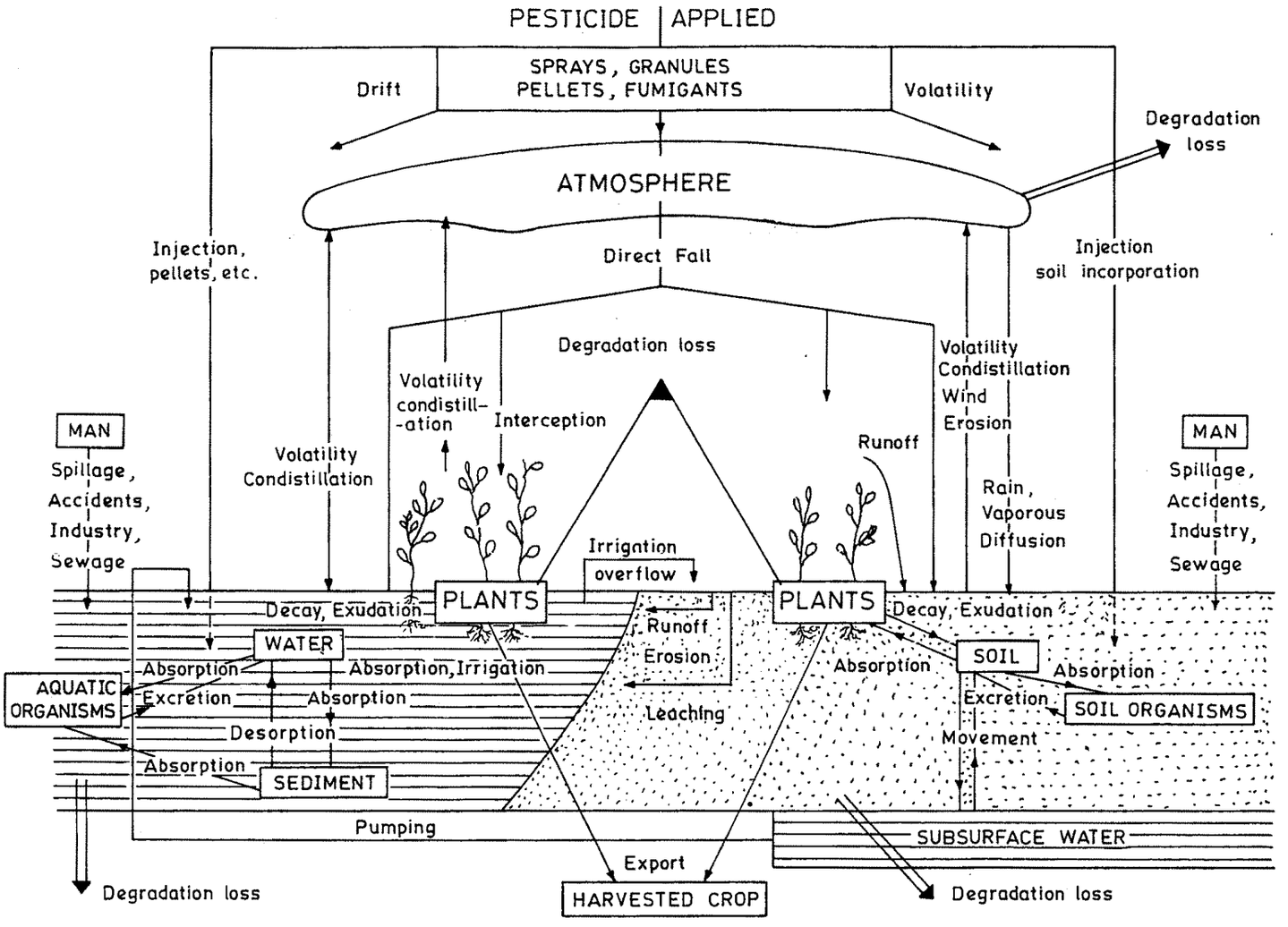

Fig. 1 Pesticide cycling in the environment

beetles, moths, and other bugs. Generally, they have provided higher quality of life to man. We cannot afford to loose the advantages gained through pesticides, but neither can we ignore the potential danger. Obviously we must derive the maximum benefits by safe pesticide use. At the same time, we must find ways to minimise or eliminate the hazards that may accompany the application of these chemicals.

From the recent reports it appears that the indiscriminate and unmeaningful use of pesticides has created not only harmful effects on man but also on crop plants on which they are applied (Hussey and Scopes, 1985). As reported by Hussey and Scopes (1985) a reputable cucumber grower can increase the yield by 25% using biological control, to control red spider mites, rather than using normal routine of 23 pesticidal sprays. This clearly indicates that pesticides reduce the yield. However, the complexities of such yield losses, apparently due to toxicity to plants are not as yet understood. There are also reports that pesticides caused insult to genetic material (Sharma, 1986). These insults may be genic, chromosomal and or genomic leading to mutagenicity, clastogenicity and turbagenicity. Besides, pesticides are also found to be affecting seedling growth, pollen fertility and seed set which are important factors in agriculture.

Looking to the danger encountered by all these pesticides one may recall the speech of Prince Bernhard of Netherlands who expressed his thoughts during Wild Life Fund dinner in London and the same has been quoted in a famous book 'Silent Spring' by Rachel Carson (1962).

" We are dreaming of conquering space. We are already preparing the conquest of the moon. But if we are going to treat other planets as we are treating our own, we had better leave the Moon, Mars and Venus strictly alone !

We are poisoning the air over our cities; we are poisoning the rivers and the seas; we are poisoning the soil itself. Some of this may be inevitable. But if we don't get together in a real and mighty effort to stop these attacks upon Mother Earth, wherever possible, we may find ourselves one day- one day soon, may be- in a world that will be only a desert full of plastic, concrete and electronic robots. In that world there will be no more "nature"; in that world man and a few domestic animals will be the only living creatures.

And yet, man cannot live without some measure of contact with nature. It is essential to his happiness." ..... Otherwise man has already lost the capacity to foresee and to forestall. If he will not compromise with the nature, he will certainly end by destroying the Mother Earth."

From the above foregoing discussion it is equivocally clear that if the indiscriminate use of pesticides will remain continue further then we may have to face the above mentioned problems which will certainly

produce unmanagable cumulative effects on the total ecosystem. Further it seems inevitable that the ultimate solution to our environmental pollution due to pesticides must be a compromise which will use the smallest possible quantities of pesticides, combined with other control measures so that environmental pollution by pesticides is kept at a minimum.

To achieve this, and to arrest imminent danger of ecological breakdown of the genetic systems in the agroecosystems, which necessarily hurts human welfare; a perspective approach in dealing with pesticidal problem is alarmingly important. Similarly very little is known about physiological response of plant to pesticide and moreover the resistance of different species and kinds of plants to pesticides is based on their biochemical differences in metabolism and on the differences in their physiological reactions to these pesticides. Therefore, the objective of present investigation was to examine physiological effects of organophosphorus pesticides on chlorophylls, polyphenols, relative water content (RWC), carbohydrates, inorganic constituents, stomatal behaviour and residual analysis in vegetables of day to day diet viz. tomato, okra and guar.