INTRODUCTION

" Worms have destroyed half the wheat, and the hippopotami have eaten the rest; there are swarms of rats in the fields; the grasshoppers 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."

The above para from an ancient Egyptian manuscript clearly indicates that the struggle between man and pest began long before the dawn of civilization, has continued without cessation to the present time and will continue, no doubt, as long as human race endures. This indicates the beginning of the invention of pesticides. From biblical times to the present day, locust have presented an indirect threat to lives of a large number of people. Since then, people were thought of some or the other material which can control such enemies. The old records (3,000 to 4,000 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, arsenic, wood ashes etc., besides organic mixtures such as asphalt, tannins, vinegar, Paris green an arsenic compound was used in 1865 against Colarado potato beetle followed by lead arsenate 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 and oils, resins etc.

came into existence during 1890 to 1920. From 1920s to the early 40s the above mentioned pesticides with improved preparations were in use (Boyce,1976)

The birth of modern insecticide occurred during world war II beginning with DDT, which opened a new vista and philosophy for development of synthetic organic compounds as pesticides. This was soon followed by the discovery of BHC. Schrader's discovery of organophosphorus, materials of which became 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 available 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 introducing new high yielding hybrid varieties of crop plants. However, unfortunately most of them have been proved to be very susceptible to different types of pests. Now to control these pests, pesticides are the main weapons in the farmers armoury of defence and hence the 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 careless use. There have been many epidemics of poisoning by pesticides in foods. About twenty one incidents from 1952-1969 tabulated in the Mrak Report (1969) are given in Table 1. 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 the 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 a report of Central Bureau of Investigation (CBI), Government 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 occurred 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 out break 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

Table 1. Epidemics of poisoning by pesticide reported in literature between 1952-1969 (After Mrak 1969)

Kind of accident	Pesticide	Material contaminated	Number of cases	Number of deaths	Location
Spillage during transportation or storage	Endrin	Flour	159	0	Wales
	Endrin	Flour	3	0	Egypt
	Endrin	Flour	691	24	Qatar
	Endrin	Flour	183	2	S. Arabia
	Dieldrin	Food	21	0	Shipboard
	Diazinon	Doughnut mix	20	0	U.S.A.
	Parathion	Wheat	360	102	India
	Parathion	Barley	38	9	Malaya
	Parathion	Flour	200	8	Egypt
	Parathion	Flour	600	88	Colombia
	Parathion	Sugar	300	17	Mexico
Consumption of treated soil	Hexachlorobenzene	Seed grain	3,000	3-11%	Turkey
	Organic mercury	Seed grain	34	4	W. Pakistan
	Organic mercury	Seed grain	321	35	Iraq
	Organic mercury	Seed grain	45	20	Guatemala
Improper application	Toxaphene	Collards	4	0	U.S.A.
	Toxaphene	Chard	3	0	U.S.A.
Miscellaneous	Parathion	Crops	400	0	U.S.A.

of DDT picked up from commercial foods, appears still to be lacking, there are clear indications that DDT will pass the placental barrier and appear in new born children (Wassermann et al., 1967). The greatest human tragedy has occurred due to leakage of methyl isocynate from storage tank of Union Carbide Company, Bhopal (India) causing more than 3,000 fatalities and blindness to number of people (Gopalakrishnan 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 obvious that only a minute fraction of the pesticide applied is required for suppression of the target pest. The remainder 99.9% is essentially wasted and enters the environment in a variety of ways (Metcalf, 1986). The possible ways of entering pesticides into these cycles are shown in Fig. 1.

Another serious problem has been the development of resistance in pest populations 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 Scopes (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 ingenuity can develop new compounds. The cartoon

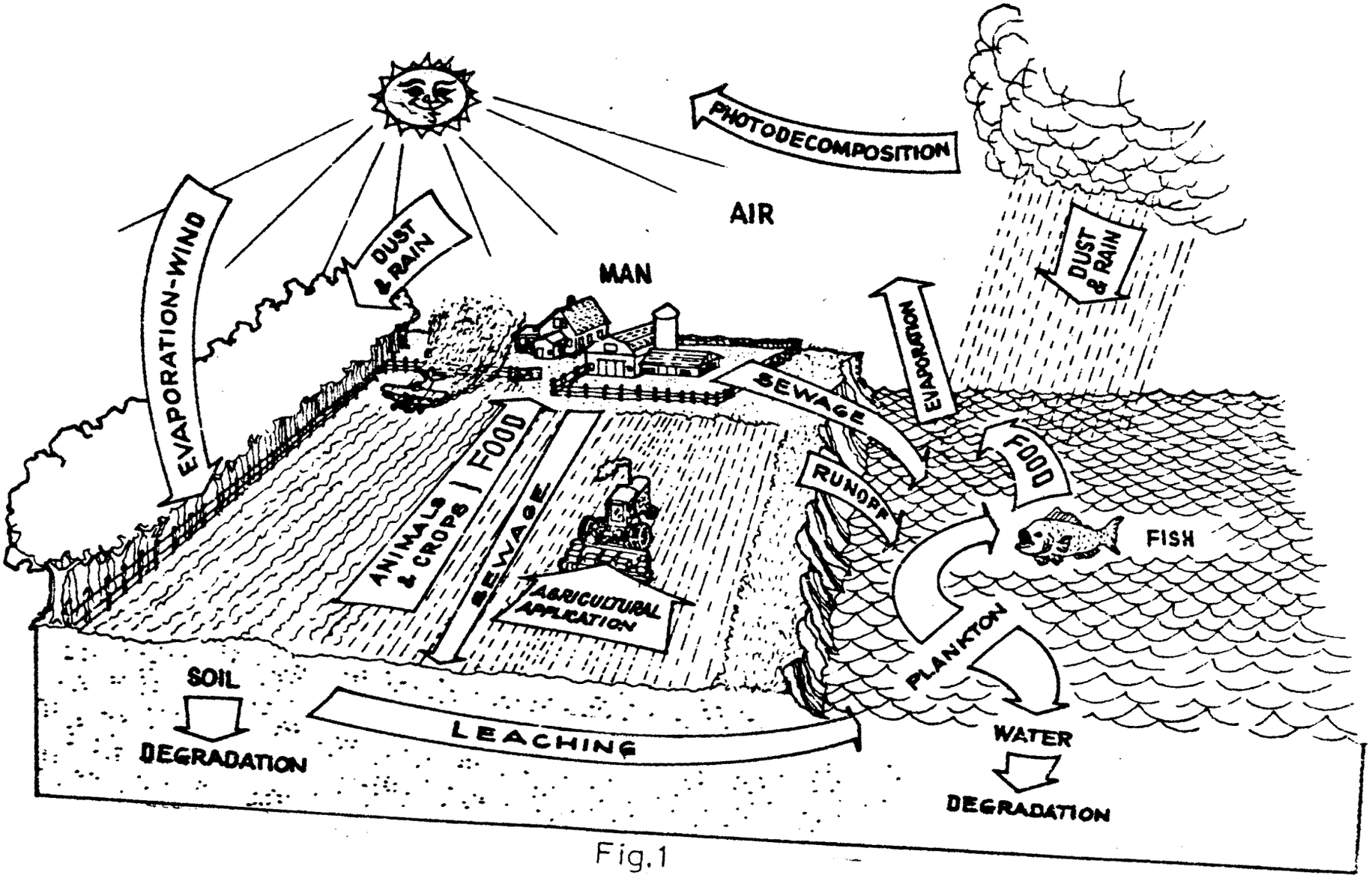

PHOTODECOMPOSITION
AIR
EVAPORATION-WIND
DUST & RAIN
MAN
DUST & RAIN
EVAPORATION
SEWAGE
FOOD
RUNOFF
FISH
ANIMALS & CROPS
FOOD
SEWAGE
AGRICULTURAL APPLICATION
PLANKTON
SOIL
LEACHING
WATER
DEGRADATION
DEGRADATION

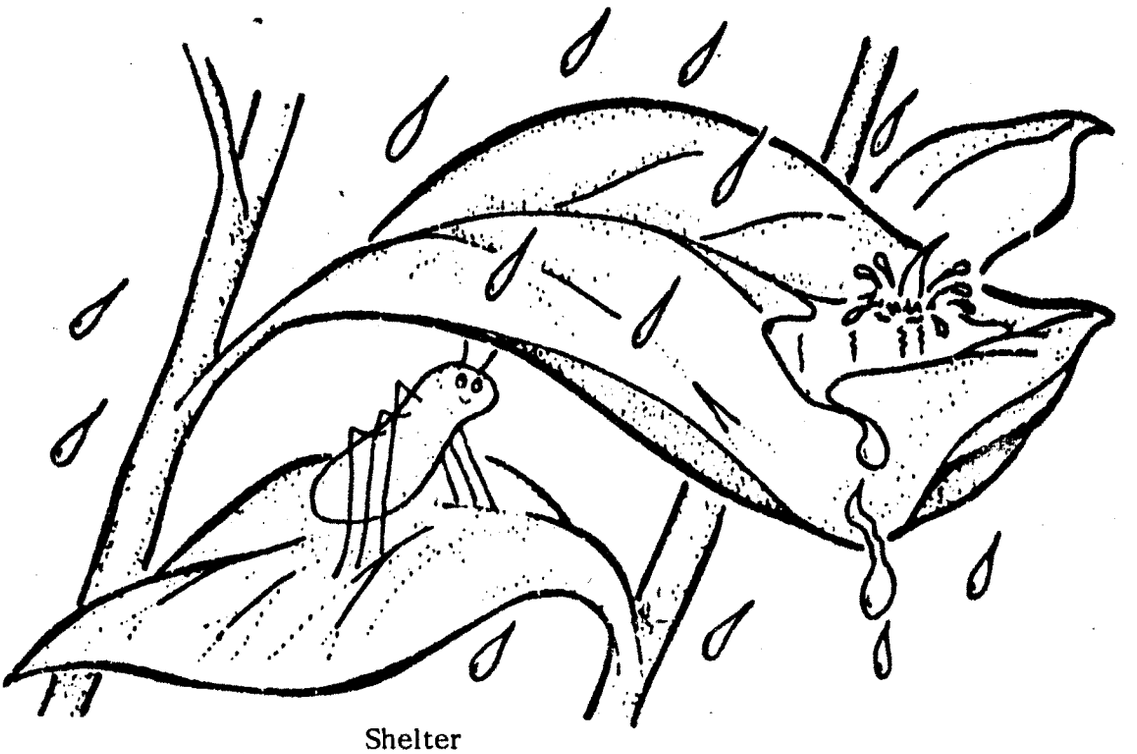
Fig.1

shown in this respect in Fig. 2 is self explanatory and the saying that 'Resistance is a oneway street - there is no going back' appears to be very true.

From the recent reports it appears that the pesticides are not only harmful to human beings but are also harmful to 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 pesticide 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. Apart from this there are also reports that pesticides cause insult to genetic material (Sharma, 1986). These insults may be genic, chromosomal and or genomic leading to mutagenicity, clastogenicity and turbagenicity. Besides this, pesticides are also found to be affecting seedling growth, pollen fertility and seed set which are important factors in agriculture.

From the above foregoing discussion, it is very clear that if the indiscriminate use of pesticide will remain continued further then we may have to face the above mentioned problems which will certainly produce unmanageable cumulative effects on the total ecosystem. Further it seems inevitable that the ultimate solution to our environmental pesticide problems 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.

Resistance



Shelter

Fig. 2

To achieve this, and to arrest the imminent danger of ecological breakdown of the genetic systems in the agro systems, which necessarily hurts human welfare, a perspective approach in dealing with pesticide problem is alarmingly important. The objective of present investigation therefore, was to examine the physiological and cytological effects of organophosphorus pesticides on germination and growth in some vegetables.