1 INTRODUCTION

With the progress of civilization man gradually realised the harm caused by pests to the crops and the diseases transmitted by them to human beings and to domestic animals. The use of chemicals to kill the pests is known from very ancient time. The oldest available record is the use of sulfur by Greeks (about 1000 B.C.). They use to burn sulfur to purge their house and the court. About A.D. 70 Pliny the Elder recommended that arsenic could be used to kill insects. Chinese were using arsenic sulphide to kill garden insects. Dioscorides, a Greek Physician (40 to 90 A.D.) knew of the toxic properties of sulfur and arsenic.

The use of arsenic compound continued and large quantities of such compounds (lead arsenate) were used to control insect pest during the early part of the twentieth century. Species of false hellobore (Veratrum album and V. nigrum) were used by Romans as rodenticides. Fungicide value of copper compound was known since 1807 and the Bordeaux mixture was used first time in the France (1883). In 1877 hydrocyanic acid was used as fumigant in museum. Carbondisulphide has also been used as an insect fumigant since 1854. The use of principle pesticides such as sulfur arsenicals, plant products like nicotine, pyrethrum and oils, resins etc. come into existence during 1890 to 1920. Until the mid of 1930 pesticides were mainly of natural origin or inorganic compounds. From 1920's to early

40's the above mentioned pesticides with improved preprations were in use (Boyce 1976).

The era of synthetic organic pesticides began about 1940 during the World War II. Paul Muller in 1939 discovered the powerful insecticidal properties of dichlorodiphenyltrichloroethane or DDT. It was manufactured in 1943 and soon became the most widely used single insecticide in the world. This was soon followed by the discovary of BHC. Discovary of organophosphorus material by Schrader and chlorinated hydrocarbons by Diels Alder reaction greatly influenced the chemical methods of pest control. Development of pesticides during historical period till the recent one has been represented in Table 1.

In order to improve agricultural productivity and farm management it is necessary to eradicate the pests, plant diseases and harmful weeds. The loss in agricultural produce due to pests is about 14%. The plant diseases contribute to 12% and weeds are responsible for a loss of 9% (Gruzdyev 1983). Of the different methods used to control the attack of pests and diseases chemical control is most widely followed. Ingeneral production of pesticides is less costlier and they can be easily handled. About 1400 basic chemicals are used in the production of thousands of formulations (Worthing and Walker 1987).

Table 1. Historical development of pesticides.

Year	Pesticide
1000 B.C.	Sulfur is used by the Greeks.
900	Arsenicals are used by the Chinese.
1763	Nicotine, as crude tobacco, used as insecticide.
1800's	First usage of Pyrethrins in Asia.
1848	First usage of rotenoids.
1939	Discovery of the insecticidal properties of DDT by P. Muller.
1940-50	Development of organochlorine insecticides (aldrin, dieldrin etc.)
1944	Synthesis of parathion by G. Schrader.
1950's	Development of insecticidal carbamates.
1963	Chlordimeform, the first of the formamidine pesticide is synthesized by Schering, A.G.
1970's	Development of modern pyrethroids.

After Costa, (1987)

Human population increases with lips and bounds, but the arable land available is limited and decreasing with the encrochment of towns and cities. In order to meet the needs of human population it is necessary to increase the agricultural production. In India green revolution took place during 1960-61, which increased area under cultivation. Irrigation facilities developed and new high yielding varieties of crops were introduced. Use of fertilizers also increased. Unfortunately most of the new hybrid varieties are found susceptible to disease and pests. To control these pests the use of pesticides became customary. So in modern day agriculture and farm management, pesticides form an important component. Admittedly, pesticides essentially constitute the chemistry of human survival (Ramanathan, 1989). It is reported that for every one rupee spent on pesticides, yield of about 3 to 4 rupees from additional crops is maintained. Annual growth in the amount of pesticides as a whole is about 6.4%. It accounts for 7.7% for herbicides, 6.2% for fungicides, 4.8% for insecticides and 7% for defoliants (Gruzdyev, 1983).

In India about 120 pesticides and 200 formulations have been approved for manufacturing and usage (Ramanathan 1989). Of these, 69 are widely used and 57 are manufactured indigenously (Kathpal, 1988). Total consumption of pesticides in India is expected to reach 1.5 million tonnes in next decade (Anonymous, 1986). In India the annual use of

insecticides is about 84,670 metric tonnes and 50% of them are used only for cotton (Joshi, 1992). The use of insecticides in Maharashtra since last 6-7 years is represented in Table 2.

It is true that pesticide have benefitted the man interms of health welfare and increased food supply of nutritional quality. However these benefits are followed by many drawbacks. Unfortunately the hazards of pesticides are not so emphasized and as a consequence the perception of the pesticide in the world is totally unbalanced.

The pesticides contaminate the entire ecosystem especially fresh water, marine water and edaphic systems. Water is vital element to sustain our life. It is most unfortunate to note that insecticides have caused pollution of water in several cases. Fresh rain water on the mountain tops of Himalayas contained insecticides. Analysis of snow from the arctic indicated the presence of insecticides. Analysis of rain water before it touched the ground in midlands (U.K.) showed the presence of pesticides. DDT is a common contaminant in water and it has been estimated in quite appreciable concentration (Pillai and Agarwal 1979).

Pesticides are also estimated in air. In a scientific survey in Florida it was found that DDT sprays, falling from skies destroyed 90% of our resources of O_2 (Hamman 1970).

Table 2. Use of insecticides in Maharashtra.

Year	Area under crop - protection scheme	Inesecticide use	
		Powder (Tons)	Liquid (Litres)
1985-86	8, 17, 500	5, 044	3, 03, 647
1986-87	4, 52, 427	2, 094	48, 643
1987-88	7, 36, 229	4, 725	2, 45, 365
1988-89	8, 51, 140	4, 642	4, 19, 460
1989-90	9, 11, 110	3, 586	3, 36, 652
1990-91	10, 89, 110	3, 627	4, 33, 454
1991-92 (Approximately)	14, 48, 556	4, 876	4, 12, 945

After Joshi (1992)

In recent survey carried out by Delhi University it was found that percent of DDT was very high in local areas around Delhi Air Port.

The greatest human tragedy has occurred due to leakage of methylisocyanate from storage tank of union carbide company Bhopal (India) causing more than 3,000 fatalities and blindness to a number of people (Gopalkrishnan and Kavi, 1984). These accidents were not due to consumption but due to carelessness during the manufacturing of pesticides.

Holway (1970) attributed 200 deaths in U.S.A. due to consumption of polluted food. In India and Malaysia unprecedented deaths occur due to contamination of flour with insecticides. The World Health Organisation estimates that one person every minute is poisoned in the third world by pesticides. Bindra (1971) reported that the level of DDT and it's metabolite was highest among Indians. The series of tests conducted by the central food laboratory the National Institute of Occupational health and Punjab Agricultural University have confirmed the presence of insecticidal residues in our food products at levels far exceeding the Acceptable Daily Intake (ADI) (Ghosh 1985). It has been found that Indians ingest more insecticides than any other nation studied. DDT in the body of Indians has been found ten times more than most other countries. DDT and BHC residues in human milk are so high here that babies ingest 21 times the ADI

recommended by the World Health Organisation. The Entomology Department of Udaipur University during a basket survey of fruits and Vegetables purchased from the local market revealed that more than 90% vegetables and fruits had insecticides higher than permissible limits (Srivastava 1989). This evidently indicates that we are eating some amount of poison which will cause health hazards in due course of time.

Although in India, less amount of pesticides is used on vegetables and fruits, the amount found on them is quite high compared to western countries, where a lot of pesticides are used yet, so little or only traces are estimated in the vegetables and fruits (Kathpal et al. 1981, Buchel 1983). DDT and it's metabolites and BHC have been detected and quantified in milk, butter, ghee, vegetable, oils, spices, meat, fish, and eggs (Singh, 1982). Shinde (1979) has 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 (Shinde 1979). In general DDT and it's metabolite DDE, accumulates in adipose tissue in human beings. DDT accumulated in the adipose tissue gets excreted through milk. It has been estimated in significant concentration in human milk in India (Aggarwal etal. 1976). Table 3 reminds some toxicologically related events involving pesticides.

Table 3. Some Toxicologically Related Events Involving Pesticides.

Year	Event
1930's	"Ginger Jake" paralysis in the U.S. caused by cresyl phosphates.
1962	Silent Spring by Rachel Carson is published.
1970-73	Restriction in the use of DDT in Sweden and U.S. for it's ecological effects.
1971-72	Outbreak of poisoning in Iraq due to alkylmercury fungicides.
1976	Poisoning of spraymen in Pakistan by malathion due to it's potentiation by impurities.
1977	Restriction on the use of dibromochloropropane for it's toxicity on the male reproductive system.
1984	Accidents in Bhopal during the manufacture of carbaryl.
1986	Over 1000 tons of pesticides are spilled in the Rhine River.

After Costa, (1987)

As a result of insecticidal pollution several diseases develop which cause death to the human beings and domisticated animals. Arsenicals cause tremors. Ghosh (1985) reported that as a result of insecticidal pollution cancer, encephalites, filariasis, virulent type malaria and viral fevers are spreading in the country. Among all the diseases caused by pesticides, the most remarkable and dreaded one is cancer. Several reports indicated the role of pesticides in tumour initiation and progression (Ghosh, 1985).

Occurence of pesticides is ubiquitous and a number of them are oncogenic in nature number as evidenced in animal studies. Organochlorine pesticides normally accumulate in adipose tissue (Kasai, et al. 1972; Unger and Olsen, 1980) and induced Leukaemia. High concentration of DDT and dieldrin cause lung cancer, gastric carcinomas and induce breast cancer and generalised metastatic carcinomatosis. Several pesticides are responsible for non-Hodgkin's lymphoma and reticular cell sarcoma. Several cases of aplastic anaemia are also reported (Reeves et al. 1981).

An epidemiological survey indicated that out of 316 men exposed to several pesticides such as 2, 4-D, MCPA, DDT, hexachlorocyclohexane, toxaphene parathion, DNOC (dinitro ortho cresol), fungicides and some amount of arsenic, 11 developed lung cancer, 4 prostratic cancer, 3 stomach cancer, 3 skin cancer, 2 bladder cancer, 2 rectal cancer, one each in

kidney, oesophagus, gall bladder, epiglottis and one case of lymphoma (IARC 1974 - 1980).

Soft tissue sarcomas in humans after the exposure to phenoxyacetic herbicides were reported by Coggon and Acheson (1982). In a particular case, the father developed liposarcoma of thigh while the son had metastazing fibrosarcomatous mesothelioma. Non-Hodgkin's lymphoma with cutaneous manifestation developed due to herbicides.

Exposure to hexa - and octachlordibenzo-dioxins induced tumours in the scalp, severe acne on the face neck, trunk and genital area and tumour in the right occipital region of scalp. In the group of 110 men, exposed to phenoxyacetic acids (2, 4-D and 2, 4, 5-T) and chlorophenols, 27% of them developed soft tissue sarcomas and some malignant lymphomas (Erikkson et al. 1981). Hexachlorobenzene was detected in human milk at concentration of 700 ppb, after 25 years of poisoning. During lactation period, fat is mobilised from adipose tissue and the pesticides accumulated in the adipose tissue reach the blood and ultimately come out in the milk. High concentration of pesticides was noted in milk compared to blood. Organochlorine pesticide also caused neoplastic lesions in gastric mucosa (Casareth et al. 1969; Wassermann et al. 1978).

Another serious problem has been the

development of resistence in pest population to pesticides and the rapid resurgence to other pests after chemical treatment. In 1938 there were only seven pests which were resistent to insecticides. But in 1984 number increased upto 447. In 1970 there was not a single weed resistant to herbicide but in 1990 about 48 weeds became resistant to herbicides (Joshi, 1992). Such a new strains appearing more rapidly than man's ingenuity can develop new compounds. Nonselective and widespread application of pesticides leaving a persistent residue favours the development of resistance in insects. Due to widespread use of insecticides a number of valuable parasites, predaters, pollinators and other useful arthropods are destroyed which are useful to crops. The effect of the pesticide is not only to reduce the numbers in any kind of natural enemy but to reduce the number of species of natural enemies in ecosystem. Since some of them are driven out for lack of prey or starved out for lack of host.

Pesticides are not only harmful to human beings and his domesticated animals but also to plants on which they are applied. Hussey and Scopes (1985) reported that a reputable cucumber-grower can increase the yield by 25% using biological control to control red spider mites rather than using normal routine of 2, 3 pesticide spray.

From the above foregoing discussion it is clear

that the global pesticide contamination is very extensive. The pesticides like DDT have contaminated all the human resources, Gunter (1966) claimed that a qualified pesticide residue analyser with proper equipment could find measurable DDT in any non fossil sample presented to him, and with enough time and patience could find several other pesticides as well.

Admittedly, pesticides are mutagenic, and teratogenic. Even though, pesticides have been proved to be toxic, still we use them liberally. We are totaly dependent on pesticides, some of them are immediate toxicants, whereas most are toxic on long run. True, our ecosystem is deteriorating slowly, gradually but steadily.