INTRODUCTION

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When pesticides were first used on a large scale, their poisonous effects on mammals, birds and beneficial insects were observed and become a matter of public concern. As information and publicity increased, other aspects of the safe use of certain very toxic chemical compounds received great attention. Now the pesticide possible harmful effects on non target animals, plants, as well as the usefull and potentially active soil microorganisms. The effect of pesticides on soil microorgrnisms depend on many factors such as, the physiochemical properties of the soil, organic matter content, the density of the microbial population, types of microoganisms and the types and dose of the pesticides used.

Effect of Insecticides on Soil Microflora :-

a - Inhibitory Effect of Pesticides :-

Wlison and Choudhri (1948) ; Chiaro (1953) and Gray (1956) stated that the hydrocarbon especially the chlorinated hydrocarbon insecticides at different levels decreased the populations of bacteria, actinomycetes and fungi in the soil

The organophosphorus pesticides such as Parathion, EPN, Malathion (at dilutions of 1/400 to 1/600), Disyston, Cucracron and Permethrin slightly reduced the total population of microbial flora especially molds and also some of them delayed the spore germination of the microbes. The overall effect of the pesticides was evaluated by Kasting and Woodward (1951); Bollen *et al* ., (1954 b); Swaminathum and Sullia (1969); Mahmoud *et al* (1972); Ramadan and Zidan (1975 a) and Mathur *et al* (1980). Also, Azad and Saleem (1976) stated that the effect of Meta-systox at all rates reduced the total bacterial counts in the soil for 28 days and Hamed (1980) found that Dipterex seemed to be more inhibit or to the microbial soil flora than Nuvacron.

Insecticides like Orthocide during the initial stages of application, Endosulphan isomers, Pyrolan, Dieldrin and Thidiazuron at high concentrations of the insecticide, and stage of applications affected badly the soil microflora.The over all effect of the pesticides is recorded by (Mahmoud *et al.*, 1970; El-Beit *et al*., 1981 and Jagnow *et al*.,1981).

Tu (1970) and Moawad *et al* . (1979) studied the application of various pesticides. Trichloronate, Diazinon, Dursban and Zinophos at 10 and 100 ppm concentrations and reported a deleterious effect on the numbers of fungi and bacteria.They studied also the effect of adding other pesticides (Cotoran, Dursban, Zineband, and Temik) at the field rates, to urea treated soil and recorded a netable decrease the proliferation rate of the microbial flora.

Carbamate insecticides caused a significant reduction in the populations of microflora, Temik lowered the total counts of bacteria, actinomycetes and fungi in soil and Carbofuran reduced the bacterial population for up to 8 days (Makawi *et al.*, 1979 and Oblisami *et al.*,_1979).

Ou *et al.* (1978); Magu and Bhowmik (1984) observed that some of herbicides such as 2,4-D or 2(methyl-4-chlorophenoxy butyric acid) MCPB at concentrations of 500 μg/g soil decreased the bacterial population when added to sand loam soil compared to the untreated soils. On the other hand, Endo et al (1982) found that Cartap Hcl [2-dimethylaminotrimethylene S,S,-bis (thio carbamate) hydrochloride] at concentrations of 10 ppm and 100 ppm had no appreciable effect on the populations of microorganisms in soil .The deleterious effect of the insecticide was recorded at 1000 ppm.

b- Stimulatory effects

Verona and Picci (1952); Naumann (1958) found that some organophosphorus compounds such as Pestox, Schardane had stimulatory effects on the microbial flora of soil, when applied in rates as high 300 ppm. In vitro, the numbers of bacteria and fungi increased at 100 to 500 ppm. Parathion exerted in vitro stimulatory effect on the proliferation of bacteria and fungi at concentrations ranging between 1,000 to 5,000 ppm. They attributed this stimulatory effected to the mineralization of some organophosphorus pesticides by soil microflora.

Mahmoud *et al.* (1972) and Magu and Bhowmik (1984) demonstrated that Disyston and Meta-iso-systox at half field application caused marked stimulatory effect on the total microbial flora. Naumann (1970) found that under field application conditions, Vapam insecticide quickly stimulated the soil bacteria for nearly 12 weeks without any considerable depression in the other microbial soil flora.

Kandasmy *et al.* (1975); Ramadan and Zidan (1975a) found organophosphorus insecticides (granular Phorate, Tamaron and Cyolane) exerted a stimulatory effect on soil microflora including fungi and bacteria. The treatments of soil with some pesticides as Fensulfothion, Quinalphos and Indar (4 -n-butyl-1,2,4- triazole) had an appreciable disruptive effect on soil microbes, particulary on fungi, bacteria and actinomycetes for 52, 37, and 37 days of incubation (Oblisami *et al.,* 1977 and Sinha and Singh, 1979).

Anan'eva and Sokolov (1979) and Sivaswamy and Mahadevan (1986) observed an abrupt increase in the saprophytic group of soil microorganisms especially bacteria when the soil was treated with 3,4 dichloroaniline (DCA). They also recorded an increase in both the bacterial and fungal populations especially upon applying bleaching powder.

Tu (1980) and kumar *et al.* (1985) studied the effect of some organophosphorus and carbamate insecticides and found that Terbufos sulfoixde, Telche C-17,Phorate,Terbufos, Dowco 275, Terbufos sulfone and Permethrin stimulated the microbial populations after varying periods of incubation and certain of them were not deleterious to the soil microbes at recommended dose did not adversely affect the soil microorganisms (bacteria, actinomycetes, azotobacters and fungi) and accerelated their colonisation where Aldicarb harbourd more populations of diverse microflora than Carbofuran, Disulfaton and Phorate. El-shanshoury and El-sayed (1988) found that Terbutryn at concentration of 10, 30 and 100 µg/g soil showed a significant stimulatory effect on the population of total bacteria, actinomycetes and fungi.

Effect of pesticides on Some Soil Microorganisms :-

The important groups of microorganisms which carry out the main biological processes in the soil such as ammonification, nitrogen fixation, nitrification, denitrification, mineralizatin of organic carbon, etc. play an important role in soil fertility. The effect of pesticides on those microorganisms and on their biological processes received great attension by many microbiologistis.

a- Effect of Pesticides on the Nitrogen Fixing microorganisms :-

The inhibitory effect of pesticides on both density and growth of the nitrogen fixing microorganisms were studied by many investigators. Mahmoud *et al* . (1972); Magu and Bhowmik (1984) and Narsale *et al* (1984) reported that Disyston increased the densities of the aerobic nitrogen fixers in low concentrations and in higher levels slight inhibition was reported which extended for a considerable period of time. The inhibitory effect of some pesticides on nitrogen fixing organisms was reported by Eisenhardt (1975); Narsale *et al* (1984) where Phoxim, at 10, 100 and 1000 ppm reduced the capacity of non-symbiotic N-fixation in soil; inoculated by *Azotobacter macrocytogenes* compared to the untreated soil. Also, after 14 days of applications of Agrosan GN and Thimet had an adverse effect on *Azotobacter* populatons especially in high doses.

Kandasmy *et al* (1995); Kishan *et al.* (1981) stated that the application of granular Phorate and Lindane increased the population of *Azotobacter* and did not exert adverse effect on the population in a sandy loam soils even after 15 days of treatment with Lindene. Azad and Saleem (1976) also reported a considerable increase in the *Azotobacter* population in both soil and synthetic media in the presence of the insecticide Folidol. Some pesticides as Orthocide (a Fungicide) or Terflan (a herbicide and the other pesticides (Cotoran ,Dursban, Zineb and Temik) inhibited the proliferation of *Azotobacter* at early stages of the experimental period when mixed with urea (Kandasmy *et al.*, 1975; Makawi. *et al.*, 1979 and Moawad *et al.*, 1979).

The azotobacters especially *Az. chroococcum* was found to be tolerant to such organophosphorus insecticides like Mephosolan, Phosfolan and Malathion since their counts increased significantly in the presence of these insecticides (Gomah *et al.*, 1976; Poi and Ghosh 1986).

Kandasmy *et al.* (1977) found that there are negative correlation between *Azotobacter* populations and the residues of the two insecticides Aldicarb. Disulfoton. In the prenece of other pesticides like Fensulfothion and Quinalphos, an increase in the *Azotobacter* number was reported Oblisami *et al.* (1977) and Rodell *et al.* (1977).

Another study on different pesticides revealed that they have two extreme effects Gammexane, Quinalphos, Benzene hexachloride, Carbofuran and Aldrin had stimulatory effect on the populations of *Azotobacter* sp. especially *Azotobacter vinelandii*. Other insecticides as BHC, Phenthoate as well as Bleaching powder declined the *Azotobacter* populations, the equilibrium of the *Azotobacter* count was regained after long time (90 days) in soil when treated with BHC and Phenthoate. Methoxychlor as the insecticide had essentially no effect on the *Azotobacter* abundance (Nain *et al.*, 1984); Thangovelu, 1984; Polyakova *et al* 1984; Poi and Ghosh; 1986, and Sivaswamy and Mahadevan, 1985).

The increase in the *Azotobacter* population in presence of certain pesticides at different concentrations supplemented in liquid media was also observed by Magu and Bhowmik (1984) and El-Shanshoury and El-Sayed (1988).

b- Effect of Pesticides on Denitrifying Microorganisms :-

Nishihar (1962) employed the insecticides BHC and Diazinon in a rice field and observed a supression of the denitrifying power of the soil and an increase in the growth of rice plants, yields of grains and straw, and the quantity of the nitrogen absorbed by the plants.

Azad and khan (1968) applied Endrin in a clay loam at rates of. 10, 25, 50, 100 and 200 ppm and found that the inhibition rates of denitrification of the added nitrate were 8, 32, 29, 45 and 42 %, respectively during the first week of incubation. The inhibitory effect continued but with a gradual increase in the denitrification rate reaching the value of the control treatments at the end of the second week.

Bollag and Nash (1970) found that the degree of inhibition of denitification of Phenylurea was dependent upon the number the of the halogen substituions on the aromatic ring. Bollag and Henninger (1976) found that the denitrification in soil was inhibited by 2,4-D. Bollag and kurek (1980) and Henninger *et al* (1976) observed denitrificatrion was suppressed by the insecticide N-serve (2-chloro-6-(Trichloro=methyl)-pyridin), N-formyl-4-chloro-O-toluidine and 4-chloro-O-toluidine while 2,5-dicholro aniline caused the accumulation of nitrite in the culture medium. Furthermore, aniline intermediates of other pesticides also inhibited the denitrificiation in soil, and were more effective than thier parent compound.

Moawad *et al.* (1979) also found that the mixture of urea and some insecitcides (Cotoran, Dursban, Zineb and Temik) inhibited the proliferation of denitrifying bacteria especially in early stages of the experimental period.

<u>The Relationship Between Soil Properties and Pesticides :-</u>

smith and wenzel (1947) and Bollen *et al.* (1954 b) reported that the effect of insecticides on soil depends on such factors like the physiochemical properties of the soil and its content of organic matter. In this respect, Harris and lichtenstein (1961), Cory (1965), Menn *et al.* (1960) and Whitney (1967) showed that the organophosphorus insecticides degraded rapidly in soil and the rate of degradation increased with the increase in soil moisture, temperature and acidity. Lichtenstein and Schulz (1964) also found the most persistent insecticide was the highest in dry soil compared to the moist soils.

Bartha *et al.* (1967) found that the supplementation of organic matter (glucose) reduced the toxicity of the pesticides by increasing the microbial degradation of pesticides in soil. Chandra (1967) also reported that the toxic effects of insecticides were the least in soils with high contents of organic matter and in clay with neutral pH value. Rahman and Matthews (1979) studied the effect of soil organic matter, on the initial and the residual phytotoxicity of thirteen S-Triazine herbicides. They found that the phytotoxicity of high water soluble compounds was less influenced by soil organic matter compared to those having low water solubility. On the other hand, Smelt *et al* (1979) reported that the rate of Oxamyl decomposition in the clay loam and humic loamy sand soils decreased in low soil moisture content while high decomposition of this insecticide was recorded under very dry soil conditions. Moawad *et al.* (1979) and Nowinska (1979) reported an advers correlation between the concentration of such insecticides like Polfos and Gardona and the properties of soil where the increase in the added pesticides correlated with the low content of the soil organic carbon. Also, Aly *et al.* (1980) found that carbaryl adsorption increased in the alluvial soil that contained high organic matter content..

The relationship between soil properties and the adsorption of pesticides to the soil materials was studied by many investigators. Hata and Akashi (1980) stated that clay minerals and organic matter contents were effective adsorbents to certain pesticides like Piperphos. The adsorption of Piperphos was correlated with CEC, phosphate adsorption coefficient and the hygroscopic water content, but not with the total clay content, carbon content and the soil pH value (Hata and Isozaki, 1980). The texture of soil was reported to be important factor for the adsorption of the pesticide Permthrin. The pesticide suppressed the biochemical activities because of its persistance in the organic soil Mathur *et al* (1980). Kim *and* Hong (1985) and De and Srivasteva (1985) assumed that the physical properties as well as the organic matter content affect on the adsorption of their experimental insecticide in soil

A- Effect of Pesticides on The biological activites of *Azotobacter* :-

a) the Relation between pesticides and growth:-

The effect of pesticides on the nitrogen fixers especially the azotobacters seems to be strain dependent. Mendoza (1975) noticed that Carbaryl (Sevin), Dimethoate

(Rogor) and Malathion reduced the growth of both species; *Azotobacter chroococcum* and *Rhizobium trifollii* at high concentrations of those pesticides. On the contrary, Peeters *et al.* (1975) recorded a stimulation of the growth of *Az. Vinelandii* in the presences of various insecticides and pesticides.

Balasubramanian and Nilakantan (1976) also reported a slight enhancement of the growth of both *Rhizobium japonicum* and *Az. chroococcum* at lower concentrations of Aldicarb. The insecticides, Sevin, Methomyl and Zineb also reduced on the growth of both *Az chroococcum* and *Az . vinelandii* (El-hoseiny *et al.*, 1985).

Narsale *et al* (1984) proved that the *Azotobacter* growth was normal in the presence of such insecticides as Agrosen GN, Thimet and Disyston. Ramadan *et al*. (1984) determined the effect of Lannate and Cyolane at different levels on *Az. chroococcum* grown in shake flasks. They found that Cyolane inhibited the bacterial growth rate during the first five days where as lannate had little or no effect during the first four days.

b- Effect of Pesticides on the Process of nitrogen Fixation :-

1- Stimulatory effect :-

Selim and El-Mokadim (1970) found that Dieldrin and lindane at normal or at 20 field rate had no effect on N_2-fixation capacity of soil bacteria.

Azad and Saleem (1976) found that in laboratory experiments either in soil or synthtic medium, Folidol at levels between 0.000025 and 0.05%, stimulated the nitrogen fixing capacity of the soil. The authors also reported that Metasystox at low rates also increased considerably the nitrogen fixing process. Sinha and Singh (1979) noticed that the treatment of soil with Inder impaired the nitrification and enhanced the ammonification processes

Visalakshi *et al.* (1979) applied Phorate granules to the soil at levels of 1,2 and 3 kg/ha and recorded an increase in the NH_4.N content by 8.84 , 40.25 and 40.87% respectively over the untreated soil. In this same experiment, the authors observed that No_2-N formation was not significantly affected by the insecticide. NH_3-N formation in the soil increased by 3.80, 5.25 and 11.58% respectively.

Jena and Rao (1987) and Tirol *et al* (1981) found that the addition of 10 μg Carbofuran per gram dried soil was not inhibitory to the mineralization of native soil nitrogen. Nitrifying activity increased with increasing the rate of Carbofuran (10, 20, 50 and 100 ppm) in flooded soil . In non-flooded soils the nitrogen-fixing capacity also increased in the presence of a mixture of bacterial and Carbofuran .

Inhibitory effect :-

Many other investigators recorded an inhibitory effect of certain pesticides upon application in soils Alexander (1969) and Helling *et al.* (1971) stated that the pesticides which inhibit nitrification can likely inhibit the mutualistic nitrogen fixation. lin *et al* (1972) reported no inhibitory effect of their experimental pesticides at lower rates on the nitrification process and at higher rates (500 ppm), deletrious effects on that process was recorded. In this respect Oblisami *et al* (1979); Jagnow *et al* (1981) studied the effect of Carbofuran and Thidiazuran on nitrogen fixation, ammonification and nitrification processes and recorded little adverse effect in soil treated with Thidiazuran. So, the treatment of the soil with 1,10 and 500 ppm Carbofuran a decrease in the ammoniacal nitrogen and an increased in the nitrate content of the soil observed.

Ishac *et al.* (1984); El-Hoseiny *et al* (1985) noticed an increase in the levels of NH_4 . N and N_3-N after 2-4 days incubation in *Az. chroococcum* cultures supplemented with the two insecticides Lannate and Cyolane. However, Sevin and Zineb deleteriously affected the main value of nitrogen fixation and Zineb was the most deleterious.

c- Effect of Pesticides on the Biosynthesis of vitamin C and indole-3-acetic acid :-

Balasubramanian and Nilakantan (1976) concluded that the insecticide Aldicarb at concentrations of 2 and 5 ppm. adversely affected the production of the growth regulator by both *Rhizobium japonicum* and *Az. chroococcum*. El-shanshoury and El-sayed (1988) found that Terbutryn at concentrations of 10,30 and 100μg/100 ml culture caused substantial increase in the biosynthesis of indole-3-acetic acid streptomycetes, fungi and azotobacters. Sengupta *et al.* (1988) studied the toxic effects of Carbaryl in the presence of gibberellic acid on some germinating seeds and found that the addition of the growth regulator overcame the growth inhibition caused by low concentrations of the pesticide Carbaryl. At concentrations of the pesticide, a deleterious effect on growth and the rates of different hydrolases was recorded. Shanimov and Isin (1977) found that Dimethoate increased vitamin C and sugar contents in apple. Sevin was generally determinal where as Chlorofos had no markd effect on these parameters. Holtkamp (1980) recorded no effect of Kerb 50 (Propyzamid) on vitamin C content in lettuce, since in field experiments, fluctuations of the vitamin content in the plant was noticed. Other valuable results in that respected were obtained in the study of Lacob *et al.* (1981) where they found that the pesticides (Phenthoate, Methidathion, Phosalane and Methomyl) stimulated the accumulation of ascorbic aicd and total acids in *Peach orchards.*

Degradation of the Insecticides :-

The application of the poisonous compounds called pesticides imparts the soil pollution. The spray of the plant or dry application add, by no mean, to the soil pollution. However, the continous addition of the pesticides of the soil, do not cause the accumulation of these compounds to the level of dangerous. This may be due either to their reactions with some soil compounds or to the biodegradation by soil microorganisms. The compounds which result from the biodegradation may either be more toxic than the orginal compound or completely not toxic.

a- Biodegradation by Living Cells :-

Ahmed and Casida (1958); Lichtenstein and Schulz (1964) studied the metabolism of thimet, Ammonium cyanamid by some soil microorganisms, like bacteria, yeast and green algea isolated from soil and grown in pure cultures. The organophosphates were rapidly absorbed by the organisms and then slowly released from the living and dead cells in the culture .Naumann (1959) stated that Parathion was rapidly decomposed by bacteria in soil.

Yasuno *et al* (1966) reported that the living cells of *B. subtilis* was found to be higly effective in inactivating Fenitrothion, Parathion and Methylparathion in culture media. The decomposition of the pesticides did not take palce by cell free filterates. Gunner and Zuckerman (1968) reported a joint action of two different microorganisms in active biodegradation of a pesticide which had not been degraded with only one organism. On the other hand, Anderson and lichtenstein (1972) found that the pure cultures of *Mucor alternous* could degrade DDT to water soluble metabolites, but adding other fungi to the mucor culture repressed the metabolism of DDT. Sethunathan and Yoshida (1973) and Siddaramappa *et al.* (1973) stated that some organophosphorus pesticides such as Tarathion may be hydrolysed under anaerobic conditions (submerged rice soils) by microbes to p-nitrophenol and inorganic phosphate or, in the presence of carbohydrates was reduced to p-amino parathion. Haider and Jagnow (1975) found that Hexachlorocyclohexan (γ-BHC and lindane) is less persistent than DDT and is very slowly degraded by microorganisms especially under anaerobic conditions. Maslennikova *et al* (1979) found that the microbial degradation of the herbicide Izofos-3 only took place in the presence of glucose and reached 61-67% after 14 days. *Pencillium* sp. was the most active among 12 strains tested, in decomposing 90% of the herbicide in 3 days. Certain species of actinomycetes and bacteria were also effective in biodegrading the aforementioned herbicide.

b- Biodegradation of Pesticides in Cell-Free Extract Cultures :-

kaufman and kearney (1965) extracted enzyme preparations from cultures of Pseudomonas sp. which hydrolysed the ester linkage of phenyl carbamates giving the alcohol moiety and the parent aniline. Heritage and Macrae (1977) found that the cell-free preparation of *C. sphenoides* degraded the insecticide Lindane (the gamma isomer of 1,2, 3,4 5,6-hexachloro-cyclohexane) to the gamma-isomer of 3,4, 5,6 tetra-chloro-1-cyclohexane.

Forrest et al (1981) isolated a *Flavobacterium* sp. which was able to degrade Diazinon in pure culture. Washed cells of peptone grown *Flavobacterium* quickly hydrolysed Diazinon, Parathion and Chloropyriphos. They concluded that enzyme (s) hydrolysing those organophosphorus esters were constitutive and not inducing enzyme (s). Barik and Munnecke (1982) studied Diazinon hydrolyses in sandy soil and identified an enzyme called Parathion hydrolase present in cell-free culture of a *Pseudomonas* sp.. Within 24 hours, insignificant amounts of the pesticide remained in soil and 98% of the formulated Diazinon was hydrolyzed in soil by the action of cell-free proparations.

c- Degradation and Persistence of Pesticides in soil :-

The chlorinated aliphatic acid herbicides like Dalapon and Trichloroacetic acid were degraded rapidly in soil and the used doses did not represent any residue problems. The persistence Trithion increased signifacntly in autoclaved soils or soils fumigated with Vapam. The degradation of Parathion depended on the of soil microorganisms, in autoclaved or dry soil with low microbial numbers, Parathion persisted for a relatively longer period of time. Soil microorganisms, especially yeasts were proved to be responsible for the reduction of Parathion into the inactive compound Aminoparathion. Bacteria played no role in that reduction. They found also, that Parathion at the rate of 20 ppm was found also to be hydrolyzed within 12 hours after its application in loam soil. Aminoparathion and β-nitrophenol added to soils disappeared within 2 and 16 days, respectively (Jensen, 1957; Menn *et al.*, 1980 and Lichtenstein and Schulz , 1964).

Bartha *et al.* (1967) reported that a few compounds were stable but without significant effect in soil (e.g chlorinated hydrocarbons).

In soil Diazinon was degraded to 2-isopropyl-6-methyl-4-hydroxy pyrimidine phosphoric acid and ethanol. Although the rate of hydrolysis was greater in soil than in soil-free systems. Diazinon was shown to be equally stable in presence or absence of microorganisms at pH6 . In sunbmerged soils, the micorflora may assist in the hydrolysis of Diazinon (konard et al., 1967; Sethunathan and Macrae, 1969; Sethunathan and Yoshida, 1969).

The role of microorganism in the initial degradation of organophosphates is not clear. In vitro, certain soil organisms could readily hydrolyze many of the organophosphates compounds. Degradation in soil, however,may be catalyzed by some other factors and may occur at a degradations rates up to 11% per day in the case of Diazinon (Kearney *et al.*, 1969).

Tucker and Pack (1972) studied the two insecticides (3 to 1 mixture of m, 1-methyl butyl phenyl methyl Carbamate) and m. (1-ethyl propyl)- phenyl methyl carbamate) and found that they were readily metabolized by soil organisms. The metabolites were not persistent in soil but were degraded at about the same rate as the parent carbamate (50% loss in 1 to 2 weeks).

Kaufman and Blake (1973) found that Diazinon inhibited the metabolism of chloropropham by *Pseudomonas striata* and *Achromobacter* sp., and increasing the persistence of chloroprophamin soil under green house conditions. Venkateswarlu and Sethunathan (1978) noticed that the presence of Carbofuran, in rice soils, has also led to increasing the microorganisms capable of degrading it and hence to the loss of effectiveness of the insecticide. Ohisa and Yamaguchi (1980) found that at atmospheric pressure and soil had an inhibitory effect on the decomposing ability of BHC by *Clostridium rectum*. The inhibition was reduced by adding of the clay mineral bentonite to the culture, and by the presence of other soil microorganisms. In flooded soil, *Clostridium* spp. were apparently the most widespread BHC decomposers.

Rajagopal *et al* (1986) recorded the disappearance of the insecticide Carbaryl more rapidly from soil pretreated with 1-naphthol than from the soil free from that chemical. Endosulphan isomers were noticed to be degraded by soil microorganisms to a much greater extent than such insecticides like Pyrolan, Dieldrin and γ-HCH. α-Endosulphan which were broken down by both bacteria and fungi, wheras β-Endosulphan was degraded mostly by bacteria and Dieldrin was utilized by fungi (El-Beit *et al.* 1981).

Polyakova *et al.* (1984) stated that Methoxychlor insecticide remained in soil for along time or was only parlty dechlorinated. Six of the cultures isolated from soil were capable of degrading Methoxychlor. Five Cultures beloning to genus *Bacillus* and one to genus *Pesudomonas* could degrade almost all the supplemented amount of Carbaryl after 20 days of application (Jhala *et al*, 1988).

MATERIAL AND METHODS