CHAPTER - II

REVIEW OF LITERATURE

Use of pesticides is indispensable in modern agriculture in order to increase crop productivity. However improper, excessive and careless use of pesticides have not only threatened survival of many organisms and human health but also have affected crop plants (Singh,1998). A number of pesticides have been reported to stimulate plant growth and development (Soni et al.2006 ; Gupta et al. 1998) .

A. Seed Germination and Seedling Growth :

Kumar and Singh (1986) observed that fungicides can check seed borne fungi in Sesame and also improve germination. Seed treatment with thirum followed by bavistin was found effective in increasing germination percentage and vigour in soybean (Pardeshi et al.1989). Kamble and Sabale (1999) reported that carbendazim seed treatment caused beneficial effect on seed germination and seedling growth in *Trigonella foenum graecum* L. Narasimhudu and Balsubramanian (2001) observed significant superior effect of fungicides on growth and vigour of Turmeric. Patil (2005) studied effect of presowing seed treatment on growth and performance of some crop plants. Their study revealed that in cowpea shoot and root development was positively influenced at all concentrations of carbendazim. In fenugreek and cluster beans, fungicides caused marked reduction in seedling growth. No pronounced effect of carbadazim on seedling growth of wheat was observed. Neelamegram and Sreelaja (2006) reported that Bavistin -WP has no significant effect on seed germination of *Phaseolus mungo.*

Negative effect of fungicides were also reported on germination and growth. Krishnamurthy and Rao (1980) reported retarding effect of antrakol and kitazin on percent germination of *Brassica nigra.* Reddy and Vidyavati (1983) observed gradual decrease in seed germination percentage of *Dolichos biflorus* L. with increasing concentration of kitazin. Somashaker and Rao (1984) reported that increasing concentration and duration of zineb treatment caused decrease in seed germination of *Raphanus sativis.* Fungicide Mancozeb 75% reduced both seed germination and coleoptile length in the case of wheat and Barley (kollmorgan & Ballinger 2003).

In studies with insecticides also both positive & negative effects are reported. Gupta and Yadav (1985) observed increased germination in BHC treated *Arachis hypogea* and *Vigna aconitifolia.* Sabale and Misal (1993) obtained a slight stimulation in germination percentage at lower concentration of endosulfan and methyl parathion in Jowar. Utpalnath

and Jayapragasam (1993) studied effect of different pesticides on germination of Rice IR-50. Their study revealed that carbofuran promoted seed germination and seedling growth ,synthetic pyrethroid sumicidin promoted germination at lower dose but decreased it at higher concentrations, Organophosphate nuvan reduced germination. Saraswathi et al.(1996) observed stimulation in germination of soybean with certain concentrations of furdan and phorate. Patil (1997) observed stimulatory effect of lower concentrations of monocrotophos and monocrotophos in combination with bavistin on germination percent of soybean while higher concentrations are inhibitory. Gupta et al. (1998) noticed phytotonic effect in imidacloprid treated plots of cotton.

Insecticides such as rogor, DDT, BHC, monocrotophos, phosphomidon and methyl parathion are known to reduce percent germination in clustard beans, *Cyamposis tetragonoloba* L., *Allium cepa* L., *Vigna mungo*, *Pisum sativum* and mustard (Benjamini, 1986 ; Ramulu and Rao,1987 ; Mitra and Raghu,1989 ; Patil and Shirshyad 1989 ;Verma et al.1994). Gupta et al. (1983) reported inhibitory effect of endosulfan on seed germination and seedling growth of *Vigna radiata* Linn. Logiswaran and Gopalan (1991) reported that endosulfan treatment did not affect seed germination in black gram. Singh and Agarwal (1991) observed a reduction in germination percentage in *Linum usitatissiulmum* L. and *Brassica campestris* L. with BHC. Sumicidin caused deleterious effect on seed germination of soybean (Saraswathi et al.1996). Singh et al. (1997) observed reduction in germination percentage with increase in concentration of aldrin in mustard species. N. K. Singh (1998) studied effect of organophosphates viz. Dimethoate and phorate on germination of wheat and rice. Their study revealed that both insecticides were more inhibitory to the germination of wheat than rice. Khan et al. (2000) observed the inhibitory effect of endosulfan on germination and growth of fenugreek. Higher concentrations of nuvacron exhibited an adverse effect on germination of *Trigonella foenum - graecum* L.(Kamble and Sabale 2001).

Vyas et al. (1985) obtained an increased nodule count with thirum and brassicol. Chakravarty et al. (1985) reported reduction in nodule number with bavistin, brassicol and vitavax. The effect of Bavistin seed treatment on nodulation was studied by Anusuya (1986), and reported significant reduction in nodule number.

Insecticides phorate and carbofuran in general influenced number of nodules in cowpea. (Kumar and Visalakshi,1983). The adverse effect on nodulation in *Pisum sativum*

with phorate was observed (Reddy et al.1986).

B. Effect of pesticides on photosynthetic pigments :

Effect of seed treatment with fungicides on photosynthetic pigments has been studied in different plants. Singh and Kang (1983) reported increased chlorophyll content in Groundnut leaves treated with oxithiins and benzimidazole fungicides. The carotene content was increased in iprodione treated lettuce plants (Rouchand et al. 1985). Paclobutrazol treated soybean plants exhibited higher chlorophyll content (Sankhla et al.1990). Sugavanam (1992) revealed that treatment of seeds with Mancozeb increased chlorophyll content in bengal gram, while higher concentrations reduced it. Carbendazim, Mancozeb and Triforine sprays were found to increase chlorophyll content in mustard leaves (Kotasthane 1994). Lower concentrations of bavistin increased total chlorophylls in leaves of *Quercus serrata* (Ghosh and Srivastava 1994). Dhopte et al. (1995) observed that paclobutrazole spray slightly stimulated chlorophyll in peanut. Hexaconazole treatment has also been reported to stimulate chlorophyll content in bottleguard (Singh and Thakore 1996). Foliar applications of metalaxyl stimulated chlorophyll synthesis in tomato and cucurbits (Bansal et al. 1982 ; Chakravarty and Thakore 1997).The foliage of triazole treated plants typically exhibits intense dark green colour (Fletcher et al. 2000). In rice, carbendazim foliar sprays did not produce any significant effect on chlorophyll content (Bhattacharya et al.2001).Lower concentrations of carbendazim were found to reduce the amount of chlorophylls while higher concentrations reduced it (Kamble and Sabale 2002). Systematic fungicides viz. iprobenphos, carbendazim , thiophanate methyl and triadimefon when sprayed on chilli crop increased the chlorophyll content (Sharma and Thakore 2004). Similar results were reported by various workers (Gautam et al. 1984 ; Karadge and Karne 1986) when triadimefon applied to soybean and carbendazim and hexaconazole applied to tomato plants. Chlorophyll content was found to be increased with respect to control grown plants treated with different concentrations of triazoles (Soni et al. 2006). Thomas et al. (1995) observed reduction in chlorophylls and carotenoids in cucumber with the treatment of thirum, benomyl and triazole.

Sukul and Handa (1989) reported stimulation in chlorophyll biosynthesis with deltamethrin, cypermethrin and permethrin. Ramulu and Rao (1987) noticed that lower concentrations of monocrotophos stimulated chlorophyll biosynthesis but high concentration

affected pigment content. Kulkarni et al.(1989) reported stimulation in chlorophyll content with the foliar application of metacid - 50 and dimecron. Patil (1997) studied effect of organophosphorous pesticides on Nitrogen fixing ability of soybean. They reported that lower concentration of monocrotophos stimulate chlorophyll and carotenoid synthesis while higher concentration was inhibitory. All concentrations of monocrotophos in combination with bavistin showed drastic reduction at all concentrations. Kumar and Khan (1982) reported that foliar application of metasystox and rogor reduced chlorophylls in ragi. Treatment with monocrotophos to tea seedlings showed a decrease in chlorophyll and carotenoid content (Upadhyaya and Panda 2004).

C. Effect of pesticides on organic constituents:

Little work has been carried out on physiological effect of various pesticides on crops. Oxithiins and benzimidazole treatment increased total sugars in groundnut (Singh and Kang 1983). Similar results were observed by systemic fungicides on carbohydrate in crops like *Capsicum annum, Vigna radiata, Solanum melanogena* and *Pennisetum americanum* (Ahmed and Siddiqui 1995 ; Siddiqui et al. 1997 ; Siddiqui and Khan 2001.Chandra and Mathur (1985) noticed that carbendazim seed treatment did not affect reducing sugar content in *Vigna mungo*. Onion seeds treated with benalate or bavistin accumulated more sugars during vegetative growth (Mohamad et al. 1988). Mancozeb treatment increased soluble sugars at lower concentration in bengalgram (Sugavanum 1992).Ghosh & Srivatsava (1994) have reported the enhancement in the level of total sugars with carbendazim treatment in *Quercus serrata*. Foliar sprays of carbendazim increased total sugars and starch content in onion (Kalebere and Sabale 2000). Sharma & Thakore (2004) observed increase in sugar content in chilli with the application of systematic fungicide. The systemic fungicides increased sugar content in soybean, peanut, onion and brinjal(Singh and Kang 1983 ; Gautam et al. 1984 ; Marshall et al.1991; Siddiqui, 1997; Mohmed et al.1988). Rogor markedly increased reducing sugar in cotyledons of *Vigna mungo* (Mathur et al.1982). Metasystox considerably decreased reducing sugar in *Vigna mungo* L. Hepper (Prasad and Mathur 1983). Santhguru et al. (1990) reported reduction in soluble sugars in *Cyamposis tetragonoloba* TAUB with increasing concentration of rogor. Malathion treatment decreased reducing sugars in cotyledons and leaves of *Vigna mungo* and mustard species (Chandra and

Mathur 1985). Sundararaj et al. (1993) studied effect of insecticides viz. cypermethrin, monocrotophos,combination of cypermethrin and chlorpyriphos (1:10) on biochemical parameters of cotton and reported that insecticides did not significantly influence reducing sugar, nonreducing sugar and total sugars. Paul et al. (1995) reported reduction in fructose and glucose content in tobacco leaves with increased concentration of monocil. Saraswathi et al. (1996) reported that reducing sugar content of the soybean seedlings was reduced when treated with furdan.

Beaumont et al. (1979) and Moly (1986) reported increase in protein content in response to atrazine and benzimidazole and dithiocarbamate fungicides in *Lemna minor* L. and groundnut respectively. Singh and Kang (1983) reported increased production of protein in groundnut plants treated with oxithiins and benzimidazole. Surichandraselven (1991) observed that in chilli, total protein content is not affected by systemic fungicides. Dominick and Mohanasundharam (1992) reported that insecticide decamethrin spray increased the level of total soluble proteins in cotton leaves. Seed treatment of Mancozeb increased protein content in bengal gram (Sugavanam 1992).Ghosh and Srivastava (1994) reported that bavistin caused stimulatory effect on increase in soluble proteins in *Quercus serrata*. Sabale and Kamble (1995) observed increase in protein content in *Trigonella* treated with bavistin and monocrotophos. Increase in protein content was observed in crops like *Capsicum annum, Vigna radiata, Solanum melanogena* and *Pennisetum americanum* treated with systemic fungicides (Ahmed and Siddiqui 1995 ; Siddiqui et al. 1997 ; Siddiqui and Khan 2001). Kalebere and Sabale (2000) reported that foliar sprays of carbendazim positively influenced protein content in onion. Pratibha and Gupta (2006) studied effect of fungicides viz. dithane, ridomil, and insecticide viz. endosulfan on maize plants and observed that total soluble proteins increased in response to all the three pesticides used.

Deltamethrin, cypermethrin and permethrin did not cause any adverse effect on the protein content of chickpea (Sukul and Handa 1989). Santhaguru et al. (1990) reported decline in protein content in *Cyamposis tetragonoloba* in response to rogor. Sahoo and Das (1992) reported accumulation of proteins in Rice cultivars after the treatment of phorate 10 - G and stomp 30 EC. Sundararaj et al. (1993) reported that insecticides did not significantly influence protein content of cotton plant. Bayleton declined the protein accumulation in in vivo grown *Vigna unguiculata* (Singh 1994). Patil (1997) reported that lower concentration

of monocrotophos treatment increased protein content while higher concentration was inhibitory. They also reported that in soybean increasing concentrations of monocrotophos in combination with bavistin caused reduction in protein content. Soni et al. (2006) reported declined soluble protein accumulation at all three growth stages in in-vivo grown sesame plants treated by bayleton and paclobutrazol.

Reilly and Klarmann (1972) reported that fungicides like maneb, nabam and benomyl induce production of phytoalexin hydroxyphaseollin in soybeans. Singh and Kang (1983) reported increased phenolic content in groundnut plants treated with bayleton and paclobutrazol. Karadge and Karne (1985) reported increase in polyphenols in leaves of *Lycopersicum esculentum* Mill. leaves treated with bavistin and calixin. Kamble and Sabale (1995) reported that polyphenol content increased with the increase in bavistin concentration while did not exhibit much change with response to monocrotophos. Sharma and Thakore (2004) observed an increase in phenol with the application of systemic fungicides as compared to untreated plants. These findings are in agreement to those of earlier workers. They reported increase of polyphenol content in peanut, onion, soybean, groundnut and *Solanum melanogena* treated with systemic fungicides like diniconazole, topsin -M and triadimefon (Gautam et al. 1984 ; Mohmad et al.1988 ; Marshall et al.1991; Ahmed and Siddiqui 1995 ; Siddiqui et al.1997 ; Siddiqui and Khan 2001).

An accumulation of total polyphenols was observed in blackgram with methyl parathion treatment (Thirumaran and Xavier,1987). Kulkarni et al. (1989) observed that methyl parathion and phosphamidon used for spray on tomato, okra and gaur favoured polyphenol synthesis. Patil (1995) reported that monocrotophos at below recommended dose stimulate polyphenol level but inhibit at higher concentration.

D. Effect of pesticides on enzyme activities :

Lower concentration of pesticides have been reported to promote growth of plants which may be related to an increased level of biochemical activities in the plant tissue. Amongst the enzymes, acid phosphatase , nitrate reductase and peroxidase enzyme are investigated in many studies with respect to the effect of pesticides.

Tripathi et al. (1982) reported that fungicide carbendazim inhibits the activity of protease in wheat. Karadge and Karne (1985) reported stimulation in the activity of enzyme

peroxidase in tomato leaves treated with bavistin and calixin. In canola leaves triazoles promoted the activity of Nitrate Reductase (Srivastava and Fletcher 1992). Ghosh and Srivastava (1994) observed increase in Nitrate Reductase activity in *Quercus serrata* with increase in concentration of bavistin upto certain level. Sabale and Kamble (1995) reported that fungicide Bavistin stimulated activities of amylase , acid phosphatase, peroxidase and Nitrate Reductase, but protease activity was inhibited, while the treatment of monocrotophos supressed the activities of all the enzymes studied except Nitrate Reductase in *Trigonella.* Patil and Sabale (2005) studied effect of fungicides on the growth and performance of some crop plants and observed that acid phosphatase activity was decreased in cowpea, fenugreek and wheat, while lower dose enhanced acid phosphatase activity and higher dose enhanced it in cluster bean and rice. They have also observed that peroxidase activity was decreased with increase in concentration in fenugreek, rice and wheat. Triazoles enhanced the NR activity in in vivo grown sesame plants (Soni et al.2006).

Reddy and Vidyavati (1983) have reported an increase in catalase and protease activity in *Dolichos biflorus* by kitazin seed treatment. Sengupta et al. (1986) observed significant inhibition in protease activity in wheat and *Vigna sinesis* treated with carbaryl, malathion and BHC. Pathak and Mukherji (1986) and Asirselin et al. (1998) reported higher activity of protease enzyme in *Vigna radiata* L. Wilzek and *Arachis hypogea* seedlings treated with sevin and bavistin respectively. Santhguru et al. (1990) noticed increase in amylase activity at all the stages of *Cyamposis tetragonoloba* treated with lower concentration of rogor. Soam (1990) reported reduced acid phosphatase activity in gram after the treatment of dimethoate. Higher concentration of BHC decreased amylase activity in *Linum usitatissimum* and *Brassica juncea* (Singh and Agarwal 1991). Saraswathi et al. (1996) reported decrease in amylase activity in soybean at higher concentrations of furdan. They also reported that sumicidin also at lowest concentration affected the activities of amylase and lipase in soybean seeds. Sharma et al. (1997) noticed decline in amylase and protease activity in seedlings of linseed and mustard species treated with aldrin. Similar results were reported by Singh and Agarwal (1991) on protease activity in BHC treated *Linum usitatissimum* and *Brassica juncea.* Sabale and Misal (2000) noticed that lower dose of endosulfan stimulated alpha amylase, protease and acid phosphatase activity, while methyl parathion suppressed activities of these enzymes in Jowar.

E. Effect of pesticides on Inorganic constituents :

An increase in nutrients has been reported by application of fungicides in plants. Godara and Thakore (1987) observed an increased Mg, Ca and P content with tridimefon and tridimenol spray in groundnut. Rozeck and Wojciechowska (1988) found that foliar sprays of benomyl and captan increased Ca content in dwarf bean. Sharma and Thakore (2004) observed an increased P content with systemic fungicides viz. iprobenphos, carbendazim, thiophanate methyl and triadimefon spray in chilli. Singh and Thakore (1996) reported an increased content of P in chilli and bottleguard with triazole and benzimidazole fungicides. Gautam and Thapliyal (1981) reported increased P content in bayleton and bayton treated soybean. Kotasthane (1994) studied effect of fungicides mancozeb, zineb, carbendazim and triforine on mustard and observed increased Mn content with mancozeb and zineb, increased Zn and Fe content with zineb and carbendazim treatment and P accumulation with Mancozeb, zineb and triforine.

Gupta and Beg (1987) observed increase in Mn, Zn, Cu and Ca content in mungbean treated with endosulfan treatment. Insecticides DDT, dinosab, trifluraline, orazalin, dichlorofopmethyl and dichlorfluanid inhibited Ca uptake in oilseed plants (Mitra et al. 1991; Hertel et al. 1983). Lower concentrations of benomyl, captan, endosulfan, monocrotophos enhanced Fe, Mg, Mn and Cu content while higher concentration decreased it in dwarf beans, fenugreek and mungbean (Rozeck and Woiciechowska, 1988 ; Khan et al. 2000 ; Kamble and Sabale, 2002). Sahoo and Das (1992) observed increased content of Mn, Zn, Cu and Fe level in rice varieties treated with stomp-30 EC and phorate G.