31

I REVIEW OF LITERATURE

Soybean has emerged as one of the prominent rainy season cash crop in central India and 3rd important oilseed crop in the country; it's cultivation is leaping down southwards in the States of Maharashtra, Karnataka and Tamil Nadu, as well as in the eastern States apart from the parts of Uttar Pradesh and Rajasthan adjoining to Madhya Pradesh. With approximately 75% share in national area and production of soybean, Madhya Pradesh has distinguished herself as "Soya-state". Growth rate in area and production of soybean in India has been spectacular. The future years are likely to exhibit increase in soybean area stabilizing it at some where around 6.00 million hectares.

Soybean cultivation is being preferred by the farmers due to low input requirement of labour and nitrogenous fertilizers and wider adaptability to climate as well as soil and comparative tolerance to draught and excessive moisture. Over and above, instant market at remunerative price has played prominent role in rapid spread of soybean in the country.

Ability to fix atmospheric nitrogen enables this crop not only to meet its requirement for nitrogen but also to leave 32 to 60 kg/ha residual nitrogen for succeeding crop. Although, soybean is largely cultivated as rainfed crop it has vast production potential under irrigated agriculture. Ever since the soybean cultivation attained the commercial status in India, it has been instrumental in improving rural economy and has shown potential to occupy a special place in cropping patterns in regions of its cultivation. Presently soybean crop is being cultivated continuously year after year, the principles of sustainable agriculture suggest rotation of this crop with other non-legumes to optimise yield with reduced risk of yield loss due to weeds, insect pests etc. and adequate use of land resources.

At present this noble crop suffering a lot by insect pest attack, fungal diseases, bacterial diseases and viral diseases and ultimately leading to severe loss in crop production. Consequently, new approaches to major problems are being pursued. The development and use of resistant varieties is crucial for the production of soybeans against nematodes, bacteria, viruses and plant pathogens and molecular biology offers new opportunities in this area.

Most of the workers are engaged to tackle the problems associated with soybean.

A. Pest Management :

Pest management in soybean has largely studied and the work carried out else where in the world has been compiled and edited by Copping et al (1992).

The pest management in soybean is mainly confined to preventive and therapeutic tacties in insect management (Padigo, 1992), fungal disease management (Yorinori 1992; Morton, 1992), chemical and biological control (Backman and Jacobsen, 1992), use of cultural techniques and genetic resistance (Weaver and Kabana, 1992), Weed management (Mitidieri, 1992; Pitelli, 1992; Naguchi, 1992) and herbicide resistant weeds of soybean (Shaner, 1992). The biopesticides prepared by using baculoviruses have also been tried in pest management programme of soybean (Funderburk et al.. 1992) and much of the work has also been concentrated on nematode control in soybean (Riggs, 1992; Young, 1992 and Kinloch, 1992).

B. Seed germination and seedling vigour

Kawale et al (1989) have studied effect of fungicide, insecticide and weedicide on seedling emergence and yield of soybean. Their study revealed that all the pesticide treatments help in increasing seedling emergence to 90-98% as compared with 70% for no treatment. Increase in the rate of seedling emergence and the length of hypocotyl in benoram treated seeds of soybean has been reported by Chung and Ju (1993). The triacontanol promoted seed germination has also been observed in cowpea and soybean (Janardhanan, 1992). Effect of different fungicides on seedling vigour and seed viability in soybean was studied by Pardeshi et al (1989). They reported that seed of soybean treated with recommended dose of mancozeb, thiram, vitavax captan, difolaton resulted into increase in germination percentage while thiram, difolaton were most effective. Root and shoot length, vigour index and seedling fresh weight increased most effectively after application of captan. Similarly no significant adverse effect either on seed germination or on the nodulation due to fungicide treatment was reported by Sundaresh and Hiremath (1993) in soybean. From this, it is quite evident that seed treatment with fungicide can give high germination good and more grain yield in soybean.

C. Enzymes of Nitrogen Metabolism

Many workers have studied the enzymes of nitrogen metabolism in soybean plant (Santoro and Magalhaes 1983, Douglas et al 1978, Akao 1991). Similarly effect of herbicide on nodulation and nitrogen fixation has been studied by Ozair, Moshier 1988, Yoshida 1990, Ohj 1989, Redzepovic et al 1991, Dalton 1992, Voli et al 1988, Hebetz and Regan 1989).

D. Photosynthesis

Camhffri et al 1987 studied effect of herbicide on ps I and chloroplast isolated from soybean and reported inhibitory action on electron transport. Abdel et al 1991, reported reduction in photosynthetic rate when soybean plants were sprayed with 25% malthion upto 7 days after treatment but no effect was observed 90 days after treatment. Reduction in chlorophyll, carotenoides and protein content was found affected due to seven weeks after herbicide treatment in soybean. Similar reports have also been made by Soskic et al 1991, Wang and Yi (1991), Li and Gupta (1993) studied photosynthetic changes in soybean with and without nitrogen and increased CO_2 concentration. The study revealed that the increase in CO_2 levels with or without nitrogen had no impact on rate of photosynthesis. Chlorophyll content was increased by 28% on exposure to 450 µl CO_2/litre in absence of nitrogen. Ratio of ch-a/ch-b was higher in plants treated with nitrogen. The total biomass increased by 18% in presence of 450 µl CO_2/litre, the root:shoot ratio increased significantly on the addition of nitrogen.

E. Minerals

Plant nutrition is by and large concerned with the provision of plants with nutrients as well as nutrients uptake and their distribution in plant. The essential nutrients required by higher plants are exclusively of inorganic nature. The supply and absorption of these inorganic constituents is needed for growth and metabolism. Soybean being a cash crop most of the workers have concentrated their efforts in studying effect of mineral nutrient on growth and metabolism.

Suo and Wu (1988) studied the effect of foliar application of phosphate on soybean leaf surface at the time flowering and podding period and reported 10% increase in the yield. Similarly phosphorus nutrition influences starch and sucrose accumulation and activates the enzymes ADP-glucose, pyrophosphorylase and sucrose-phosphate synthatase during grain filling period in soybean (Crafts-Brandner, 1992). He also noticed acceleration of leaf senescence during phosphorus deficiency and delay in the rate of leaf senescence when the plants have supraoptimum phosphorus level. Effect of nitrogen and phosphorous on grain yield and quality of soybean studied by Turkhede et al (1991). According to them seed yield, protein and oil concentration were found increased. nitrogen appliction increased seed protein percentage but did not affect seed oil percentage while phosphorus application had no clear effect on seed protein or oil percentage. Narayanan et al. (1993) reported that iron deficiency in soybean causes initial inter veinal chlorosis of young leaves. Similar results have been observed with potash deficiency in soybean by Ismunadji and Manshuri (1989). Higher concentration of potassium in soil and leaves lowers disease incidence in soybean (Ito et al. 1994). According to Srivastava et al. (1991) interactions of NxP, NxK and PxK had a significant effect on lowering disease intensity (Myrothecium leaf spot) but that of NxPxK was nonsignificant in soybean.

Effect of Mo, W and Cr on nitrogen fixation of soybean nodules and activity of nitrate reductase has also been studied by Deng (1990). Kandpal and Chandel (1993) have also studied the effect of gypsum pyrite as sources of sulphur on nitrogen fixation, dry matter yield and quality of soybean. The effect of Mo, B, rare earth element and mult effect triazoles (MET) on bontanical characters and yield of spring soybean has been studied by a group of workers (Ye et al. 1991). Physiological role of Boron in soybean (Schon, 1990) revealed that it increases yield by increasing pod on branches and seed weight per plant. According to Khan (1988) Zn in soybean was either free or associate with very low MW proteins, peptides or their complexes with phytic acid and Mn concentration (Romera and Gomez 1991) generally greatest in roots and least in stem.

CO_2 -saturated photosynthesis as affected by phosphate stress in soybean, maize, grain sorghum and cotton has been studied by Pfthgrfw et al. (1990). Their study reveals that the soybean and cotton control plants had 13.2 and 13.4% PN values respectively than their P-stressed counter parts; maize and sorghum did not give stastically significant results. When soybean and maize PN were integrated over the measurement period the P-stressed plants had 11.7 and 9.8% lower weighted average PN values respectively than the control. On the basis of this they concluded that P-stress can limit PN when CO_2 and irradiance or saturating possibly due to disruption of the leaf sugar partitioning and transport. Deactivation of ribulose1,5- bisphosphate carboxylase due to decrease in the level of inorganic phosphate in the leaves of soybean has also reported by Swada et al. (1992). Photosynthetic changes in soybean with and without nitrogen and increased CO_2 concentration studied by LI and Gupta (1993) and reported that the increase in CO_2 levels with or without nitrogen had no impact on net photosynthetic rate.

F. Stomatal Regulation

Many workers have studied stomatal transpiration and conductivity in soybean. Lee et al. (1990) studied effect of photo-synthetically active radiation and leaf water potential on stomatal deffusive resistance under field conditions. Under draught condition stomatal diffusive resistance of upper canopy leaves increasec with leaf water potential below -10 bar. Similar observation was also made by Rosa et al. (1991). Adaxial stomatal response to water potential tends to be more pronounced than that of abaxial stomata. Under well watered conditions total stomatal deffusive resistance was related to photosynthetic active radiation. High soil hydraulic conductivity caused higher transpiration rate in soybeans than low soil hydraulic conductivity (Tanaka 1990). Stoinova et al. (1991) studied effect of fusicoccin on photosynthesis, transpiration and stomatal state of soybean leaves. According to them stomata remain more open in the morning and closely shut at mid-day in fusicoccin treated plant than that of control plants. According to Djekoun and Planchon (1992) although maintenance of stomatal opening during water stress appeared to be favourable to photosynthetic activity, the accompanying soil water depletion limits nitrogen fixation by descreasing nodule water content.

G. Insect and Disease Resistance

Eldon and Kenworthy (1995) studied physiological responses of an insect resistant soybean line to light and nutrient stress. Structural analysis of antioxidative peptides from soybean have been made by Chen et al. (1995). The work on resistance of hard seeded soybean lines to seed infection by Phomopsis, other fungi and soybean mosaic virus is in progress

(Roy et al. 1994). In order to develop defence mechanism against pathogen Gianfagna and Lawton (1995) actively engaged in studying specific activation of soybean defence genes by the phosphoprotein phosphatase inhibitor. Few workers are also engaged in studyijg enzymes of the phenyl propanoid pathway in soybean infected with nematode and fungal pathogen (Eldens et al. 1995). Efficacy of heavy metal salts such as $CdCl_2$ (10^{-4} M) in induction of disease resistance and alteration of specific antigen in soybean leaves has been studied by Purkaystha and Ghosh (1992).

The work on analysis of peroxidase and esterase isoenzymes (Chen et al. 1993), the correlation of contents of flavonoid, total phenolate and enzymes in soybean with resistant level to insect (Zhuang et al. 1992), rapid accumulation of anionic peroxidases and phenolic polymers following treatment with Phyrophthora megasperma (Graham and Graham 1991), phytoalexin defense response (Ebel et al, 1990), differential expression of phenylalanine ammonia-lyase during nodule development (Estabrook and Sen Gupta 1991), effect of oxygen and malate on NO_3^- inhibition of nitrogenase (Heckmann et al. 1989) in nodules and distribution of superoxide dismutase (Zhuang et al. 1988) in soybean leaves is in progress.

H. Scope of Present Investigation

The problem of plant protection has become particularly important in recent years because of the threat to human health and environment through the large scale use of pesticides (Fiinnlayson and Mc Carthy, 1973). However, now-a-days, nonselective and liberal use of these chemicals is becoming problematic with respect to the health of human beings and animals. Methyl parathion an organophosphorus pesticide is widely used as an insecticide as a foliar spray whose residual effect is known to remain in the environment for long time (Sharma and Chopra 1970, Deshpande and Swamy 1987). Moreover most of the pesticides have been shown to cause toxic effects on plant in various ways (Prasad and Mathur, 1983, Karadge and Karne 1985, Deshpande and Swamy 1987).

Pesticides also play a very important role in protecting vegetables, fruits and food grains right from the seed stage through germination to growth and then storing (Mann 1977). However, their use has many consequences (Bernard 1963, Brown 1962,1963, Cottom 1965) and from studies of many environmental chemicals, biocides a conclusion has been reached that they can induce considerable damage into the human gene pool (Grant 1970 and 1971). Recent studies on cyto and cytochromatic effects on agro and environmental chemicals and their possible genotoxic effects have prompted several international agencies to recommend the screening mutagenic chromatic effects of almost all the chemicals being used commercially (Alacevic 1980, Kaur and Grover 1985, Shirashyad 1985). The problem of residual persistance in the pesticide sprayed plants is alarmingly important and several workers are engaged in studying residual persistance on plant, in soil and in water.

From above foregoing literature survey it is very clear that the maximum attention has been paid in emphasizing the effects of different pesticides on seedling growth, cytotoxicity and enzymes involved in germination. It is also clear from the literature that studies pertaining to physiological response of pesticices are very limited.

In the present investigation, therefore, an attempt has been made to analyse the physiological effects of monocrotophos as an organo-phosphorus insecticide and monocrotophos in combination with bavistin (fungicide).

The parameters selected for study are seed germination, root-shoot ratio, leaf area expansion, organic constituents such as chlorophylls, polyphenols, mineral content, stomatal behaviour, nitrogen content and enzymes of nitrogen metabolism, amino-acid composition and crude protein content in soybean plants. It is hoped that the study will provide basic clue to envisage judicial use of pesticide and their possible effect on the above mentioned parameters.