INTRODUCTION

Soybean is the world's most important source of food, oil and protein (Plate 1). It has a long history as an important food crop.

A. History :

Soybean food crop is believed to be of South East Asian origin. It was reported in China from prehistoric times. The first record of this plant appears in Materia Medica. [The ancient book "Heavenly farmer" written by Chinese Emporer Sheng-Nung in 2838 B.C.], mentioned this plant as "Sou" from which present day name soybean appears to have been derived.

Soybean [Glycine max (L) merrl.] (Plate 2) evolved from Glycine ussuriensis a wild legume native to Northern China. It has been known and used in China since the eleventh century B.C. It was introduced to Europe in the 18th century and into the United States in 1804 as an ornamental garden plant in Philadelphia. In 1905 the first commercial plant for extraction of oil from the seeds was developed but it was not until around 1926 that it became an economically important crop. Now it is a major crop in the United States, and in Brazil, Paraguay and Argentina, and its cultivation is being extended in Southern Europe and later on in almost all over the world.

B. Importance of Soybean :

1) Food Value

It is an important legume, grown mainly as food crop. It is nutritious and easily digested, and one of the richest and cheapest sources of protein. It is currently vital for the sustenance of many people and it wil play an

Plate 1. Soybean ; A source of food, oil and protein

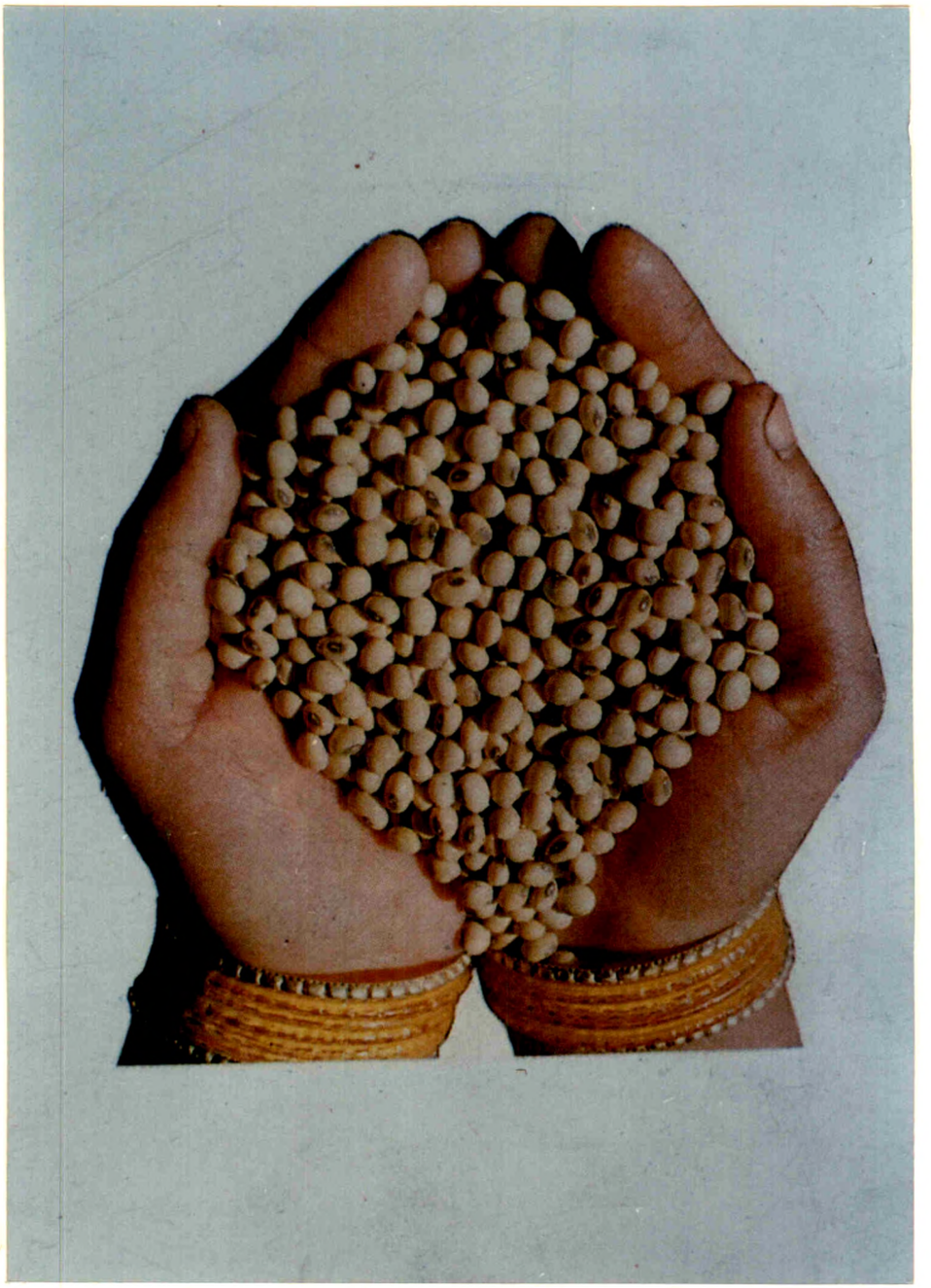


PLATE - 1

Plate 2. Soybean : (Glycine max (L.) Merrl.)
a) Vegetative stage
b) Harvesting stage

a

b

PLATE - 2

integral role in any future attempts to relieve world hunger. Soybean seed contains about 17 to 22% oil and about 63% of meal, half of which is protein. Besides edible oil it produces de-oiled flour with as high protein as 55-60%. It's use in fast food and nutritious soft drink is also catching up. Modern research has developed a variety of use of soybean oil. It is processed into margarine, shortening, mayonnaise, salad, creams and vegetarian cheeses etc.

2) Importance as an oil

Contribution of soybean in the oil seed basket of world has been maximum and now ranks at the top in world production of edible oil. Soybean along with groundnut and rape-seed mustard has established itself as a third important oil seed crop in India. India experienced an annual production of about 6 million tones of edible oil obtained from about 21 million tones of oil seeds during 1988-89. This production provides daily requirement of 18 g of oil per person. A target of 25.0 to 26.0 million tones of oil seeds has been set by Planning Commission for the year 2000-2001 A.D. for which we have to strive in an integrated manner. India has a definite niche not only for oil but for high quality protein as well.

3) Industrial importance

Soybean is used in resin, plastics, paints, adhesives, fertilizers, sizing for cloths, linoleum, baking, fire extinguishing materials, printing inks and a variety of other products.

C. Area Under Cultivation and Yield :

Soybean is fully grown in China, Japan, Korea and in other Asian countries such as Indochina, Thialand, Indonesia and Philippines. In recent years it has attained a great importance in the U.S.A. which shows highest acerage under this crop covering more than 16 millions hectares and rank at the top producer contributing more than 2/3 of world's production of soybean. China stands next to U.S.A. in acerage which covers more than 8 million hectares producing less than 1/5 of th world total.

In India soybean is grown in North India, particularly in hills of Assam, West Bengal, Manipur and Nagaland and also in the hilly area of U.P. and H.P. at 5000'-6000' altitude as mixed crop with maize. It is also cultivated in Kashmir valley. Now it is cultivated in M.P. and Maharashtra and some other States also.

The crop has occupied 4.25 million hectares producing 4.62 million tonnes of soybean in India. India is among the top three countries in respect of growth rate in area expansion under soybean, the other two being Argentina and Brazil.

In Maharashtra out of 205 lakh hectares cultivable land 27.3 lakh hectares is under oil seed cultivation. Soybean is one of it, which contribute 4.60 lakh hectares cultivation (Patil, 1995).

Department of Agricultural Development of Maharashtra planned to increase area under cultivation upto 7 lakh hectares in 1996-97. Now soybean cultivation in Maharashtra has taking proper shape due to high yield potential and multifold uses. There is steady increase in area under soybean because it is highly remunerative crop with less input demand. It

has bright prospectus of production in monsoon and post-monsoon seasons also.

The present national average yield of about 9 quintols/ha which is about half the world average. The reasons for low productivity are mainly non-adoption of recommended package of practices, the major being inadequate use of fertilizers. Besides the crop is heavily suffering from insect pest attack and fungal diseases. These are also one of the causes of low productivity of soybean.

D. Major Insect Pests of Soybean

soybean being luxurient crop, having lush green, soft succulent and nutritive dense foliage is attacked by over 273 types of insects (Bhatnagar and Tiwari, 1995). Out of the whole range, however, only about two dozens of insects are of significant importance. On the basis of their feeding habits, soybean insects are categorised into six groups

1. Seed and seedling feeders
2. Stem borers
3. Foliage feeders
4. Sap suckers
5. Flower and pod feeders
6. Storage insects.

1. Seed and seedling feeders

i. Field cricket (Gryllus sp.)
ii. Seed maggot (Delia platura (Mieg)
iii. Cut worms [(Agrotis ipsilon (Hufn.) and A. flammatara (Schiff.)]
iv. White grub (Holotrichea consanguinea (Blan chard)

2. Stem borers

i. Girdle Beetle [(Obereopsis brevis (Swed), Nupserha bicolor (Thomas.) N.nitidior (Brug)]
ii. Stem Fly : [Melanagromyza sojae (Zehnt) and Ophiomyia phaseoli (Tryon)]

3. Foliage feeders

i. Green semilooper (Diachrysia orichalcea (Fabr) and Chrysodeixis acuta (WIK.) and Plusia signata (Fabr)]
ii. Brown stripped semilooper [Mocis undata (Fabr)]
iii. Leaf miner [Bilobata subsecivella (Zell.)]
iv. Tobacco caterpillar [Spodoptera litura (Fabr.)]
v. Linseed caterpillar [Spodoptera exigua (Hb)]
vi. Bihar hairy caterpillar (Spilosoma obliqua (WIK)]
vii. Green pod borer [Heliothis armigera (Hub)]
viii. Blue beetle [Cneorane sp.]
ix. Grey weevil [Myllocerus maculosus (Desb)]
x. Leaf folder [Hedylepta indicata (Fab)]

4. Sap Suckers

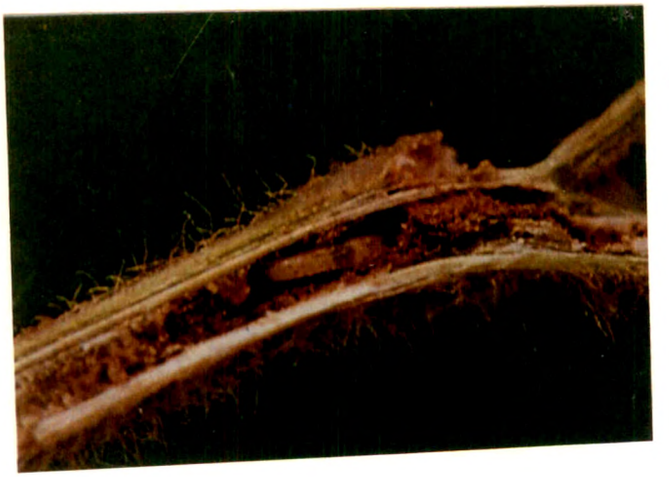
i. White fly [Bemisia tabaci (Genn)]
ii. Green jassids [Empoasca terminalis (Dist)]
iii. Thrips [Caliothrips indicus (Bag), Thrips tabaci (Linn), Ayyaria chaetophora (Ky)]
iv. Green stink bug [Nezara viridula (Linn)]

5. Flower and Pod Feeders

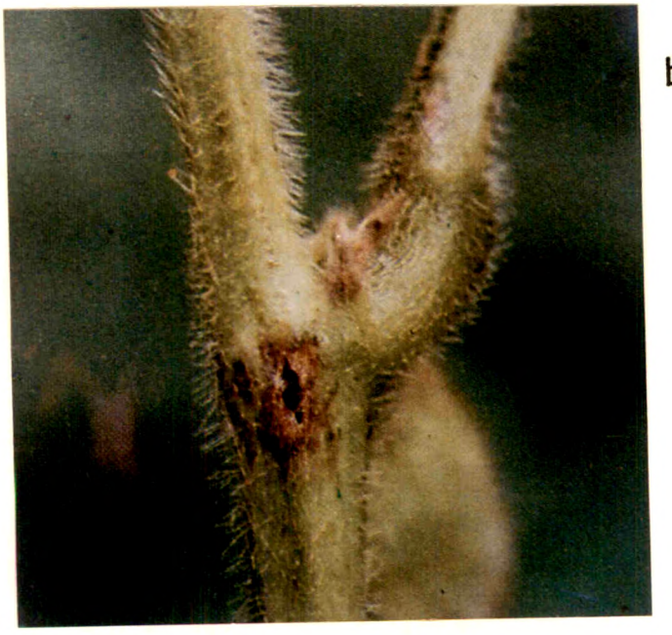
i. Blister beetle [Mylabris pustulata (Thunb), Epicauta mannerheim (Makl.), E. hirtipes (Waters)]
ii. Pod borer [Cydia ptychora (Meyrick)]

Plate 3. Stem fly (Melanagromyza sojae (Zehnter))

a) Larvae feeding within stem
b) Exit holes made by the maggots for emergence of adults.



a



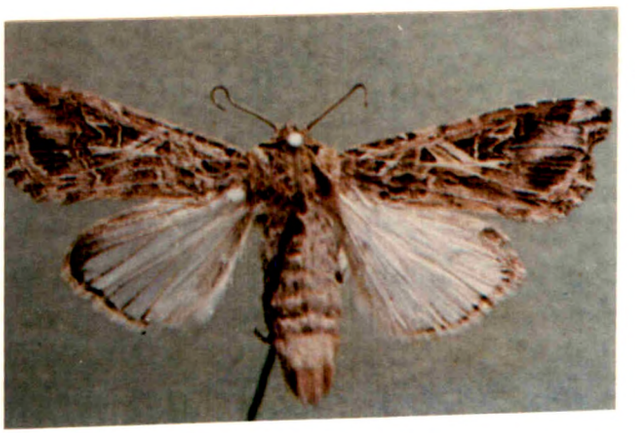
b

PLATE -3

Plate 4. Tobacco caterpillar (Spodoptera litura (Fabricius)

a) Moth b) Larvae

c) Dammage caused to the pods.



a

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c

PLATE -4

Plate 5. Leaf folder (Hedylepta indicata (Fabricius)).

a) Larvae : Feeding on chlorophyll content of leaf without making any perforation on the leaves.

b) Leaf folding caused by larvae.

a

b

PLATE - 5

Plate 6. Pod borer (Hliothis armigera (Hubner))

a) Adult b) Larvae

a

b

PLATE - 6

Plate 7. Green semilooper (Diachrysia orichalcea (Fabricius))
a) Larvae b) Damage caused by larvae to soybean leaves, showing scratching of green matter leaving behind midrib and veins.

a

b

PLATE - 7

Plate 8. Hairy caterpillar (Spilosoma obliqua (Walker))

a) Young larvae gregariously feeding on chlorophyll of soybean leaves.

b) Damage caused by larvae to soybean leaves showing brownish net work.

a

b

PLATE - 8

Plate 9. Green stink bug : (Nezara viridula (Linnaeus))

a) Eggs of green stink bug on soybean leaf.

b) Young ones of green stink bug sucking the sap from soybean leaves.

c) Adult green stink bug sucking the sap from the pod.

a

b

c

PLATE - 9

Plate 10. Gray Weevil : (Myllocerus undecimpustulatus)

a) Adult feeding on leaf :

It makes C shaped holes on the margin.

PLATE - 10

Plate 11. Girdle beetle : (Obereopsis brevis (Swedenbord))
Adult female of girdle beetle engaged in girdling the stem for egg laying. Portion above the girdle dries down.

PLATE - 11

Plate 12. White fly : (Bemisia tabaci (Gennadius))

a) Adult of white fly sucking the cell sap from the leaves of soybean.

b) Soybean plant heavily infected by white flies.

a

b

PLATE -12

6. Storage Insects

19

i. Pulse beetle [Callosobruchus chinensis (Linn)]
ii. Khapra beetle [Trogoderma graynarium)]
iii. Almond moth [Ephestia cautella (Hb)]

E. Major diseases of Soybean

Soybean is also attacked by a large number of fungi. However, disease induced losses have remained relatively low in most temperate production centers and are higher in areas with tropical and sub-tropical environments (Backman and Jacobson, 1992). Soil borne pathogens including Phytopthora rot, charcol rot and brown stem rot and the soybean cyst nematode have caused the greatest losses in temperate regions. As the range of soybean adaptation has been expanded to lower latitudes with their humid environments, foliage and stem diseases, bacteria viruses, seed, pathogens and root knot nematode have been identified as limiting factors. The major diseases of soybean prevalent else where in Maharashtra have been listed below.

1. Seedling diseases and Stem/Root diseases caused by fungi :

i. Charcoal-rot (Ashy stem blighrt, Dry root rot and stem rot,
Macrophomina phaseolina (Tassi) Goid
Rhizoctonia bactericola (Taub) Butler
ii. Collar rot or sclerotial blight :
Sclerotium rolfsii (Sacc.)
iii, Frog eye leaf spot
Cercospora sojina (Hara)
iv. Pod blight or Anthracnose
Colletotrichum dematium f.sp. truncatum (Schw)
v. Rust :
Phakospora pachyrhizi (Syd.)
vi. Rhizoctonia aerial blight :
Rhizoctonia solani (Kuhn)

Plate 13. a) Soybean leaves infected with Myrothecium leaf spot.

b) Myrothecium spot infection on stem, pod and seeds of soybean.

a

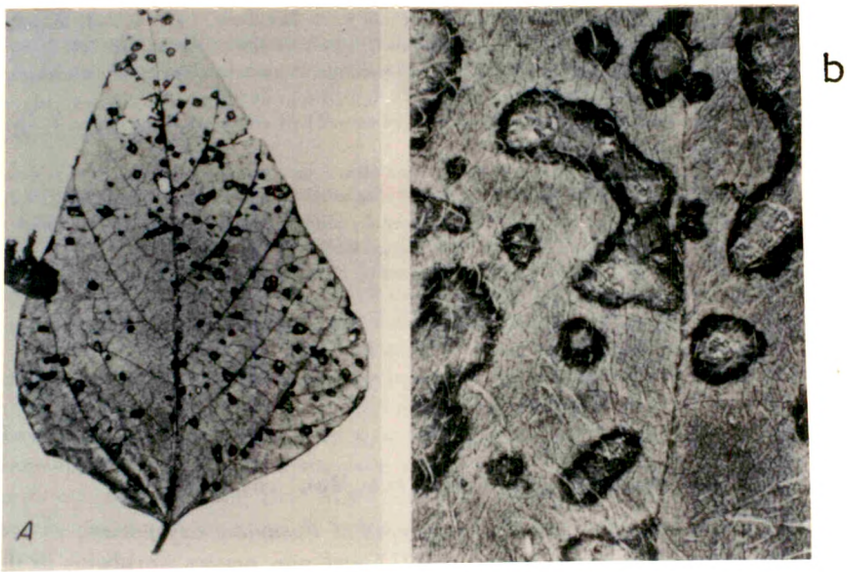
b

PLATE -13

Plate 14. a) Severe infection of collar rot caused by Sclerotium rolfsii.

b) Frog eye disease of soybean caused by Cercospora sojina (Hara.)

a

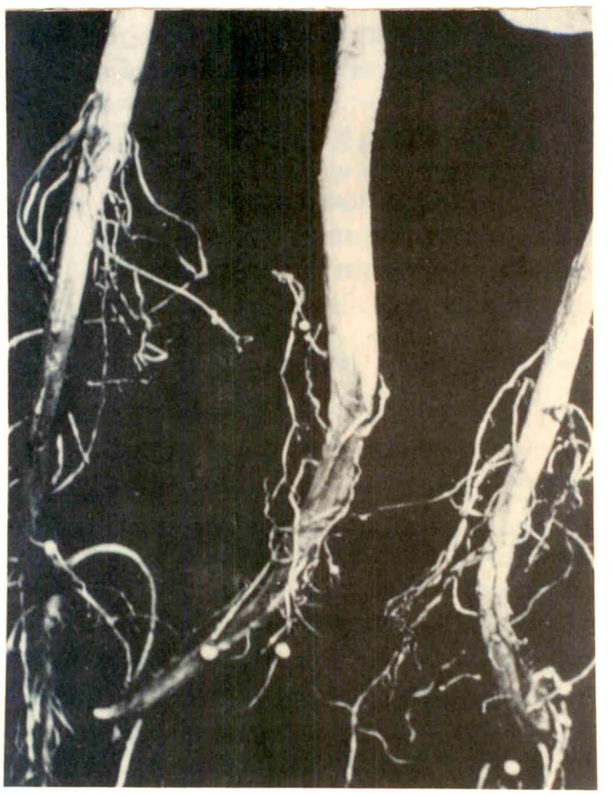


b

PLATE - 14

Plate 15. a) Soybean seedling showing Fusarium root rot.

b) Soybean plant showing Phytophthora root rot.



a

b

PLATE - 15

Plate 16. a) Soybean leaf showing Target spot disease caused by Corynespora cassiicola.

b) Rust pustules on upper (left) and lower (right) surfaces of soybean leaves caused by Phakospora pachyrhizi (Sydow).

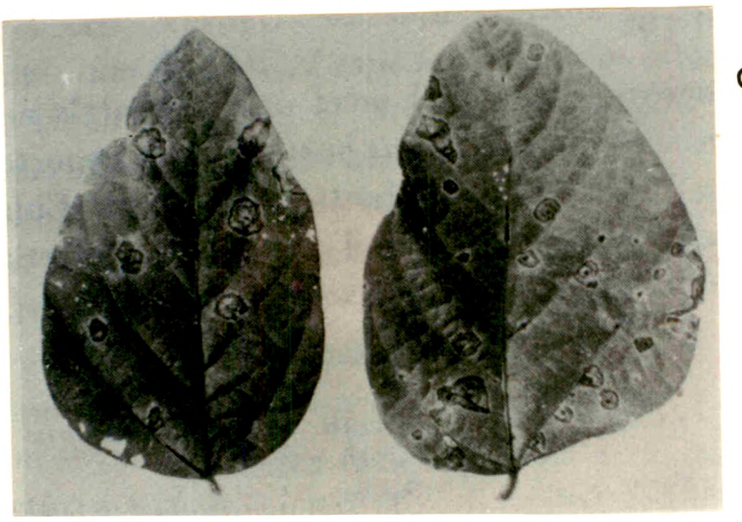


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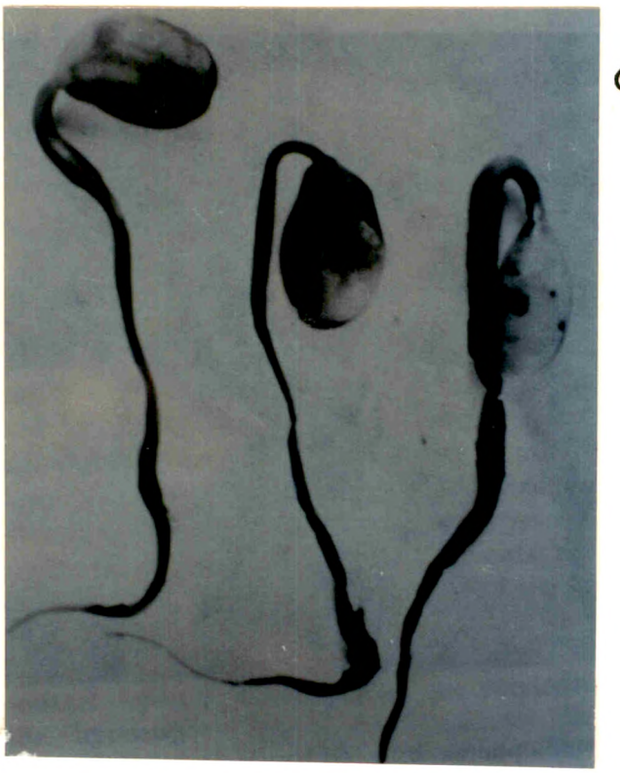
PLATE - 16

Plate 17. a) Soybean seedling showing Pythium rot.

b)Anthracnose symptoms on soybean stem caused by Colletotrichum dermatium.



a

b

PLATE - 17

Plate 18. a) Bacterial pustule on soybean leaves caused by Xanthomonas campestris.

PLATE - 18

vii. Myrothecium leaf spot :
Myrothecium roridum (Tode ex. Fries)

2. Foliage or Pod (seed) diseases caused by bacteria

i. Bacterial pustule
Xanthomonas campestris Pv. glycines (E.F.Smith) Dowson var. sojensis (Hedges) Star and Burkh.

3. Foliage diseases caused by viruses.

i. Soybean mosiac,
Soybean mosiac virus.
ii. Yellow moisac :
Mung bean yellow mosiac virus

Yield, losses in soybean due to uncontrolled insect pests and fungal disease complex have been reported to the tune of 50% by Bhatnagar and Tiwari (1995).

Chemicals for insect pest control and disease control are finding increased uses in soybean production. Seed treatments are used to improve seedling emergence and to reduce primary inoculum for mid seasons diseases. Foliage applied fungicides and insecticides have been used to increase yields and improve seed quality by controlling anthracnose, Cercospora leaf blight, frog eye leaf spot, Rhizoctonia, aerial blight, pod and stem blight and many sucking and chewing type of insects.

However, due to their "misuse" hazardous consequences like development of insecticide/ fungicide resistance, occurrence of minor pests as major pests, environmental contamination are inevitable in future.

In the tropical country like India in general and Maharashtra in particular, the illiterate rural people use pesticides indiscriminately, unmeaningful of the concept of time, space and quality. This has posed a great danger to humanity. The problem of pesticide contamination, development of resistance in pest population combined with the destruction 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 Scoopes (1985), leaf minors, aphids, and white flies posses 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.

Apart from the possible danger of synthetic organic pesticides, when used properly, have been of tremendous benefit to man and his environment but when misused they cause considerable harm. They have saved millions of lives through control of disease carrying insects. They have minimised catastrophic crop damage by insects, weeds, plant diseases, rodents and other pests, preserved valuable forests and parkland from insect destruction and protected households against damaging beetles, moths and other bugs. Generally, they have provided higher quality of life to man. We can not afford to lose the advantages gained through pesticides but neither we can ignore the potential danger. Obviously we must derive the maximum benefits by safe pesticide use. At the same time we must find ways to minimise or eliminate the hazards that may accompany the application of these chemicals.

From the recent reports it appears that the indiscriminate and unmeaningful use of pesticides has created not only harmful effects on man but also on crop plants on which they are applied (Hussey and Scoopes, 1985). As reported by Hussey and Scoopes (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 pesticidal 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. There are also reports that pesticides caused insult to genetic material (Sharma, 1986). These insults may be genic, chromosomal and/or genomic leading to a mutagenicity, clastogenicity and turbagenicity. Besides, pesticides are also found to be affecting seedling growth, pollen fertility and seed set which are important factors in agriculture.

Looking to the danger encountered by all these pesticides, one may recall the speech of Prince Bernhard of Netherlands who expressed his thoughts during Wild Life Fund dinner in London and the same has been quoted in a famous book "Silent Spring" by Rachel Carson (1962) :

" We are dreaming of conquering space. We are already preparing the conquest of the moon. But if we are going to treat other planets as we are treating our own, we had better leave the Moon, Mars and Venus strictly alone!

We are poisoning the air over our cities, we are poisoning the rivers and the seas; we are poisoning the soil itself. Some of this may be inevitable. But if don't get together in real and mighty effort to stop these attacks upon Mother Earth, wherever possible, we may find

ourselves one day - one day soon, may be in a world that will be only a desert full of plastic, concrete and electronic robots. In that world there will be no more "nature.", in that world man and a few domestic animals will be the only living creatures.

And yet, man cannot live without some measure of contact with nature. It is essential to his happiness.

..... *otherwise man has already lost the capacity to foresee and to forestall. If he will not compromise with the nature, he will certainly end by destroying the Mother Earth."*

From the above foregoing discussion it is equivocally clear that if the indiscriminate use of pesticides will remain continue further then we may have to face the above mentioned problems which will certainly produce unmanagable cumulative effects on the total ecosystem. Further it seems inevitable that the ultimate solution to our environmental pollution due to pesticides 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.

To achieve this and to arrest imminent danger of ecological breakdown of the genetic systems in the agroecosystems, which necessarily hurts human welfare, a perspective approach in dealing with pesticidal problem is alarmingly important. Similarly very little is known about physiological response of plant to pesticide and moreover the resistance of different species and kinds of plants to pesticides is based on their biochemical differences in metabolism and on the differences in their physiological reactions to these pesticides. To control the insect pest attack and fungal diseases of soybean different insecticides and fungicides

are wide in use. Most of the farmers knowingly or unknowingly use these pesticides rather at higher doses which may seriously affect the physiological metabolism. Therefore, the objective of present investigation is to examine physiological effects of monocrotophos and monocrotophos in combination with bavistin on soybean.