Chapter - I

INTRODUCTION
1. INTRODUCTION

Nowadays soybean (Glycine max (L.) Merrill) is very popular and important cash crop in India especially in Madhya Pradesh. It has attracted the Indian farmers due to its versatile habits of adaptability and almost double yield potential than other kharif pulse or oilseed crops. It can withstand abnormal rains and crop pests to a greater extent than any other crop grown during kharif, with all the virtues of a good legume. It can also fit well in intercropping and double cropping systems of rainfed and irrigated areas. It contains 40 per cent protein, 18 to 20 per cent edible oil and fair quantity of vitamins and essential trace elements such as copper, iron and other ingredients vital for body development. It is rich in lecithine, plant steroles and unsaturated fatty acids. Lecithine plays the most important role in lowering the blood cholesterol, preventing coronary heart disease and weakness of arteries. Soybean though rarely recognised as a dietary constituent, is a food that is as nearly perfect as milk and at the same time it is richer in minerals and vitamins than those in milk. Thus, it can befitting boon and it alone can play a pivotal role in abridging the agricultural economy and nutritional gap.

Soybean cultivation has been reported in China since 2838 B.C. (Caldwell, 1973). After second world war, it became
popular in the western countries. At present, U.S.A. is the major soybean producing country (58%), followed by Brazil (18.30%), China (9.20%), Argentina (6.50%) and India (0.90%). The black soybean (Kalitur) had been under cultivation for ages in the foothills of Himalayas and scattered pockets of Central India, but it did not become popular in other parts of India. The limited cultivation of indigenous cultivars viz., Kalitur and T49 was due to their undesirable genomes responsible for late maturity, small seed size, indeterminate, profuse vegetativeness and susceptibility to shattering, lodging, diseases and pests.

The yellow soybean viz., Bragg, Lee, Clark etc. were introduced from U.S.A. in 1960. Subsequently by genetic engineering, adaptive high yielding varieties viz., JS2, JS72-44 (Gaurav), JS75-46 (Durga) and JS76-205 (black) were developed at Jawaharlal Nehru Krishi Vishwa Vidyalaya, Jabalpur which replaced the old varieties and made the breakthrough in soybean production and changed the cropping pattern of Madhya Pradesh. Now Madhya Pradesh is the leading soybean growing State which has an area of 17.5 lakh hectares with the production of 15.0 lakh tonnes. About 87 per cent of the total area under soybean of the country is in Madhya Pradesh with 81 per cent of total production having an average of 857.14 kg/ha (Agril. Statistics, 1989).

In Madhya Pradesh, soybean cultivation has increased faster in Ujjain, Bhopal, Indore, Jabalpur, Hoshangabad,
Sagar and Gwalior divisions.

One of the major constraints observed in its cultivation is to manage the weeds, the frail, innocent and dubious plants which deserve timely destruction, are regarded as one of the important foes of the farmers. Hence, the weeds are noxious plant species which are required by law to be controlled or eradicated. The farmers fail to manage the weeds in soybean due to certain climatic and edaphic conditions and labour scarcity at critical period of weed competition. The growth of these unwanted plants rob the soybean crop and utilize the valuable inputs like nutrients, moisture, energy and space causing the greater stress on growth, development and yield of soybean, and the expenses of the farmers in terms of time, energy and money for managing these weeds.

The crop-weed association and crop-weed competition will remain continue to be the menace even under highly advanced agricultural technology due to various adaptive characteristics of weeds. Reports indicated that weeds utilize the nutrients faster and in relatively larger quantity than the crops. Mani (1975) reported that weeds growing in crop field during kharif drain off 46.6 kg N, 12.1 kg P and 73.3 kg K/ha. Rajan and Sankaran (1974) from Coimbatore reported 7 to 10 times more removal of plant nutrients by weeds than the maize crop at 30 DAS. At harvest, the uptake of nitrogen, phosphorus and potash by weeds
decreased from 39.4, 6.4 and 23.6 kg/ha under weedy check to 7.2, 1.1 and 4.6 kg/ha, respectively under herbicide treated plots. Yadav et al. (1985) reported that among various weeds present in the field, Echinochloa colomum depleted maximum nutrients, i.e., 92.8, 12.4 and 92.0 kg N, P$_2$O$_5$ and K$_2$O/ha, respectively.

The substantial removal of nitrogen and potassium by weeds and depletion of nitrogen is comparatively higher in kharif crops (730 kg N/ha) than rabi (√ 30 kg/ha). The nitrogen depletion to the tune of 80 per cent is attained within 5 to 6 weeks after sowing, whereas a good crop of soybean yielding about 30 q/ha removes about 140 kg N, 35 kg P and 60 kg K/ha from soil. Although soybean requires even larger amount of N, but being a legume crop, it has the ability to supply some of its N requirement by fixing N through symbiosis as the plants develop efficient nodules. Soybean also requires larger amount of P and K as compared to other crops for better seed production. The P is taken up by soybean plants throughout the growing season. The period of great demand starts just before the pod formation, whereas demand of K climbs to the peak during the period of rapid vegetative growth and then comes down as the pod formation starts. Hence, the weeds during this period compete with crop for sharing the nutrients and result in stress on crop growth and yield.
Holm et al. (1977) listed 34 weeds that are considered "serious", "principal" or "common" weeds in soybean in various regions of the world. In Madhya Pradesh, soybean fields are mainly infested with grassy and broad-leaf weeds which pose major problems for its successful cultivation (Tiwari and Jain, 1990). Most of these weeds emerge along with soybean and some weeds emerge in different flushes after emergence of soybean. This causes greater crop-weed competition at early stage and reduces the yield. The reduction of yield is, in general, the most serious and common kind of damage associated with rivalry among weeds and crops. Any factor that enhances the degree of competition or reduces the competitive ability of the crop will result in greater loss in yield. Some important factors affecting the degree of competition among weeds and crops, are the nature of weed species, densities, niche adaptability, soil fertility, seedbed preparation and prevailing aerodynamic conditions at sowing.

Weed competition tends to be greater in the tropics and sub-tropic than the temperate zone because of greater weed densities, more numberous weed species with vigorous growth habits. The improved technology will certainly fail in boosting the yield of soybean if dominant weeds are not managed at critical period of weed stress. The critical period ranges from first two weeks to seven weeks after sowing during which period growth rate of crop seedling is poor and cannot compete well against weeds. Hence, control of weeds is one of the most
important step in soybean production. Most of the farmers' time is spent in battle against weeds. Like other crops, in soybean too, weeds present a major hazard in successful production.

In general, the adverse effects of weeds on growth and yield are seldom realized until the major infestation occurs. Recent estimates reveal that out of 20 to 30 per cent total field losses in soybean due to all kinds of pests, 13 per cent are due to diseases, 24 per cent due to insects & nematodes and 63 per cent due to weeds (Ennis, 1976). Madrid et al. (1972) reported that yield reduction in soybean due to weeds may be as high as 55 to 100 per cent. Moreover, the tropical conditions are better suited to the growth and reproduction of weeds. A survey conducted by the National Soybean Crop Improvement Council (NSIC) indicated that weeds caused greater difficulties in soybean production than all other pests complex. In most tropical countries, losses due to the uncontrolled weed growth in soybean ranges from 50 to 60 per cent (Vega et al., 1970; Bhan, 1975 and Jain and Tiwari, 1990). In one instance, complete crop loss has been reported.

In India, yearly loss of about Rs.7,500 crores of agricultural products due to weeds is estimated. Weeds utilize about 30 per cent of the plant nutrients applied to crop plants. This is because of the fact that the stress due to weeds is not of a ocular nature. Unlike the diseases and insects epidemic, energy losses in weed control before sowing
and yield reduction due to competing weeds often fail to create a sensation. Therefore, it is important to realise the impact of weeds present in crop. Unless weed stress is eliminated, it becomes impossible to obtain full yield potential of high yielding soybean varieties even with the application of all other inputs.

Although the mechanical operations such as hand weeding, use of hoes and other implements to physically remove weeds are widely used in India, a critical evaluation of the possible utility of new herbicidal weed control techniques is required under changing crop-weed ecosystem and behaviour of the farming society.

In India, manual weeding is predominant tool to combat with weeds but is inefficient for managing the weeds at the required time. This method has many shortcomings like the unavailability of required labour to all farmers at right time and unfavourable weather conditions to perform weeding. The weeds are not killed if rains occur after weeding and further weeding is postponed or dropped due to continuous rains. Besides, there is severe depletion of valuable plant nutrients by weeds when weeding is done after two or three weeks of weed growth. The changing role of women in the society and migration of agricultural labourers from village to cities and other paying industries as the labours are wage and leisure-oriented, will further add to problems. The
delayed weeding cause serious pruning of the roots and nodules, breaking of plants and leaves which reduce the photosynthetic efficiency. The implements designed at present are inefficient to work under delayed conditions when crop canopy is developed or field is wet.

In general, the farmers with small holdings do not engage the labour out of their families hence, the fields are not weeded at critical stage as they start weeding from one corner of the field and reaching up to the end, they will take about one month. So half of the field will be seriously stressed due to weed competition. In case of large holdings, the farmers are dependent on labours and unable to provide weeding to all the fields at critical stage because sowing is commenced within a week. Hence, about half of the net sown area suffers from weed stress which is one of the major causes of reduction in soybean yield per unit area with the expansion of soybean area. Moreover, other crops sown during the same season also require weeding simultaneously.

In this context any efficient time saving method will be highly appreciated by farmers, even when it is costlier than hand weeding or there is adequate labour available at cheaper rates, as the latter may be engaged for improvement of other farm operations thus, raising food production per unit area. With these reasons, herbicides offer the most practical, efficient and economically viable means of reducing weed stress at critical stages.
The availability of new herbicides with high selectivity to soybean and efficient weed control will lead to an accelerated acceptance of chemical weed control for higher soybean production. In India, the use of herbicides is still at infancy stage. Apart from this, the main problem is lack of suitable equipments, training and extension as the extension workers are afraid of demonstrating the use of herbicides at farmers' fields. The farmers do not use the herbicides because they are less educated and herbicides need calibrations otherwise crop can be damaged if incorrectly used.

Presently, there are many agricultural situations in which herbicides may be considered an effective tool. Weed control researches have received greater recognition since last three decades. The knowledge of herbicidal use, their doses and application methods and proper time and differential crop response to the herbicides, will definitely contribute for increasing weed control efficacy besides stimulating soybean growth. The herbicides in vogue, since three decades, are 2,4-D and MCPA, mostly used traditionally to control dicot weeds in cereals but the selective use of herbicides for controlling the weeds in pulses and oilseed crops are meagre.

Although hand weeding, hoes and other bullock-drawn interculture implements are being used in Madhya Pradesh to control the weeds, but these methods are ineffective under heavy soil and unfavourable soil conditions. Hence, mechanical
Manipulation for reducing weed competition in standing soybean crop may prove ineffective technique.

The invention of newly synthesized specific herbicides for specific crops have miracle in selective weed control which attracted the farmers and revolutionized the agriculture. The weed control through selective herbicides as pre or post-emergence application will lead to elevate soybean production and economic standard of the farmers, particularly the pre-emergence herbicides are wet weather insurance in weed control. In the light of modern cropping pattern and agro-ecological situations, herbicidal weed control could be an effective and economically viable means of weed control in soybean. The efficacy of herbicides to control weeds in soybean was also reported by Hammerton (1973), Tiwari et al. (1980) and Singh and Singh (1984).

With the progress in herbicide science, many herbicides synthesized in recent years, which are more effective, many times faster, easier and cheaper than the conventional methods. Different formulations of these herbicides are available for specific control of sedges, grasses and dicot weeds in soybean such as fluchloralin, oxadiazon, heloxyfop-methyl etc. These herbicides are characterised by their broad-spectrum of effects in controlling annual grasses and dicot weeds with higher selectivity to crop. Various herbicides which are used, have proved potential as grass killers in soybean either applied as pre-emergence or post-emergence,
depending upon the interaction of agro-climatic conditions, application rate and time of herbicides. Properties of herbicides depend on many factors such as soil pH, soil moisture content, organic matter content, soil texture and ambient temperature.

The combined use of chemicals, with adoption of all useful agronomic practices to prevent incidence and spread of weeds will be more fruitful. The sowing of crop at a time which will give better vigour to the crops to compete with weeds and increase the herbicidal bio-efficacy will improve the weed control technology. For this, adequate informations on the chronological emergence of weed flora in different flushes after receiving the monsoon and cultivating the fields, are essential for effective control of weeds through mechanical or herbicidal means or by both as an integrated approach. A stale seedbed is one where one to two flushes of weeds are destroyed before planting main crop. Most weed seeds germinate from top 4 to 5 cm of surface soil. If a finally prepared seedbed is withheld from planting and it contains adequate moisture in its top 4 to 5 cm of soil, a flush of young weed seedlings will grow on it in about a week's time. These weed seedlings can be destroyed either with a contact herbicide like paraquat or by shallow non-inverting tillage implements viz., harrows. One to two flushes of weeds can be destroyed by post-tillage operations but well before planting of crops in the stale seedbeds. The main advantage of stale
seedbed is that crop germinates in weed-free environment and may soon attain good growth before subsequent flushes of weeds appear on the land. Stale seedbed can be highly effective in controlling weeds in crops planted in rain-free period with paleva irrigation (light irrigation) for quick germination of weeds. Many new types of weed seedlings will be dislodged during the preparation of stale seedbed.

As the weeds emerge at different intervals, an ideal combination of integrated practices for weed control seems to be the only way of breaking the barriers in higher productivity of soybean crop. The cost of controlling weeds and losses from failure to control them are borne directly or indirectly by many segments of private and public life. Therefore, concentration on non-monetary inputs like manipulation of growing methods and killing of weeds before sowing, synchronization of sowing time with environmental conditions in best way so that it becomes most favourable for soybean and least favourable to weeds, fostering beneficial and suppressing undesirable vegetation is greatly needed for maximization of soybean yield.

Keeping these facts in views, the present study was undertaken with the following objectives :-

(1) To study weed flora and find the suitable herbicides for control of weeds in soybean.

(2) To investigate the relative effects of herbicides on growth and yield of soybean.
(3) To study the yield and comparative economics of weed control in soybean.

(4) To find the inter-relations of weeds with crop.

(5) To predict the losses due to weeds in soybean growth and yield.

(6) To find out the suitable cultural methods, particularly for manipulation in sowing time and seedbed preparation for killing the weeds.

(7) To study the emergence of weeds in different flushes in soybean crop.

(8) To find out the most competitive weed species which create the stress on the growth and yield of soybean

(9) To determine the resistant and susceptible weeds for the herbicides which will be used in controlling the weeds in soybean.