CHAPTER I
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It is axiomatic that agriculture must be sustainable at some predetermined, practical level of acceptability to support the world's current and ever-burgeoning population. Five billion people now inhabit the earth with an additional one billion expected each decade. Hence, the farmers have to produce more food per unit area and time to fulfill the basic need of sustenance of themselves and others. It has been widely and rightly stated that "agriculture is not only the most important industry but only essential industry". Agriculture also has a dominant role in the economy of nations, state and regions. In India for example, it contribute nearly half of the national income and provide employment to about 70% of the working population of India. It also accounts for a sizable share of country's foreign exchange earnings.

In developing crop and animal husbandry man primarily learned to supplement his own physical ability with that of domestic animals, later the advent of the internal combustion engine and petroleum based fuels, much animal energy was replaced by mechanical energy. With more recent advances in technology, chemical energy has replaced or supplemented both animal and mechanical energy. Indeed, our times are some times referred to as the "chemical age of agriculture". Considering that from
planting to consumption an estimated 50% or more of the world's production of food is lost due to weeds, insects, diseases and other factors. Globally, agriculture production losses due to weeds thought to be in the range of 10 to 20% with fairly sharp differences between yield losses in the highly developed and under developing countries. Among several production constraints, weed management is perhaps the important single element needed to improve crop stability.

As with the use of other agricultural inputs, the weed control problem is inextricably linked with the farmer's socio-economic milieu is critical in determining appropriate control measures, what constitutes a reasonable weed control strategy in one situation may be totally out of place in another because of different input-output costs, different labour use patterns or different objectives of farmers. Sound weed management is an essential ingredient of any system of sustainable agriculture. However, requirements vary by country, region, locality and even from field to field due to variations in weed species, severity of infestations, soil and environmental conditions and crop management systems practiced. Thus no single simple prescription will fit all situations. In India agriculture would remain the mainstay for the sustenance of population for years to commence during the coming decades. The Indian agriculture has to transform from sustenance to commercial farming by making the advances in research and educational infrastructure, formulation
of agro-ecological based technologies and efficient production input delivery system. The agriculture scenario is now changing fast and the task of keeping pace with the population growth is arduous and challenging.

There is need for careful management of research and developmental programmes to sustain the agricultural production and conserve the natural resources. To feed the future generations without degrading the resource base, the Indian agriculture must become economically and ecologically sustainable.

The cultivation of high yielding exotic crop varieties, free trade, use of fertilizers, irrigation and intensive cropping systems have brought to the forefront of the problems of weeds more severe which cause tremendous losses to crops and their produce. The availability of cost effective modern quick weed control technology making possible to avoid or minimise losses caused by weeds, has now made the Indian farmers more conscious. More over the consumption of herbicides in India has increased from 60 tones (technical grade) in mid sixties to more than 5000 metric tones in 1990-91. The weed control is not only needed in Kharif crops but the Rabi crops also suffer due to infestation of weeds.

In Madhya Pradesh, the major Rabi crops comprised of wheat (cereal), gram, lentil (pulses), linseed and mustard
(oilseeds). Which have greater importance in food and economic of the farmers of the state and country.

Wheat (Triticum aestivum L.) emend. Fiori and Poal.) is one of the major staple food crops grown during Rabi in Madhya Pradesh and India. It is grown in 23457 thousand hectares with a production of 49652 tones. The average production of wheat in Madhya Pradesh is lower 1587 kg ha⁻¹ as compared to the country's average 2117 kg ha⁻¹. The efforts made for increasing its productivity through irrigation, fertilizer application and breeding of new high yielding dwarf varieties could not enhance the production to the desired level. One of the major causes is more infestation of weeds with increasing inputs and intensive cropping under irrigated fields of wheat. The research results concur that uncontrolled weeds in wheat may take 30 to 40% nutrients from the soil (Kumar, 1987). Grassy weeds have a potential to remove 40 to 50 kg N ha⁻¹ in wheat (Walia and Gill, 1985). Weed complex in wheat eco-system comprised of grassy and broad leaf weeds viz., Phalaris minor Retz., Avena fatua L., Chenopodium album L., Vicia sativa L., Convolvulus arvensis L., Rumex dentatus L., etc. These weeds create greater competitive stress on growth and reduce the yield from 20 to 40%. Therefore, it is essential to find the suitable herbicides for managing these weeds in wheat.

Gram or chickpea (Cicer arietinum L.) is one of the important pulse legume in India and plays an important role in
human diet as a source of protein. This crop occupies 6495 thousand hectares with a production of 4232 thousand tones. The average production is very low (652 kg ha\(^{-1}\)). Madhya Pradesh has greater contribution, hence there is need to increase the yield of gram. The weed stress is one of the major factor responsible for low production of this crop under irrigated conditions. The slow growth at early stage and shorter stature offer greater weed competition stress in this crop as most of the weeds grow taller and create shading effects. The losses due to weeds ranges from 20 to 65%. In view of low production as per need of this country, India imports the gram from other countries. Therefore, the efforts to raise the productivity of this crop is essential. The judicial weed management will boost the production of this crop.

Lentil (\emph{Lens culinaris} L.) is another very important pulse crop grown in Madhya Pradesh and occupy an area of 335 thousand hectares, which is next to gram. The average production of this crop is very low with a total production of 167 thousand tones. Among all Rabi crops, lentil is very poor weed competitor due to its slow growth at early stage and short stature. The common weeds like \emph{Chenopodium album} L., \emph{Melilotus alba}, \emph{Euphorbia dracuculaides} Lamk., \emph{Launia splenifolia}, \emph{Visia sativa} L., \emph{Covolylus arvensis} L., etc. cause a heavy stress on growth and yield of this crop particularly under irrigated conditions. Depending on the nature of weeds and their densities the losses in lentil vary from 30 to 55%. Hence irrigation potentialities
and other inputs are rendered ineffective for increasing the production of lentil.

India is fortunate enough to have wide range of oilseed crops grown during rainy and winter season in different agro-ecological zones. The country is one of the biggest producers of oilseed crops in world. India stand first in the production of groundnut, sesame and castor. Nearly fifth of the world rapeseed-mustard is produced in the country. In 1991-92 oilseed crops grown in area of 25.4 million hectare with a production of only 719 kg ha⁻¹. Inspite of premier position occupied by India in the world oilseed scenario, the yield per hectare of these crops is very low as compared to the world average. Even after persistent efforts made by plant breeders in evolving high yielding varieties and agronomists in developing optimum technology for raising the yield level, it is not upto the expected level. For low yields of oilseed crops, there are several constraints, among them the important are-these crops are generally grown on unirrigated lands, the use of low inputs particularly fertilizers, diseases and pests, uncontrolled weed growth in the fields and poor extension network for farmers' guidance.

Linseed (Linum usitatissimum L.) is grown in an area of 441 hectare with a production of 119 thousand tonnes particularly on heavy deep black soil in Madhya Pradesh and Maharashtra, on lighter alluvium in Uttar Pradesh and Bihar and on rich soil in
Himachal Pradesh, Punjab and Chattisgarh in Madhya Pradesh. Morphologically, linseed plant is a poor weed competitor due to its slender stem, small leaves, short stature and slow growth at early stage. Hence, weeds get ample opportunity for better growth under bare surface. The weeds in linseed not only decrease the yield of seed, oil content, fiber and iodine number but deteriorate the quality.

As regard mustard-rapeseed, India is first in the world with respect to production (423 thousand tones) and area (4989 thousand hectare). Mustard commonly known as rai or laha (Brassica juncea (L.) Zern. & Coss.) is major crop in this group. The highest record yield of 7000 kg ha\(^{-1}\) was obtained in Germany, while in India 3800 kg ha\(^{-1}\) was noted. However, the average yields are 2289 kg ha\(^{-1}\) and 613 kg ha\(^{-1}\), respectively. One of the major constraints in high production is weed infestation apart from the insect problems. The reduction in yield due to weeds may vary from 30 to 70\% depending on the density and nature of weed species in mustard fields. The infestation of Asphodelus tenuifolius, Convolvulus arvensis L. and other weeds which were found in other Rabi crops infests this crop also. Although, the research work has initiated for weed control in mustard, but the information on herbicidal weed control in this region is lacking.

Thus the presence of unwanted weeds easily nullify the various improvements and inputs applied to these major Rabi crops. The weed which emerge before sowing they are controlled
easily by mechanical means, but the weeds which emerge along with crops become a heavy drain of added fertilizers and moisture conserved before sowing or applied irrigation and create the greater competitive stress on growth and yield.

Although, the traditional method of hand weeding is prevalent to control these weeds but the hand weeding is performed very late perhaps only for removal of weeds as green fodder. By that time, the crop growth is hampered due to weed stress and the crops are injured during weeding if at all it is performed. The whole area is not weeded due to costlier labour or unavailability of labour at critical stage due to diversion of labours towards factories and small scale industries, which pay attractive wages. The hand weeding is very time consuming, back-bone breaking and difficult to perform in this era when the man afraid of physical labour. It also has the problem of reemergence of weeds. Hence, there is a need to find location specific herbicidal weed control technology for quick and easy control of the weeds in major Rabi crops grown in Sagar Division of Madhya Pradesh. This will save the labor consumption in weeding, encourage the use of labour in other important works and increase the crop production.

Therefore, the present investigation oriented on "Evaluation of suitable herbicide for weed management in Rabi cereal, pulses and oilseeds", grown in Rabi season under
irrigated condition in Sagar Division was conducted with the following objectives:

1. To find out the effective herbicide for management of weeds in rabi crops of the region namely wheat, gram, lentil, linseed and mustard.

2. To evaluate the efficacy of selective herbicides for monocot and dicot weeds of the rabi crops.

3. To find out the economic herbicide for reducing the weed population and growth without affecting the growth and yield of the principal crop.

4. To determine the extent of losses caused by different weeds on the yields of rabi crops.

5. To find out the smothering effects of different crops on rabi weeds.

6. To find out the dominant weed flora, which infest the rabi crops of region.

7. To find out the susceptible and resistant weed flora in rabi crop eco-system.