Chapter - VI

SUMMARY, CONCLUSIONS AND SUGGESTIONS
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6.1 Summary

The present endeavour deals with weed management in soybean (*Glycine max* (L.) Merrill) to explore functional cause-effect relationships of various components of crop-weed system. The field experiments were carried out at research farm of Jawaharlal Nehru Krishi Vishwa Vidyalaya, Sagar, Madhya Pradesh in *kharif* seasons of 1986 and 1987.

Three main plot treatments comprising of cultural manipulations viz., three methods of sowing, i.e. (i) sowing immediately after monsoon without killing the weeds, (ii) sowing after receiving first shower and killing the first flush of weeds, and (iii) sowing after receiving second shower and killing the second flush of weeds and five sup-plot treatments viz., (i) weedy check, (ii) hand weeding at 20 days after sowing, (iii) fluchloralin 1.0 kg/ha ppi, (iv) oxadiazon 1.0 kg/ha pre-emergence, and (v) haloxyfopmethyl 0.25 kg/ha post-emergence 20 days after sowing in all possible combinations were tested in a split plot design with four replications.

The experimental field was infested with location-specific weeds representative of Vindhyan Plateau. The soil of the experimental field was clay loam with neutral pH, medium in available P, K and organic carbon, but low in
available N content. The climate of this tract is sub-humid type with an average annual rainfall of 1013 to 1104 mm. The eco-climate during 1986 was more congenial for plant growth and development than 1987. A recommended nutrient dose of 20 kg N, 60 kg P₂O₅ and 20 kg K₂O/ha was given at the time of sowing. Variety JS72-44 was sown in plots of 5.0 m x 3.6 m.

The weed flora of the experimental field was studied. The data were recorded for weed population, specieswise, weed-shoot biomass, crop growth parameters, nodulation and yield components and yield. The NPK uptake by weeds, crop and seed, oil and protein contents in seeds and energy utilization by weeds and crop were also determined. The secondary data were generated for weed control efficiency (WCE), weed index, harvest index (HI), leaf area index (LAI), economics and cost-benefit ratio adopting the standard statistical methods. The functional cause-effect relationships amongst various components of crop-weed system were explored through correlation metrics and prediction equations using computer 640 K (Uptron).

The salient findings are summarised below.

6.1.1. Influence on weeds

The major weed flora of the experimental field under normal and stale seedbed conditions during 1986 and 1987 revealed that 17 weed species infested the soybean fields consisted of Euphorbia geniculata Orteg, Euphorbia hirta L., Psoralea corylifolia L., Justicia diffusa WYA., Anotis

The different methods of sowing had the significant influences on the weed population at different intervals. The sowing after receiving second shower and killing the second flush of weeds was the most effective in reducing the weed population and weed dry weight but decreased the seed yield slightly due to delay in sowing.

The effects of different treatments revealed that weed control efficiency in oxadiazon was 63.58 and 74.83 per cent in first and second year, respectively, followed by haloxyfop-methyl (64.56 and 72.12%) and fluchloralin (42.31 and 78.66%). The oxadiazon had broad-spectrum effects and can substitute hand weeding where annual weeds are dominant. Fluchloralin and haloxyfopmethyl were highly effective in controlling *Echinochloa crusgalli* and other grasses.
6.1.2. Influence on crop growth and development

6.1.2.1 Influence of methods of sowing

The data on plant population m\(^{-1}\) row length at initial stage revealed that different methods of sowing had significant effect. The poor crop emergence was noted when sowing was done without killing the weeds (15.82) as compared to plant population after killing the first flush of weeds (21.63) in the first year. Similarly, the plant population at final stage was significantly higher under M\(_2\) (13.52, 16.16), followed by M\(_3\) (11.59, 15.23) as compared to M\(_1\) (9.06, 12.71) during both the years.

The number of branches per plant recorded at different intervals varied significantly due to different methods of sowing. The higher number of branches per plant was recorded under M\(_2\) method of sowing as compared to M\(_3\) and M\(_1\) in both the years.

Significantly higher LAI was noted in M\(_2\) (10.13) as compared to M\(_1\) (5.10).

Different methods of sowing revealed that maximum number of seeds was produces in M\(_2\) (33.60) as compared to M\(_3\) (21.60) and M\(_1\) (20.20). Significantly more number of seeds per plant was noted under M\(_2\) (44.63) as compared to M\(_1\) (27.90). The seed yield per plant was maximum under M\(_2\) (3.84 q) as compared to M\(_1\) (2.69 q).
Significantly greater plant dry weight was noted in $M_2$ (18.45 g) as compared to $M_3$ (11.86) and $M_1$ (9.33). The greater seed index was noted in $M_2$ (11.57 g) as compared to $M_1$ and $M_3$ (10.63) in first year, whereas number of filled and unfilled pods per plant, pod weight per plant, seed weight per pod and number of seeds per pod did not vary significantly during both the years.

Significantly greater crop-shoot biomass was obtained in $M_2$ method of sowing (4697, 4126 kg/ha) as compared to $M_3$ (3729, 3094) and $M_1$ (1894, 1992). The highest production of seed yield was noted when sowing was done after killing the first flush of weeds (1004, 767 kg/ha) which was at par to those plots where sowing was done after killing two flushes of weeds (953, 722). Sowing immediately after monsoon without killing the weeds resulted in significantly lower yield (480, 560) than $M_2$ and $M_3$ during both the years.

In first year, significantly higher harvest index was noted in $M_2$ (26.19%) as compared to $M_3$ (20.68%) and $M_1$ (23.58%), while in second year, the maximum harvest index was noted in $M_1$ (28.05%), followed by $M_2$ (23.64%) and $M_3$ (18.42%). The weed index was significantly more when sowing was done without killing the weeds (61.93 and 49.44%) as compared to the plots where sowing was done after killing the first flush of weeds (33.06, 38.38) or second flush of weeds (23.07, 37.90).
6.1.2.2 Influence of weed control treatments

Significant reduction in crop population emergence was found in herbicidal treatments as compared to untreated plots. Greater mortality due to weed stress was occurred under weedy check.

Oxadiazon resulted in delayed seedling emergence by one day, abnormal seedling growth increased epicotylar region with characteristic bending and slight leaf chlorosis but acquired normal growth within two weeks. Later on, all the herbicides produced dark green leaves and resulted in better growth. Oxadiazon reduced the stem length and leaf size but increased the root dry weight, number of branches, plant dry weight, number of pods, seed yield per plant and harvest index.

Significantly more LAI was obtained under hand weeding (9.72, 15.44), followed by oxadiazon (6.15, 15.05).

Various sink parameters viz., number of filled pods, pod weight per plant, number of seeds per pod, number of seeds and seed yield per plant were significantly reduced under weedy check as compared to hand weeding and oxadiazon. An increase was noted under fluchloralin.

The weed index was greater under weedy check (63.72%) as weeds caused greater reduction in number of branches, filled pods, number of seeds and seed yield per plant.
significantly higher crop biomass was recorded under hand weeding (4358 and 4185 kg/ha), followed by oxadiazon (3363 and 3267), fluchloralin (3446 and 2923) and haloxyfop-methyl (3442 and 2559). Weedy check had significantly lower crop biomass (2591 and 2428 kg/ha).

The most advantageous herbicide was oxadiazon which resulted in higher yield of 1219 kg/ha with maximum net profit of Rs. 2593/ha under favourable season, while 836 kg/ha and Rs. 688/ha under less favourable season. Hand weeding resulted in higher yield of 1296 and 1237 kg/ha with maximum net profit of Rs. 220 and Rs. 888/ha. The lowest was noted under weedy check. The highest cost-benefit ratio was noted under hand weeding (1:0.44) and oxadiazon (1:0.43).

The interactions of various cultural and herbicidal treatments were significant on weeds, crop growth and yield. The maximum yield was obtained under hand weeding, followed by oxadiazon. Average profit was the highest under hand weeding (Rs. 2047/ha), followed by oxadiazon (Rs. 1641/ha).

The greater NPK drain by weeds was under weedy check (45.45, 11.34, 152.07 NPK kg/ha), while minimum was under hand weeding (3.84, 0.87, 9.71 NPK kg/ha).

The latent effects of herbicides were not found on seed germination, oil and protein contents; weed stress did not affect the seed quality.
Amongst the different parameters the linear increase in yield was predicted with crop biomass, LAI, branches per plant, number of filled pods per plant, whole plant weight and seed yield/plant. The increase in yield could be predicted by 0.21, 72.35, 322.85, 63.88, 66.42 and 313.00 kg/ha, respectively with the increase of one unit of each parameter. The decline in yield could be predicted by 204.59 kg/ha with increase in test weight by one unit.

6.2 Conclusions

The present investigation enabled to conclude the following:-

1. The major weeds of soybean ecosystem in the experimental field consisted of *Euphorbia geniculata*, *Euphorbia hirta*, *Psoralea corylifolia*, *Justicia diffusa*, *Anotis montholoni*, *Digera alternifolia*, *Corchorus olitorius*, *Convolvulus arvensis*, *Indigofera glandulosa*, *Physalis minima*, *Acelyphe indica*, *Caesulia axillaris* and *Alysicarpus longifolius* amongst dicotyledonous weeds. Amongst monocotyledonous weeds, *Echinochloa crusgalli*, *Cyperus iria*, *Commelina benghalensis* and *Commelina communis* were present.

2. *Echinochloa crusgalli*, *Euphorbia geniculata*, *Commelina benghalensis*, *Psoralea corylifolia*, *Justicia diffusa* and *Cyperus iria* were greater contributors for weed biomass. The
weed biomass, total weed population, *Echinochloa crusgalli*, *Euphorbia geniculata*, *Commelina benghalensis*, *Psoralea corylifolia*, *Justicia diffusa* and *Cyperus iria* were found most detrimental for crop growth and seed yield.

3. The weed stress on crop resulted in decline in yield mainly due to reduction in branches per plant, filled pods per plant, number of grains per plant and ultimately seed yield per plant.

4. The extortion of NPK by weeds under weedy check was 45.45, 11.34, 152.07 NPK kg/ha, while by crops was 96.39, 18.47, 98.57 NPK kg/ha.

5. The manipulation in weed population through the stale seedbed preparation revealed that sowing after receiving first shower and killing the first flush of weeds had greater smothering effect on weed growth and resulted in substantial increase in yield under the situation of greater weed growth. The sowing after killing the second flush of weeds also produced less weed dry weight but reduced yield due to delayed sowing.

6. Amongst different herbicides, oxadiazon had greater bioefficacy to control the weeds (63.58, 74.83%), followed by haloxyfopmethyl (64.56, 72.12%) and fluchloralin (42.31, 78.66%). The efficacy of fluchloralin and haloxyfopmethyl was greater against grassy weeds. Hand weeding had 87.67 and 92.10 per cent WCE.
7. The solar energy utilization by weeds was maximum under those plots where sowing was done without killing the weeds i.e. $M_1$ (132.97), followed by those plots where sowing was done after killing the first flush of weeds i.e. $M_2$ (71.999 lakh K cal/ha).

Amongst different weed control treatments, the weeds utilized the greater energy under weedy check (178.37), followed by oxadiazon (79.84), whereas minimum utilization was under hand weeding (11.64).

The energy utilization by total crop was higher in $M_2$ method (366.90), followed by $M_3$ (302.29).

Effect of weed control treatments revealed that maximum energy utilization by crop was under hand weeding (412.62), followed by fluchloralin. The lowest utilization was under weedy check (224.73).

8. Oxadiazon not only had greater WCE but also had growth regulating effects which reduced the plant height and increased the LAI, branching and podding. Fluchloralin and haloxyfopmethyl had increased the plant height.

Hand weeding was the most profitable which gave the highest economic return. Oxadiazon 1.0 kg/ha pre-emergence and fluchloralin 1.0 kg/ha pre-plant incorporation and haloxyfopmethyl 0.25 kg/ha post-emergence were more profitable than weedy check. None of these herbicides had phytotoxic effects
on nodulation and growth which increased the yield as compared to weedy check.

9. The highest net profit of Rs. 2047/ha was noted under hand weeding. All the herbicidal treatments were profitable when sowing was done after killing the first flush of weeds. Under this method, oxadiazon gave the higher net profit of Rs. 1641/ha, the next in order were fluchloralin and haloxyfopmethyl which gave net profit of Rs. 564 and 391/ha, respectively.

10. The herbicidal or cultural treatments did not affect the seed quality and had no latent effect on seed germination.

6.3 Suggestions

It is proposed to develop the competitive soybean plant type through genetic manipulation considering the branches, plant height and LAI as the major selection criteria.

A large number of germplasm may be evaluated for resistance to the herbicides.

The available varieties may be tested under different localities for identifying a better competitor with weeds having high yield.

Bullock or tractor drawn interculture implements may also be tested for effective weed management and integrated
with herbicidal treatments. The different cultural methods and herbicides must be tested for confirmation of the results under different soil and climatic conditions.

The interaction of different varieties with various planting geometry and plant densities may be evaluated in relation to seed growth.

To manage the weeds in soybean, sowing after receiving first shower and killing the first flush of weeds with the use of oxadiazon 1.0 kg/ha pre-emergence and fluchloralin 1.0 kg/ha pre-plant soil incorporation are recommendable. Amongst farmers' practices, stale seedbed preparations followed by manual weeding or herbicidal treatments as pre-plant or pre-emergence are important for controlling weeds in soybean.