5. SUMMARY AND CONCLUSIONS

The field investigation entitled, “Bio-efficacy and residue studies of herbicides in soybean-wheat cropping system” was conducted at the research farm of the Department of Agronomy, Forages and Grassland Management, CSK HPKV, Palampur during Kharif (2009) to Rabi (2010-11). The experiment aimed to study the bio-efficacy of different herbicides to manage weeds and their effect on growth, development, productivity and quality of soybean, the residual effect of herbicides on weeds and growth, development and productivity of succeeding wheat crop and the relative economics of different treatments in soybean and soybean-wheat sequence.

Experiment consisted of eight weed control treatments in soybean (viz. pendimethalin 1500 g ha\(^{-1}\) (pre), imazethapyr 200 g ha\(^{-1}\) (pre), quizalofop ethyl 60 g ha\(^{-1}\) (early post), imazethapyr 75 g ha\(^{-1}\) (pre) fb. imazethapyr 75 g ha\(^{-1}\) (early post), quizalofop ethyl 50 g ha\(^{-1}\) + chlorimuron ethyl 4 g ha\(^{-1}\) (early post), pendimethalin 1500 g ha\(^{-1}\) (pre) fb. chlorimuron ethyl 4 g ha\(^{-1}\) (early post), hand weeding (twice) and unweeded check and three in wheat (viz. weedy check, isoproturon 1000 g ha\(^{-1}\) + 2,4-D 500 g ha\(^{-1}\) and isoproturon 750 g ha\(^{-1}\) + 2,4-D 500 g ha\(^{-1}\)) constituting 24 treatments, were evaluated against weeds and crop performance. The bioassay studies to study the residual effect of herbicides applied in soybean were also undertaken in laboratory, using four indicator crops viz. oats, mustard, cucumber and maize.

The salient findings emerged from field as well as laboratory studies have been summarized in this chapter as under:

1. In soybean, application of pendimethalin 1500 g ha\(^{-1}\) (pre) fb. chlorimuron ethyl 4 g ha\(^{-1}\) (early post) effectively controlled Commelina, Echinochloa, Digitaria, Ageratum and Cyperus.

2. Application of pendimethalin fb chlorimuron ethyl resulted in significantly lower total weed count and dry weight and highest total weed control efficiency of 59.4 and 62.8 per cent during 2009 and 2010, respectively.
3. Application of pendimethalin fb chlorimuron ethyl reduced nitrogen, phosphorus and potassium depletion by weeds by 89.19, 89.06 and 88.94 per cent as compared to weedy check during 2010.

4. Application of pendimethalin fb chlorimuron ethyl resulted in significantly higher growth and yield attributes viz. plant height, number of branches, pods per plant, grain and straw yields during both the years of study. However, pendimethalin fb chlorimuron ethyl was at par with quizalofop ethyl + chlorimuron ethyl in influencing 1000-grain weight. Weeds reduced the seed yield to the tune of 59.9 and 41.0 per cent during 2009 and 2010, respectively as compared to pendimethalin fb chlorimuron ethyl.

5. Pendimethalin fb chlorimuron ethyl resulted in 13.0 and 17.0 per cent higher protein and 37.96 and 40.20 per cent higher oil content than unweeded check during 2009 and 2010, respectively.

6. In general, all the herbicide combinations were superior to alone application herbicides in improving the nutrient uptake by crop during both the years of study. Significantly higher nitrogen uptake by soybean crop was obtained with pendimethalin fb chlorimuron ethyl during both the years of study. The increase in nitrogen uptake was 187.50 and 52.67 per cent over unweeded check during 2009 and 2010, respectively. However, this treatment recorded significantly higher phosphorus and potassium uptake during 2010 only.

7. Weed control treatments applied in soybean crop did not exhibit significant effect on the population and dry matter accumulation of weeds, yield attributes and yield of succeeding wheat crop during both the years of study.

8. In wheat, both isoproturon 1000 g ha$^{-1}$ + 2,4-D 500 g ha$^{-1}$ and isoproturon 750 g ha$^{-1}$ + 2,4-D 500 g ha$^{-1}$ were comparable in controlling *Phalaris*, *Avena*, *Lolium*, *Vicia* and *Coronopus*.

9. Isoproturon 1000 g ha$^{-1}$ + 2,4-D 500 g ha$^{-1}$ resulted in significantly lower count and dry matter of weeds as compared to weedy check. It gave
significantly taller plants and higher dry matter accumulation of wheat at harvest. However, this treatment behaved statistically alike with isoproturon 750 g ha\(^{-1}\) + 2,4-D 500 g ha\(^{-1}\) during both the years.

10. Application of isoproturon 1000 g ha\(^{-1}\) + 2,4-D 500 g ha\(^{-1}\) behaving statistically alike with isoproturon 750 g ha\(^{-1}\) + 2,4-D 500 g ha\(^{-1}\) resulted in significantly higher yield attributing characters viz. number of effective tillers m\(^{-2}\), grains per spike and 1000-grain weight as compared to unweeded check.

11. Application of isoproturon 1000 g ha\(^{-1}\) + 2,4-D 500 g ha\(^{-1}\) behaving statistically alike with isoproturon 750 g ha\(^{-1}\) + 2,4-D 500 g ha\(^{-1}\) resulted in significantly higher yield during 2009. However, during 2010 isoproturon 1000 g ha\(^{-1}\) + 2,4-D 500 g ha\(^{-1}\) resulted in significantly highest grain yield of wheat as compared to isoproturon 750 g ha\(^{-1}\) + 2,4-D 500 g ha\(^{-1}\). Weeds in weedy check reduced the grain yield of wheat by 17.28 and 17.09 per cent over the best treatment i.e. application of isoproturon 1000 g ha\(^{-1}\) + 2,4-D 500 g ha\(^{-1}\) during 2009 and 2010, respectively.

12. Application of isoproturon 1000 g ha\(^{-1}\) + 2,4-D 500 g ha\(^{-1}\) behaving statistically alike with isoproturon 750 g ha\(^{-1}\) + 2,4-D 500 g ha\(^{-1}\) resulted in significantly higher protein content during 2010.

13. Application of isoproturon 1000 g ha\(^{-1}\) + 2,4-D 500 g ha\(^{-1}\) resulted in significantly higher nitrogen, phosphorus and potassium uptake over weedy check during both the years of study.

14. In soybean-wheat cropping system, application of imazethapyre fb imazethapyre in soybean crop produced higher soybean equivalent yield (33.41 q ha\(^{-1}\)) during 2009, whereas during 2010 application of pendimethalin fb chlorimuron (31.59 q ha\(^{-1}\)) proved better in this regard. In wheat, application of isoproturon 750 g ha\(^{-1}\) + 2,4-D 500 g ha\(^{-1}\) being at par with isoproturon 1000 g ha\(^{-1}\) + 2,4-D 500 g ha\(^{-1}\) produced higher soybean equivalent yield during 2009. However, during 2010, isoproturon 1000 g ha\(^{-1}\) + 2,4-D 500 g ha\(^{-1}\) gave highest soybean equivalent yield (29.73 q ha\(^{-1}\)).
15. Among different treatments in soybean, application of pendimethalin fb chlorimuron and in wheat, isoproturon 1000 g ha\(^{-1}\) + 2,4-D 500 g ha\(^{-1}\) resulted in higher gross returns, net returns and net returns per rupee invested from soybean-wheat cropping system during both the years.

CONCLUSIONS

1. Application of pendimethalin 1500 g ha\(^{-1}\) (pre) fb. chlorimuron ethyl 4 g ha\(^{-1}\) (early post) was more effective against weeds in soybean and improving its growth, development, yield attributes and quality during both the years.

2. The residual effects of herbicides applied in soybean were not observed to affect the population and dry matter accumulation of weeds as well as growth, development and productivity of succeeding wheat crop during both the years. However, application of isoproturon 1000 g ha\(^{-1}\) + 2,4-D 500 g ha\(^{-1}\) in wheat improved its growth, development, yield attributes, yield and quality.

3. Highest gross returns (Rs. 68583, 65588 during 2009 and 2010, respectively), net returns (Rs. 45614, Rs. 42619) and net returns per rupee invested (1.99 and 1.86) were obtained with application of pendimethalin fb chlorimuron ethyl in soybean. From soybean-wheat cropping system, highest gross returns, net returns and net returns per rupee invested were obtained with application of pendimethalin fb chlorimuron in soybean and isoproturon 1000 g ha\(^{-1}\) + 2,4-D 500 g ha\(^{-1}\) in wheat.