DISCUSSION

An attempt has been made to evaluate and explain the important finding establishing ‘cause’ and ‘effect’ relationship as far as possible. For clarity of discussion, the effect of treatments on weeds and their resultant effect on crop has been discussed under separate headings.

5.1 Effect of treatment on weeds

There were twelve weed species (3 grassy, 8 non grassy and 1 sedge) in the experimental field. The percent density of grassy and sedge weeds were increased with advancement of crop growth while relative density of non grassy weeds decreased during both the years (Table 4.1a). This trend was mainly due to the fact that non grassy weeds like *Parthenium hysterophorous* L. and *Anagallis arvensis* L. were suppressed by other weed species and the crop itself in weedy check plots due to their poor competing ability. These indicate that grassy weeds and sedges were more competitive than non grassy weeds. The results are in conformity with the findings of Singh *et al.* (1993).

The relative density of non grassy weeds to the total weed mass was higher at all stages of crop growth as compared to grasses and sedge (table 4.1.a). Higher relative density of non grassy weed at all stages was due to the more aggregate population of *Parthenium hysterophorous* L., *Anagallis arvensis* L. and *Cynodon dactylon* L. to the
total weed population at all stages of crop growth during both the years. Only sedge, *Cyperus rotundus* L. was present in experimental field which relative density to the total weed population was less as compared with grassy and non-grassy weeds of crop growth during both the years. Singh *et al.* (2010) also reported similar findings that *Parthenium hysterophorus* L. and *Anagallis arvensis* L. constituents 75.14% of total weed at 90 days stage of crop growth.

The total weed density was not successively increased upto 90 days in weedy plot thereafter it decreased at harvest stage of crop growth during both the years (Table 4.8). This indicate that all weed emerged during first 90 days thereafter competition among weeds and with the crop plant caused reduction in total weed population. Higher number of total weed per unit area was registered at 90 days crop growth stage as compared to 60 days crop growth stage during both the years. The similar result was also reported by Dixit and Bhan (1997).

The average density of total weeds (450.50 weed/m²) was the maximum at 90 days crop growth stage in weedy plot and thereafter it decreases (table 4.8). This led to the assumption that weed emergence was over by 90 days after sowing. The density of weed were decreased after 90 days of crop growth stage this might be due to competition among themselves and crop plant as well. Based on relative density of weeds it may be calculated that weed emergence during 0-30, 30-60 and 60-90 days period was 64.26, 28.97 and 6.77 per cent, respectively. This indicated that nearly two third of total weeds emerged during first 30 days of crop growth stage and remaining weeds were emerged in
coming 30 days, therefore, weed control measures should be devised to take care of the weeds during initial 30 to 45 days to avoid maximum weed competition.

The prominent weeds i.e. *Parthenium hysterophorous* L., *Anagallis arvensis* L., *Phalaris minor* L., *Cynodon dactylon* L. and *Cyperus rotundus* L. at 60 days crop growth stage were 22.86, 22.39, 12.86, 12.50 and 19.88 per cent of the total weed population recorded in weedy check correspondingly (Table 4.1b). The per cent values of various weed in total weed density show the dominance of *Parthenium hysterophorous* L. over other weed species. This is probably due to the fact that the dwarf wheat varieties with short stature and erect leaf allowing more light penetration through the canopy and less competitive against weed like *Parthenium hysterophorus* L.. These kind of findings were also observed by Rao (2000).

The highest average weed dry matter (68.21 g/m²) was recorded in weedy check at 90 days stage of crop growth (Table 4-9). The rate of dry matter production of weed in weedy check was 0.29, 0.996, 0.984 and -0.63 g/m²/day during 0-30, 30-60, 60-90 and 90 days and at harvest stages, correspondingly. This indicated that rate of dry matter production increased with advancement of crop growth up to 60 days and weed crop competition was intensified during initial 30 to 60 days stage of crop growth.

The emergence of *Parthenium hysterophorous* L. was (most dominant weed species) over up to 90 days after sowing in both the crop season (Table 4-2) and first 30 days accounted for 60.6 per cent of total emergence whereas upto 60 days stage 91 per cent of *Parthenium hysterophorous* L. emergence was completed. The number of *Parthenium hysterophorous* L. was maximum at all stages of crop growth during both the
years except 30 days stage of crop growth. It is evident from table 4.1 b that the relative per cent density of *Parthenium hysterophorus* L., *Cynodon dactylon* L. and *Cyperus rotundus* L. were increased with the advancement of crop growth in weedy check while per cent density of *Anagallis arvensis* L. was decreased with growing period of crop. This revealed that *Anagallis arvensis* was least competitive than other dominant weed species Singh *et al.* (2010) were recorded the major weed flora of experimental field included *Parthenium hysterophorus* L. and *Anagallis arvensis* L. among the broad leaves, *Phalaris minor* L. and *Cynodon dactylon* L. among the grasses and one sedge *Cyperus rotundus*. *Parthenium hysterophorus* L., *Anagallis arvensis* L., *Cynodon dactylon* L., *Phalaris minor* L. and *Cyperus rotundus* L. constituted 57.28, 17.49, 6.81, 6.46 and 5.64% of total weed flora during first year; 57.73, 17.85, 7.02, 6.04 and 5.06% during second year, respectively under weedy check. The Sulfosulfuron @ 0.025 and 0.030 kg a.i./ha and isoproturon + 2, 4-D @ 1.00 a.i.+ 0.50 kg a.e./ha caused significant reduction in total weed density and weed dry weight as compared to weedy check at 60, 90 & at harvest stage of crop growth during both the years (Table 4.8–4.9). The reduction in total weed density and weed dry weight by sulfosulfuron and isoproturon +2, 4-D treatment were due to its phytotoxic effects against *Parthenium hysterophorous* L., *Anagallis arvensis* L., *phalaris minor* L., *Cynodon dactylon* L. and *Cyperus rotundus* L. (table 4-2, 3, 4, 5 & 4-6). The significant reduction in total weed density and dry matter of weed were also reported by, Loubser (1998), Kumar *et al.* (2003), Mishra and Yaduraj (2005) and Banga *et al.* (2004).
It is evident that nutrient depletion by weed was maximum in weedy check plots and minimum in weed free followed by the sulfosulfuron @ 0.030 kg a.i/ha isoproturon +2,4-D @ 1.00 kg a.i. + 0.50 kg a.e./ha sulfosulfuron @ 0.025 kg a.i./ha treated plots. All the herbicidal treatment significantly brought down N, P₂O₅ and K₂O depletion by weed as compared to weedy check. The nutrient removal by weed is the product of weed dry matter accumulation and the nutrient content in weed. Therefore, treatments which suppress the growth of weed noticed less weed dry matter and accordingly registered less nutrient depletion by weed. Singh et al. (1985) reported that post emergence application of isoproturon @ 1.00 kg a.i./ha reduced the nitrogen uptake by weed by 98 per cent over unweeded control and thus increased the nitrogen uptake by crop by 84 per cent. Kumar et al. (1997) registered 4128 kg/ha weed dry weight from weedy plot at 90 days stage of crop growth which removed 782 kg nitrogen 19.4 kg phosphorus and 85.56 kg potassium per ha with 2657 kg/ha reduction in wheat grain yield while crop removed 29.5 kg N, 19.2 kg phosphorus and 22.1 kg potassium.

5.2 Effect of treatment on crop

The grain yield of wheat severely reduced due to weed crop competition. Yield reduction to the tune of 30.49 per cent in weedy check was observed as compared to weed free condition (Table 4.15). Uncontrolled weeds reduced the grain yield by 13.86 q/ha. Maximum and minimum average grain yield of 45.46 and 31.60 q/ha were recorded in weed-free and weedy condition, respectively. The application of different herbicides (sulfosulfuron clodinpop and isoproturon alone or in combination with 2, 4-D) resulted
significantly higher grain yield when compared with weedy check during both the years. Fenoxaprop-p-ethyl & metribuzin would not produce significantly higher yield as compared to weedy check. Weed free condition produced relatively higher grain yield than all other weed control treatments but it remain statistically similar with sulfosulfuron @ 0.03 kg a.i./ha & isoproturon + 2, 4-D @ 1 kg a.i. + 0.50 kg a.e./ha during both the years (table 4.15). Higher grain yield in weed control treatments of wheat as compared to weedy check had also been reported by Lal et. al. (1996). Mishra (2006) has also reported that sulfosulfuron @ 0.025 kg a.i. /ha resulted statistically similar grain yield as registered in two land weeding at 30, 60 DAS.

Yield attributes of wheat grain yield are number of spike/m², number of grain/spike and test weight. The lowest grain yield obtained in weedy plots might be due to the lowest number of spike/m², length of spike (cm), number of spikelet/spike, number of grain/spike, grain weight/spike (g) and test weight (Table 4.14). The reduction in yield component was due to heavy crop weed-crop competition which resulted poor crop growth has evidenced by data recorded on plant dry matter production, plant population per running meter, leaf area index at 90 days stage in weedy check (Table 4.12, 4.10 & 4.13). Magnitude of losses in grain yield of wheat due to uncontrolled weed in different stages have also been reported by number of workers that were 50.26 percent in Himachal Pradesh (Saini and Angiras, 2005); 42.09 per cent in Haryana (Malik et al., 2005); 48.45 per cent in Punjab (Walia and Singh, 2005); 43.33 per cent in Uttar Pradesh (Mishra and Yaduraj, 2005) and 72.41 per cent in Uttarakhal (Singh et al., 2003).
On an average 43.86 per cent higher grain yield of wheat was obtained under weed free condition over weedy check. This was because of no competition under weed free condition as evidence by the highest number of spike/m², length of spike, number of spikelet/spike, numbers of grain/spike, grain weight/spike and test weight (Table 4.14). These yield attributing characters were favoured due to better crop growth under weed free condition which is evidenced by the observation recorded on plant population/running metre, crop dry matter production and leaf area index at 90 days stage of crop growth (Table 4.10, 4.12, and 4.13).

Application of sulfosulfuron @ 0.03 kg a.i./ha and isoproturon + 2, 4-D @ 1.00 kg a.i. + 0.50 kg a.e./ha yielded statistically similar with weed-free condition during both the years. The different yield and growth attributing characters in these treatments were comparable with that of weed free condition. This might be due to very low degree of crop weed competition under these treatments as evidenced by low nitrogen, phosphorus, and potassium uptake by weeds (Table 4.16). This result colloborate the finding of Singh et al. (2003) who reported that sulfosulfuron @ 25 g/ha resulted significantly higher grain yield than 2, 4-D and it was statistically at par with isoproturon @ 1.00 kg/ha.

Among the herbicides treatments, sulfosulfuron @ 0.03 kg a.i./ha and isoproturon +2, 4-D @ 1.00 kg a.i. + 0.50 kg a.e./ha being statistically similar among themselves and produced higher grain yield than rest of the herbicides treatments. The reduction in weed density and dry matter production were evidenced by effective control of grassy as well as non-grassy weeds due to application of sulfosulfuron @ 0.03 kg a.i./ha and
isoproturon+2, 4-D @ 1.0 kg a.i.+0.50 kg a.e./ha which led to higher crop dry matter production, number of spike/m², length of spike (cm), number of spikelet/spike, number of grain/spike, grain weight/spike(g) and test weight. Similar findings were also observed by Banga and Yadav (2004).

Sulfosulfuron @ 0.030 kg a.i./ha and isoproturon + 2, 4-D @ 1.00 kg a.i.+ 0.50 kg a.e./ha were recorded relatively higher grain yield as compared to sulfosulfuron @ 0.025 kg a.i./ha, isoproturon @ 1.00 kg a.i./ha, both rates of clodinofop, metribuzin and fenaxaprop-p-ethyl during both the years (Table 4.15). Higher grain yield of wheat due to application of sulfosulfuron and isoproturon + 2, 4-D was the result of less crop-weed competition as evidenced by less weed density and dry matter production because sulfosulfuron and isoproturon+2, 4-D controlled grassy, non-grassy and sedges weed at a time whereas isoproturon & clodinofop were effective against grassy weed only. The same result was also noticed by Singh et al. (2005). They reported that application of sulfosulfuron @ 0.025 kg a.i./ha resulted significantly less number of Phalanis minor L. & total weed and total weed dry weight as compared to metribuzin 0.14 kg a.i./ha and weedy check.

The weed in weedy plot depleted on an average 9.68 kg nitrogen, 1.94 kg phosphorus and 8.13 kg potassium per hectare at 60 days stage. This showed that a greater part of nutrients was shared by weeds, therefore, crop suffered for these nutrients. As a result there were only 118.79 kg nitrogen, 22.77 kg phosphorus and 95.04 kg potassium per hectare were taken up by crop in weedy check plots in comparison to 157.2 kg nitrogen, 30.13 kg phosphorus and 125.74 kg potassium per hectare were
exhausted by the crop at harvest stage, respectively in weed-free condition. Mukhopadhyay and Bera (1980), Pandey and Singh (1983) reported that weed, when allowed to compete with wheat crop depleted marketable amount of nitrogen, phosphorus and potassium which resulted lower grain yield of wheat.

The result of the present study indicated that economics of experimentation such as maximum net return (Rs. 36196.74) was obtained with weed free plot followed by (Rs. 34985.33) with the application of sulfosulfuron@ 0.030 kg a.i./ha and the maximum benefit cost ratio (2.50) was observed with the use of isoproturon+2, 4-D @ 1.0 kg a.i.+0.50 kg a.e./ha followed by (2.48) sulfosulfuron @ 0.030 kg a.i./ha treated plot (Table 4.19). The results are similar to the finding of J.S. Mishra (2006) he found that among the herbicides application of sulfosulfuron 25 g/ha recorded the maximum net return (Rs. 11,940/ha) followed by clodinofop-propargyl 60 g/ha (Rs. 991/ha), Clodinofop 120g/ha, (Rs. 9,529/ha) and hand-weedings at 30 and 60 DAS (Rs, 8, 254/ha). Raj Singh and Bhagwan Singh (2004) observed similar findings with two hand weedicings while additional investment with two hand weedings decreased the net return over pendimethalin + One hand weedings. He also reported that higher net returns (Rs. 7673.00) with the application of Pendimethalin @ 0.75 kg/ha followed by 2, 4-D@ 0.50 kg/ha.

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