DISCUSSION
CHAPTER 5

DISCUSSION

The present investigation entitled "Studies on weed management in chickpea/mustard intercropping system" was conducted during the rabi (winter) season of 1998-99 and 1999 2000 at the farm of R.M.P. Post Graduate college, Gurukul-Narsan, Hardwar (Uttarakhand) and the important results of investigation have been presented in foregoing pages. In this chapter attempts have been made to discuss the significant experimental findings obtained during the course of present investigation and to offer possible explanation and evidences wherever necessary with a view to find out the cause and effect relationship among the treatments with respect to various characters studies and short out the information for practical value.

The perception of the value of intercropping has changed radically over the year. In past, it was considered chiefly to be risk minimizing practice, but now a day it is aimed at increasing productivity per unit area as a potentially beneficial system and evidence suggested that intercropping can provide substantial yield advantages compared to sole. These advantages may be especially important because they are achieved not by means of costly inputs, but the simple expedient of growing crops together.

Growth and yield of a plant type is a function of various physiological processes taken place in the plant body which affected by plant genotype, soil, environment and weather conditions of the habitat, where a plant is being grown. The various growth attributes were affected by applied treatments and the ultimate resulted direct and indirect impact on
yield attributes and seed yield. Seed yield is the function of yield attributes and number of plants per unit area. Better yield attributes are positively correlated with the increase in seed yield. The final yield is the cumulated function of various components of plant photosynthetic system, its efficiency, duration and translocation of the economic sink of plant. The function of physiological and metabolic process depend upon the growth characters produced which are modified to the crop during its growing seasons.

Weather conditions:

The important meteorological data pertaining to the experimental period (Oct. to April) in the consecutive rabi seasons of 1998-99 and 1999-2000 are given in Table 3.1 and also plotted against each week of every month in Fig. 3.1. In general the meteorological parameters during the crop season were fair and favourable to stimulate crop growth and ultimately yield attributes and yield. But it is clear that, in the first year, a total precipitation of 219.0 mm was received, while in the second year 121.1 mm was recorded during the experimental period. Obviously, the second year was comparatively better for crop from rainfall distribution point of view at later stages of crop growth, because in first year, 136 mm rainfall was received just few days earlier of sowing. However, this rainfall helped in better germination and accelerated early growth and development.

At later stages, i.e. in second week of February and third & fourth week of March, there was enough rainfall which helped in grain development. Thus, the environtmental conditions pertaining to rainfall prevailing in the second year appear to have been more conducive than in the previous year. The superiority of the second year over the first year as judged by the grain production (Table 4.21 & 4.22) is thus, reasonably justified.

The effect of different intercropping system and weed management practices was observed on growth and yield of crops and their results described under experimental findings are given below:
Effect of intercropping system on growth, yield and associated characters of chickpea:

Inspection of the results presented in Table 4.21 makes it clear that the chickpea sole gave significantly more grain yield (13.42 q/ha and 13.25 q/ha) than the other intercropping systems. Chickpea + Mustard 4 : 1 also recorded significantly higher yield (10.93 q/ha and 11.10 q/ha) than chickpea + mustard 3 : 1 and chickpea + mustard 6 : 2. Chickpea + mustard 3 : 1 system being at par with chickpea + mustard 6 : 2 in both the years. Intercropping decreased the seed yield of chickpea significantly as compared to sole crop predominately by lower plant population of intercrops. Similar results have also been reported by Mehta et al. (1996).

Intercropping system had no significant effect on plant stand per metre row length of chickpea. However, the final plant stand slightly decreased than initial during both the years.

In general, there was no competition for resources in influencing the plant height of chickpea in different intercropping treatments. So any significant difference not occurred among the different intercropping systems in respect of plant height during both the years.

Non significant difference in fresh and dry weight per plant in different intercropping system at 30 DAS (Table 4.7 & 4.9) were due to non significant difference in number of branches per plant (Table 4.5). Fresh and dry weight per plant increased at slower rate upto 60 DAS and thereafter faster rate. At later stage, intercropping showed significant effect in fresh and dry weight per plant as well as number of branches per plant both the years.

The point of discussion here is that the increased in grain yield based on yield governing characters (number of pods per plant, number of seeds per pod, number of seeds per plant, grain weight per plant). Persual results in Table 4.11, 4.15 and 4.17 makes it clear that chickpea sole
intercropping system maintained significantly higher number of pods per plant, number of seeds per plant and grain weight per plant in both the years.

Chickpea sole being in pair with chickpea + mustard 1 : 1 and chickpea + mustard 6 : 2 had significant positive effect on size of the grain only during 1998-99 (Table 4.19).

It is clear from the above discussion that increase in grain yield of chickpea due to intercropping system was mainly attributed to total plant population and increased number of branches, number of pods, number of seeds and grain weight per plant.

The extent of increase in biological yield and straw yield of crops due to chickpea sole and chickpea + mustard 1 : 1 over chickpea + mustard 3 : 1 and chickpea + mustard 6 : 2 intercropping system was attributed to better plant population, better number of branches and better fresh and dry weight (Table 4.23).

Nitrogen and protein content in seed was not affected by intercropping system (Table 4.27 & 4.28). These results are supported by

\[\text{Effect of intercropping system on growth, yield and associated characters of mustard.}\]

The results in respect of the effect of intercropping systems reveal that mustard grown regular produced significantly higher seed yield (11.2 q/ha and 11.59 q/ha) in comparison to chickpea + mustard 3 : 1, chickpea + mustard 6 : 2 and chickpea + mustard 1 : 1 intercropping systems during the years (Table 4.22). Intercropping decreased the seed yield of mustard significantly as compared to sole crop predominately by lower plant population. Plant stand per metre row length in mustard sole was found significantly lower than other intercropping system at harvest.

There was no significant effect of intercropping system on plant
ight of mustard at any stages of crop growth. However, in mustard sole crop plant height increased as compared to other systems (Table 4.3). This might possibly be due to dense population.

Intercropping system did not show perceptible variation in terms of number of branches per plant in both the years, except at 120 DAS & at harvest during 1999-2000. However, the highest values of branches per plant were noted with chickpea + mustard 1 : 1 system (Table 4.6).

In comparison to sole crop, the fresh and dry matter of mustard increased when intercropped with chickpea, being maximum in 1 : 1 row arrangement (Table 4.8 & 4.10). The competition may be for space and sunlight. Higher leaf surface area increased the synthesis of food materials through larger leaves ultimately resulted increased fresh and dry matter accumulation per plant.

The point of discussion here is that the increased in grain yield was based on yield governing characters (number of siliqueae per plant, number of seeds per plant and seed weight per plant). Persual of the results in Table 4.12, 4.16 and 4.20 makes it clear that chickpea + mustard 1 : 1 intercropping system maintained higher significantly number of siliqueae per plant, number of seeds per plant and seed weight per plant.

It is clear from the discussion that increase in seed yield of mustard due to intercropping system was mainly attributed to increase in number of branches per plant, siliqueae per plant, seeds per plant and seed weight per plant.

The extent of increase in biological yield and straw yield of crop due to mustard sole over other intercropping with chickpea was attributed to more plant population per unit area.

The oil content did not differ significantly by various intercropping treatments (Table 4.29).
Effect of intercropping system on weed intensity, dry matter accumulation by weeds and weed control efficiency:

It is clear from the results presented in Table 4.31 - 4.36 that the intercropping system did not produce any significantly effect on intensity of weeds at any stages of crop growth during both the years. In previous year, weed population of grassy weed as well as total weed increased up to 80 DAS with faster rate and decreased at 90 DAS, whereas in second year weed population decreased at 60 DAS. The dry weight of weeds was also significantly effected by intercropping system. The reduction in weed population and less dry matter production may be due to a appreciable checkering effect on weeds. Weed population was increased again at 90 DAS during 1999-2000.

Weed control efficiency did not differ significantly by various inter- and sole cropping treatments (Table 4.38). However, the highest weed control efficiency was noted with mustard sole (50.42% and 44.51%) during both the years.

Effect of weed management practices on growth, yield and associated characters of chickpea:

Perusal of the results presented in Table 4.21 make it clear that all weed control treatments significantly increased the grain yield over weedy check control. The significantly higher grain yield of chickpea was observed in weed free plots. The increase in grain yield due to weed free was calculated to be 17.14 & 17.50, 34.39 & 33.75 and 61.49 & 59.31% higher on hand weeding twice at 30 & 60 DAS, pendimethalin @ 1 kg a.i. and weedy check control in both the years and establish its superiority over respect of the weed control methods. Mechanical weed control was found significantly better than chemical weed control. The higher grain yield in weed free is attributed to timely control of weeds in the early stages of crop with and maintenance of less weed problem throughout the crop growth.
period. These results are supported by Vanishya et al. (1993) and Shokhan et al. (1993).

All these factors resulted in better availability of nutrients and moisture to the less crop-weed competition. As evident from the beneficial effects on the crop growth in terms of number of branches per plant (Table 4.6) and yield attributing characters mainly number of pods per plant, number of seeds per pod, number of seeds per plant, seed weight per plant & thousand seed weight (Table 4.11, 4.13, 4.15, 4.17 and 4.19). These findings are supported by Balyan et al. (1998).

Nitrogen and protein content in seed was not affected by weed control treatments (Table 4.27 & 4.28). It was mainly due to similar variation in protein and almost equal nitrogen content in different weed control treatments.

Effect of weed management practices on growth, yield and associated parameters of mustard:

Persuasive of the results presented in Table 4.22 make it clear that all weed control treatments significantly increased the grain yield over weedy check control. Pahuja et al. (1993), Rajput et al. (1993) & Singh et al. (1993) reported similar results. The significantly higher grain yield of chickpea as observed in weed free plots. The increase in grain yield due to weed free calculated to be 16.15 & 13.50, 38.85 & 30.12 and 74.06 & 47.74% higher hand weeding twice at 30 & 60 DAS, pendimethalin @ 1 kg a.i. and check control in both the years and establish its superiority over weed of the weed control methods. Mechanical weed control was found significantly better than chemical weed control. Rajput et al. (1993) and Singh et al. (2001) also reported similar results. The higher grain yield in weed free attributed to timely control of weeds in the early stages of crop growth and maintenance of no weed problem throughout the crop growth.
### Appendix 146: Interaction effect of intercropping system and weed management practices on land equivalent ratio during 1998-99

<table>
<thead>
<tr>
<th>TREATMENT</th>
<th>Chickpea sole</th>
<th>Mustard sole</th>
<th>Chickpea+Mustard (3:1)</th>
<th>Chickpea+Mustard (4:1)</th>
<th>Chickpea+Mustard (6:2)</th>
<th>Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>Weedy check control</td>
<td>1.00</td>
<td>1.00</td>
<td>0.98</td>
<td>1.07</td>
<td>0.96</td>
<td>1.00</td>
</tr>
<tr>
<td>HW twice at 30 &amp; 60DAS</td>
<td>1.00</td>
<td>1.00</td>
<td>1.91</td>
<td>1.10</td>
<td>1.00</td>
<td>1.02</td>
</tr>
<tr>
<td>Weed Free</td>
<td>1.00</td>
<td>1.00</td>
<td>1.04</td>
<td>1.11</td>
<td>1.03</td>
<td>1.03</td>
</tr>
<tr>
<td>Pendimethalin 5Kg a.i/ha</td>
<td>1.00</td>
<td>1.00</td>
<td>0.97</td>
<td>1.01</td>
<td>0.97</td>
<td>0.99</td>
</tr>
<tr>
<td>Mean</td>
<td>1.00</td>
<td>1.00</td>
<td>1.00</td>
<td>1.07</td>
<td>0.99</td>
<td>CD at 5%</td>
</tr>
</tbody>
</table>

### Appendix 147: Interaction effect of intercropping system and weed management practices on land equivalent ratio during 1999-2000

<table>
<thead>
<tr>
<th>TREATMENT</th>
<th>Chickpea sole</th>
<th>Mustard sole</th>
<th>Chickpea+Mustard (3:1)</th>
<th>Chickpea+Mustard (4:1)</th>
<th>Chickpea+Mustard (6:2)</th>
<th>Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>Weedy check control</td>
<td>1.00</td>
<td>1.00</td>
<td>1.16</td>
<td>1.11</td>
<td>0.93</td>
<td>1.03</td>
</tr>
<tr>
<td>W twice at 30 &amp; 60DAS</td>
<td>1.00</td>
<td>1.00</td>
<td>1.15</td>
<td>1.34</td>
<td>0.97</td>
<td>1.05</td>
</tr>
<tr>
<td>Weed Free</td>
<td>1.00</td>
<td>1.00</td>
<td>1.34</td>
<td>1.38</td>
<td>1.05</td>
<td>1.07</td>
</tr>
<tr>
<td>Pendimethalin 5Kg a.i/ha</td>
<td>1.00</td>
<td>1.00</td>
<td>1.08</td>
<td>1.10</td>
<td>0.97</td>
<td>1.03</td>
</tr>
<tr>
<td>Mean</td>
<td>1.00</td>
<td>1.00</td>
<td>1.12</td>
<td>1.13</td>
<td>0.98</td>
<td>CD at 5%</td>
</tr>
</tbody>
</table>
reported similar results. Weed free conditions was accumulated utilised dry matter. In the comparison of mechanical and chemical weed control treatment, mechanical weed control treatment was found significantly superior to check the weed dry matter accumulation over chemical weed control treatment. The similar results has been reported by Alessandro et al. (1990) & Sharma and Chauhan (1995).

The weed control efficiency of plot kept weed free for entire crop season was 100%. Next highest weed control efficiency (46.43 and 46.37%) was recorded with hand weeding twice at 30 and 60 DAS (Table 1.36). Though, weed free conditions gave the highest gross profit of Rs 17478 /ha and Rs 17557 /ha in both the years but it needed highest cost of cultivation of Rs 14627 /ha and 14727 /ha respectively and its net profit and cost : benefit ratio were lowest than other weed management practices. Hand weeding twice at 30 and 60 DAS gave the highest net profit (Rs 6277 and Rs 6417 /ha) with highest cost : benefit ratio (1.73 and 1.74) in both the years. Hand weeding twice at 30 and 60 DAS with only an additional cost of cultivation of Rs. 102 /ha gave an additional net profit of Rs. 1975 /ha in 1998-99 and Rs 1788 /ha in 1999-2000 over application of pendimethalin @ 1 kg a.i. /ha. Rajput et al. (1993) also reported similar results.

It is clear from the above discussion that hand weeding twice at 30 & 60 DAS is the best & economically beneficial weed management practices.

**Intercropping indices and Assessment:**

The biological advantages in terms of land equivalent ratio was the highest (1.02 & 1.13) when chick pea + mustard 1 : 1 with weed free conditions followed by HW twice. Higher land equivalent ratio in intercropping might be due to efficient utilisation of resources. Resulted in higher yields in association may be due to synergistic effect of crop over each other. The land equivalent ratio was highest (1.02) with chick pea intercropped with mustard.
in a 4 : 1 ratio have been reported by Ali (1992).

Assessment of various cropping systems and their combinations can be either on the basis of seed yield equivalent or on the basis of net profit from the intercropping as a whole. For this purpose, crop seed yield equivalent and economics of the treatment was estimated. Biological potential, production efficiency and economic viability in relation to weed management practices in chickpea + mustard intercropping system were evaluated and compared its pure cropping. As per the aim of experiment, effect of crops over others was analysed and presented in Table 4.33. These findings are being discussed here as under.

The intercropping of chickpea + mustard 4 : 1 row ratio was found to be advantageous in terms of seed equivalent yield and net profit. The maximum total productivity in terms of chickpea equivalent yield was scored in chickpea + mustard 4 : 2 intercropping system. This is mainly due to yield advantages accrued from mustard in the intercropping system over the sole crop by way of reduction competition and lose of chickpea yield proportionate to cropped area in chickpea + mustard 4 : 1 system. These results are similar with the findings of Singh and Yadav (1992), and Ali (1992).

The point of discussion here is that all weed management practices significantly increase the seed equivalent yield over weedy check control. Weed free brought significantly higher equivalent yield of 64.84 & 31.39, 34.91 & 32.16 and 15.88 & 15.03% over weedy check, pendimethalin @ 1 kg a.i. and hand weeding twice at 30 & 60 DAS respectively during both the years. Though, weed free gave the highest seed equivalent yield and gross profit but it needed higher cost of cultivation. Its net profit and cost : benefit ratio was lowest than other weed control methods. Apparently, the maximum net return (Rs 6277/ha & Rs 6470/ha) and cost : benefit ratio (1.73 & 1.74) was derived from hand weeding twice at 30 & 60 DAS during
both the years, Singh et al. 1987 have also reported similar results. The loss in weed yields in chickpea : mustard 1:1, caused by crop competition with weeds until the time of crop maturity was 63% in chickpea and 34% in mustard. Chickpea yields increased significantly when weed free conditions were extended until 60 DAS. In mustard maintaining weed free conditions beyond 40 DAS did not prove beneficial. The critical period of crop weed competition was found to be the 1st 8 week after sowing (Ali, 1993).

**Interaction between intercropping system and weed management practices (S x W)**:

Interaction effect of S x W was found in respect of plant stand of mustard (after thinning) during 1998-99 (Appendix 3), plant height of mustard at 90 DAS during 1999-2000 (Appendix 27), functional leaves of mustard at 90 DAS during 1998-99 (Appendix 32), number of branches per plant of mustard at 60 DAS 1998-99 (Appendix 48), fresh weight of mustard at 120 DAS & at harvest 1998-99 (Appendix 71 & 72) and at 90 & 120 DAS in 1999-2000 (Appendix 75 & 76), dry weight of mustard at 120 DAS in 1998-99 (Appendix 95) and at 90 & 120 DAS in 1999-2000 (Appendix 99 & 100). Values for these characters were significantly higher in chickpea + mustard 4 : 1 with weed free. When ever, fresh weight of mustard at 60 & 90 DAS in 1998-99 (Appendix 69 & 70), dry weight of mustard at 60 & 90 DAS in 1998-99 were significantly higher in chickpea + mustard 3 : 1 with weed free. The values for fresh weight of chickpea at harvest 1998-99 and at 60 DAS in 1999-2000 (Appendix 60 & 62), dry weight of chickpea at 60 DAS in 1999-2000 (Appendix 86) were higher in chickpea sole with weed free. Plant stand of mustard (after thinning) in 1999-2000 was higher in chickpea 4 : 1 with hand weeding twice (Appendix 7) and number of branches of chickpea at 30 DAS in 1999-2000 were higher in chickpea + mustard 3 : 1 with HW twice.
The results presented in Appendix 105, 106, 117, 122, 123 are clear that significant interaction effect of both factors on number of per plant and number of seeds per pod (chickpea), number of seeds siliqua, number of seeds per plant (chickpea), grain weight per plant of pea, thousand grain weight of chickpea and mustard during both the seasons. Values for these characters were significantly higher in S<sub>1</sub> W<sub>4</sub> tons.

It is evident from the results presented in Appendix 125 - 130, 132 - 7 make it clear that the highest seed yield, (15.37 and 16.19 q/ha) and biological yield (31.58 and 31.27 q/ha) of chickpea was recorded under the treatment combination of S<sub>1</sub> W<sub>4</sub> (Chickpea sole+weed free). Whenever the ed yield (13.62 and 13.37 q/ha) and biological yield (47.22 and 47.16 q/ha) mustard was noted under the treatment combination of S<sub>2</sub> W<sub>3</sub> (mustard le+weed free). Highest values of harvest index of chickpea were recorded S<sub>4</sub> W<sub>4</sub> during 1998-99 and S<sub>1</sub> W<sub>4</sub> during 1999-2000. Wherever, uminim harvest index of mustard was found in S<sub>1</sub> W<sub>4</sub> during both the seasons.

It is clear from the appendix 148-151 that the highest chickpea yield (17.58 and 18.36 q/ha) as well as mustard equivalent yields 9 and 16.00 q/ha) were obtained in S<sub>4</sub> W<sub>4</sub> (chickpea+mustard; 1:1)+weed treatment.

Further scrutiny of interaction effect of intercropping system and management practices on weed presented in Appendix 194 reveals significantly lowest weed dry matter accumulation was observed in all the cropping system with weed free conditions followed by S<sub>2</sub> W<sub>4</sub> treatment during 1998-99.