SUMMARY
AND
CONCLUSION
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An experiment entitled "Studies on weed management in chickpea/mustard intercropping system" was conducted at the Agriculture farm, Raja Mahender Pratap (Post-graduate) College, Gurkul-Narsan (Hardwar), during the years 1998-99 and 1999-2000. The treatments comprised five intercropping systems (chickpea sole at 15 cm spacing, mustard sole at 15 cm spacing, chickpea + mustard (3:1) row ratio, chickpea + mustard (4:1) row ratio, and chickpea + mustard (6:2) row ratio) and four weed management practices (Weedy check control, Hand weeding twice at 30 and 60 days after sowing, weed free (repeated weeding) and pendimethalin @ 1 kg a.i./ha) replicated four times in split plot design, keeping intercropping systems in main-plots and weed management practices in sub-plots. The results are summarized below:

Effect of intercropping system:

1. Intercropping system had no significant effect on plant stand per metre length of both crops during both the years, except mustard sole at harvest. Final plant stand of mustard was lower than other intercropping systems.

2. Intercropping system had no significant effect on plant height of both crops at any stages of crop growth in both the seasons.

3. Number of functional leaves per plant did not markedly differ among the four intercropping systems at various stages of crop growth in both the years.

Intercropping system showed significant effect on number of branches per plant of chickpea at later stages. The highest number of branches per
mustard and as 3:1 system in both the years.

Mustard sole produced significantly more branches than other systems at 120 DAS and at harvest during 1999-2000 only.

5. Chickpea sole produced more fresh and dry weight per plant than other intercropping system. Whenever the highest values of fresh and dry weight per plant of mustard crop were noted in chickpea + mustard (3:1) system.

6. Intercropping system showed significant effect on number of pods per plant (chickpea) during both the years. The highest number of pods per plant were recorded in chickpea sole system during 1998-99 and in chickpea + mustard, 1:1 system during 1999-2000.

Intercropping system had marked effect on number of siliquae per plant (mustard) in both the seasons. The maximum siliquae per plant were recorded with system S\textsubscript{3}.

7. Intercropping system had no significant effect on number of seeds per pod or per siliqua in both the crops during both the years.

The highest values of number of seeds per plant (chickpea) were recorded in chickpea sole during 1998-99 and in chickpea + mustard (4:1) during 1999-2000.

In mustard crop, number of seeds per plant were found significantly higher in chickpea + mustard (4:1) system in both the seasons.

Chickpea sole was produced greater quantity of seed per plant but not significantly differ during 1999-2000.

In mustard crop, chickpea + mustard (4:1) system produced higher weight per plant.

8. Intercropping system affected the thousand grain weight of chickpea significantly during 1998-99 only.

9. Thousand seed weight of mustard did not showed marked variation in all intercropping system.

10. Intercropping system had significant effect on seed yield and
1. Intercropping systems had no significant effect on nitrogen and protein content in seed of chickpea and in oil content in seed of mustard. However, chickpea + mustard (4:1) system had the highest land equivalent ratio of 1.07 and 1.13. Chickpea + mustard (6:2) system during both seasons did not find efficient system in terms of land equivalent ratio.

2. Intercropping system did not differ significantly in respect of chickpea equivalent yield and mustard equivalent yield in both the seasons. However, chickpea + mustard (4:1) intercropping system produced higher chickpea as well as mustard equivalent yield in both the seasons (13.99 & 14.68 q/ha) (12.72 & 13.35 q/ha).

3. The highest gross profit of Rs. 14673 and Rs. 15350/ha was recorded in chickpea + mustard (4:1) intercropping system with higher net profit of Rs. 4711 and Rs. 5289/ha respectively. While highest cost:benefit ratio of 1:1.56 and 1:1.61 was observed in mustard sole intercropping system. The cost of cultivation was highest in chickpea sole and lowest in mustard sole.

4. Intercropping system did not produce any significant effect on intensity of grassy weeds as well as non-grassy weeds at any stages of crop growth. However, the highest number of both weeds were found in chickpea + mustard (3:1) system and lowest in mustard sole intercropping system. Intercropping system showed a significant effect on weed dry matter accumulation at harvest. The highest weed dry matter was noted in chickpea sole (198.88 g/m²) during 1998-99 and in mustard sole (113.63 g/m²) during 1999-2000 over all intercropping system.

5. Intercropping system did not show marked variation in weed control efficiency. However, mustard sole showed maximum weed control efficiency in both the seasons.
Effect of weed management practices:

1. Application of pendimethalin as pre-emergence has no any adverse effect on germination of chickpea and mustard and on plant stand at any stage of crop growth.

2. Weed management practices did not mark variation in plant height in chickpea at any stages of crop growth in both the years. While weed management practices significantly affected the plant height of mustard at all the stages of crop growth. Application of pendimethalin was found significantly poor than others at 30 DAS. At later stages, this treatment recovered the plant height and was found significantly better than weedy check control. Weed free conditions were found superior in respect of plant height followed by HW twice.

3. Weed management practices significantly affected number of functional leaves per plant at all stages of crop growth except 30 DAS in both seasons.

4. Weed management practices showed marked effect on number of branches per plant of both crops in both the seasons except 30 DAS. Weed free conditions produced highest number of branches as compared with other practices.

5. Fresh and dry weight per plant were markedly different among four weed management practices at various stages of crop growth except at 30 DAS in both the crops during both the years. The highest values of above were noted in weed free conditions.

6. Number of pods/silica per plant, number of seed per pod/silica, number of seeds per plant, seed weight per plant, thousand seed weight were positively increased due to weed management practices and their highest values were noted in weed free conditions in both the crops during both the years.

7. All the weed management practices were found superior for significantly higher seed yield and biological yield of chickpea as well as mustard to weedy check control. Weed free conditions produced more seed
teraction effect of intercropping system & weed management tactics:

In the present investigation two factors (intercropping systems and weed management practices) were tried. Therefore, the interaction effect of first order (intercropping system x weed management practices) on growth characters, yield attributes, yield characters, yield quality, intercropping advantages and economics and also weed population, weed dry matter accumulation and weed control efficiency were studied and the results pertaining to interaction effect have been presented in Appendices 1 to 198.

It is clear from the appendices 3, 7, 27, 32, 43, 48, 60, 62, 69-72, 86, 93-95, 99 and 100 that significant interaction effect of intercropping system and weed management practices were observed only on plant stand of mustard (after thinning) during both the years, plant height of mustard at 0 DAS during 1999-2000, functional leaves of mustard at 90 DAS during 1999-2000, number of branches of chickpea at 30 DAS in 1999-2000, number of branches per plant of mustard at 60 DAS in 1998-99, fresh weight of chickpea per plant at harvest in 1998-99 and at 60 DAS in 1999-2000, fresh weight per plant of mustard at 60, 90, 120 DAS & at harvest in 1998-99 and 1999-2000, dry weight per plant of chickpea at 60 DAS in 1999-2000 and of mustard at 60, 90 DAS in 1998-99 and at 90 DAS in 1999-2000.

The results presented in Appendices 103-112, 116, 117, 122 & 123 make it clear that significant interaction effect of both factors on number of pods per plant and number of seeds per pod (chickpea), number of seeds per plant of chickpea, number of seeds per plant (chickpea), grain weight per plant of chickpea, thousand grain weight of chickpea and mustard during both the years.

It is evident from the results presented in Appendices 125-130, 132-137 make it clear that the highest seed yield, (16.37 and 16.19 q/ha) and biological yield (31.53 and 31.27 q/ha) of chickpea was recorded under the
as well as sown followed by HW twice and application of pendimethalin.

The highest values of harvest index were recorded in weed free condition followed by HW twice and her bicide treated plots.

Weed control treatments did not show any significant improvement in nitrogen and protein content in seed of chickpea and in oil content in seed of mustard.

Weed free conditions proved superior land equivalent ratio (1.03 and 0.7) in both the seasons. While application of pendimethalin did not find efficient weed management practices in terms of LER.

Chickpea equivalent yield as well as mustard equivalent yield increased steadily with weed free conditions in both the seasons followed by HW rice and applications of pendimethalin. The weeds, when allowed to compete with crop for entire crop season, reduced the chickpea and also mustard equivalent yield by 29.70, 39.34 and 18.16 percent during 1998-99 and 24.92, 35.23 and 14.40 percent during 1999-2000 with HW twice, weed free and application of pendimethalin respectively.

2. Weed free conditions with highest cost of cultivation gave higher gross profit while highest net profit and and cost : benefit ratio were noted in those plots which were weeded twice at 30 and 60 DAS. Hand weeding rice at 30 and 60 DAS with only on additional cost of cultivation of Rs. 12/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.

Weed free conditions were found to be more effective in reducing the weed population and dry matter accumulation by weeds than other treatments.

The highest weed control efficiency (100%) was recorded with weed conditions followed by HW twice at 30 and 60 DAS (46.33 and 46.37%) application of pendimethalin (27.99 and 24.65%). HW twice proved significantly superior to application of pendimethalin and weedy check control in all the years.
Weed free treatment registered a significant superiority to rest of the seed management practices viz. chemical and mechanical weeding.

The weeds, when allowed to compete with crop for entire crop season, reduced the chickpea and also mustard equivalent yield by 29.79, 39.31 and 36 percent during 1998-99 and 24.92, 35.23 and 44.10 percent during 1999-2000 with HW twice, weed free and application of pendimethalin respectively.

Though, weed free conditions gave the highest gross profit in both the cases but it needed higher cost of cultivation. While hand weeding twice at 0 and 60 DAS gave the highest net returns of Rs 6277/ha and of Rs 6117/ha with highest cost : benefit ratio (1 : 1.73 and 1 : 1.74) respectively.

Thus, the chickpea + mustard (4:1) with hand weeding twice at 0 and 60 DAS may appreciably be recommended for obtaining maximum economical yield with greater profitability for the tract. In case of limited availability of labour or other wise if cost of labour is high, application of pendimethane (0.1 kg a.i./ha) as pre-emergence may be made in same stem without much economical loss.