CHAPTER 2

REVIEW OF LITERATURE

It is usual to speak of the best employment and utilization of field space for increasing the production per unit area of land as described earlier. Gram as main or mixed crop has been popular since long for growing inter or mixed cropping with tall wheat and barley but very limited research work is available on the inter or mixed cropping of mustard with gram. Gram is an important pulse crop of rabi season while mustard among rabi oilseeds. In recent past some workers have studied the effect of intercropping system of mustard with gram (chickpea), but the literature is meagre on the intercropping aspects of chickpea and mustard in relation to different planting patterns and weed management practices. In the present trial chickpea was taken as main crop grown by different row spacing adjustment by adjusting one row of mustard as intercrop under different methods of weed control. The available information on related aspects of the study is, therefore, presented under the following heads:

A. GROWTH, YIELD AND ECONOMICS OF CHICKPEA AND MUSTARD IN INTERCROPPING UNDER DIFFERENT PLANTING PATTERNS:

Keshwa et al. (1988) reported that net returns were highest in mustard in pure stand and intermediate in intercropped stand and lowest in gram in pure stand.

Mehta et al. (1990) reported that in the 4 treatments (Chickpea in rows 45 cm. apart was intercropped with mustard in 3:1 and 1:1 row ratio, or Chickpea in paired rows 30 cm. apart was intercropped with one row of mustard in the interspace 60 cm. wide, or mustard was cross sown in rows
2.25 m apart in chickpea in row 3. When sown 2.75 m apart, chickpea gave an average yield of 1.82, 1.52, 1.35 and 1.65 t/ha, respectively, compared with 2.42 t/ha in pure stands. Mustard as an intercrop gave seed yields of 0.9, 0.99, 1.30 and 0.77 t/ha, respectively, compared with 2.65 t in pure stand. An equation to ascertain the comparative ratio for each crop in intercropping system showed that mustard was a better competitor than chickpea.

In field trials chickpea were intercropped with *Brassica juncea*, safflower or linseed in row ratio ranging from 1:1 to 7:1. The highest gross returns and land equivalent ratio were obtained with intercropping chickpea with safflower, mustard and linseed in 7:1, 2:1 and 3:1 row ratio, respectively (Bhatnagar et al., 1991).

Mandal et al. (1991) conducted a field trial in which mustard, Chickpea and lentil were grown pure or intercrops with or without mulching with 7.5 t/ha straw and reported that mulching increased DM production, LAI and seed yield. Mustard seed yield was 1.25 t/ha in pure stand and 0.84-0.94 t/ha in intercrops; corresponding yield in chickpea were 0.91 and 0.31-0.65 t/ha and in lentil were 0.62 and 0.18-0.39 t/ha. Total yield of the intercrops was highest (1.24 t/ha) in 2:1 mustard : chickpea intercrop and lowest (0.72 t/ha) in 2:4 chickpea : lentil intercrop. LER and financial returns were highest in 2:1 intercrop of mustard : chickpea or mustard : lentil.

In a field trial mustard and chickpea were grown as sole crop and intercropped at 4:1 or 1:3 row ratio. The highest mustard and lowest chickpea DM production was obtained from 1:3 ratio (Vyas et al., 1991).

Singh (1991) obtained seed yield of gram and mustard 1.54 and 1.41 t/ha respectively when grown alone compared with the combined yield of 1.10 t (gram) + 0.53 t (mustard) from intercropping in 3:1 ratio. The highest net profits were obtained from intercropping.

In a field trial chickpea intercropped with wheat, mustard, linseed and safflower in 2:2, 4:1 or 8:1 row ratio gave an average seed yield of 0.40-1.17 t/ha compared with 1.44 t in pure stand. The four intercrops gave yields of 0.26-
In a field trial, chickpea intercropped with mustard in row ratio of 1:1, 2:1, 4:1 or 6:1 produced mean chickpea equivalent yield of 2.82, 2.31, 2.10 and 2.38 t/ha respectively compared with 1.39 t/ha from chickpea crop and 1.93 t from the pure mustard crop. The highest yields under intercropping were related to improved microclimatic conditions (Bishnoi et al., 1992).

Sachan and Uttam (1992) conducted a field trial in which gram and mustard were grown as sole crop and intercropped at 2:1, 2:2 or 3:1 row ratio and reported that seed yields of gram in intercropping were 0.96, 0.78 and 1.09 t/ha respectively and in sole crop 1.38 t. The corresponding mustard seed yields were 0.52, 0.63 and 0.35 t/ha in intercropping, and 1.08 t in the sole crop. The 2:1 and 2:2 row ratio produced similar net returns which were greater than the other 2 treatments.

Singh and Yadav (1992) reported that intercropping of chickpea with mustard in 4:1 row ratio gave the highest chickpea equivalent yields and the highest net returns compared with 8:1 row ratio.

In a field trial, chickpea were intercropped with wheat, mustard and lentil in various seed mixture or row ratios. Seed yield of chickpea 1.42 t/ha as pure stand in single row (30 cm) compared with 2.15 t from paired rows (30/60 cm). Chickpea + mustard (75 + 25% seed mixture) produced the highest chickpea equivalent yield of 3.20 t and had the highest cost-benefit ratio (Singh et al., 1992).

In a field trial chickpea were grown alone or intercropped with mustard in a 4:1 (30 cm) or 1:2 (40 cm) row ratio. Mustard was also grown alone in 40 cm rowspacing. Chickpea equivalent seed yields were highest (3.25 t) intercropped mustard in a 4:1 row ratio. The land equivalent ratio was high
est (1.022) with chickpea intercropped with mustard in a 4:1 row ratio (Ali, 1992).

Aziz and Salahuddin (1993) reported that mustard intercropped with gram at a row ratio of 2:2 gave seed yield of 0.98 and 1.49 t/ha respectively and the highest gross margins compared with other intercropping treatments (row ratio 2:1 or 3:1) and where mustard alone or both crops were broadcasted sown in various mixtures.

Punia et al. (1999) conducted a field experiment to assess the production potential of various pulses and linseed intercropped with Indian mustard under rainfed conditions. On an average, highest seed yield of mustard equivalent (1878 kg/ha) and net return (Rs. 16957/ha) were recorded under sole mustard followed by its intercropping with chickpea (1 : 5 ratio). Intercropping of mustard with chickpea and field pea increased the LER as compared to sole crop.

B. EFFECT OF WEED MANAGEMENT PRACTICES ON WEEDS AND GROWTH AND YIELD OF CHICKPEA:

In a field experiment conducted at pantnagar to study the effect of mechanical and herbicidal weed control in chickpea and observed that weeding at 60 DAS was more effective than earlier single weeding and best result were obtained by weeding twice at 30 and 60 days. Herbicides were less effective only fluchloraline controlled all weeds sufficiently and increased crop yield. Nazafen was effective only in the first trial. Mattrubizin was phytotoxic to the crop. (Singh et al., 1987)

In a trial in winter sown chickpea infested with 40% surface cover of grasses and broadleaved weeds, EPTC incorporated pre-sowing and diphenamid pre-em. gave good control of grasses, while both triluralin incorporated pre-sowing and nitrofen + linuron pre-em. gave excellent, selective control of broadleaved weed and resulted in grain yields comparable to those of hand weeded control, other pre-em. herbicides, including pendimethalin & dinosob acetate, were active against a broad spectrum of
weed, but no herbicide controlled Galium aparine (Venova and Gallo, 1987).

Balyan et al. (1980) reported that weeding once 45 DAS resulted in significantly higher yields and yield components than weeding at 15 or 30 DAS.

Balyan et al. (1990) reported that all manual weeding treatments (Unweeded, weed free up to 120 DAS and weed free) resulted in significantly reduced density and DW of weeds at crop harvesting time, compared to the unweeded control.

Trials in chickpea demonstrated excellent weed control and highest yields from manual treatments and from imazethapyr, while control from metobromuron + metazachlor linuron + alachlor and propyzamide + simazine was barely sufficient. (D. Alessandro et al., 1990)

A field trial conducted at Faisalabad to created the effect of pre-emergence application of pendimethalin, dimethyl tetra chloroterephthalate (chlorothal), trifluralin and methabenzthiazuron on chickpea and weeds. None of the herbicides adversely affected the nodulation of chickpea. Pendimethalin, trifluralin and methabenzthiazuron applied @ 1.32 litre, 0.64 litre and 1.4 kg/ha a.i. respectively, were suitable for chickpea on sandy loam soil. However, methabenzthiazuron gave a higher yield. (Iqbal et al., 1991).

Vaishya et al. (1995) reported that all weed control treatments proved superior to the unweeded check treatment. However, hand-weeding at 25 and 45 DAS was found most promising in increasing the grain yield of chickpea as compared with alone application of fluchloralin @ 1.0 kg/ha and in combination with 1 hand-weeding at 25 DAS. Uncontrolled weeds reduced the crop yield by 47.3% compared with hand-weedings at 25 and 15 Days.

A field trial conducted at Srikakulam to access the efficacy and economics of integrated weed management in chickpea and blackgram and reported that yield attributes were best in the integrated treatments but the treatments were more costly. Net profits were highest with hand weeding
twice and 0.5–1.0 kg alachlor in blackgram and with 0.5–1.0 kg fluchloralin + handweeding in chickpea. (De et al., 1995).

Vaishya et al. (1996) reported that integration of the 75 kg seed rate and manual removal of weeds at 15 and 30 DAS was the best weed control solution.

A field trial conducted at Pantnagar to assess that efficacy of hand weeding 30 and/or 45 or 60 DAS, pre-em. pendimethalin at 0.75–1.5 kg/ha or oxyfluorfen at 0.08–0.15 kg/ha or pre-plant incorporated fluchloralin at 1.0 kg and observed that hand weeding once 60 DAS was sufficient to control weeds in this system. (Singh and Sahni, 1996).

A field trial conducted at Jabalpur to study the competitive effects of 4 weeds species (Vicia sativa, Cichorium intybus, Phalaris minor and Chenopodium album) at 4 densities (50, 100, 150 and 200 plants/m²) on the growth and yield of gram and reported that the most competitive weed spp. was Cichorium intybus which caused 56.8, 53.5, 56.1 and 60.7 reduction in yield at densities of 50, 100, 150 and 200 plants/m² respectively (Paradkar et al., 1997).

Malik et al. (1998) reported that application of fluchloralin and pendimethalin @ 1.5 kg/ha gave the highest yields of Chickpea.

Shakhatari and Sharma (1998) reported that fluchloralin @ 0.5 kg/ha incorporated pre-sowing gave the best control of weeds and crop yield. Hand-weeding once and isoproturon @ 0.02 kg gave good yield. Simazine @ 0.5 kg. was phytotoxic to the crop of chickpea.

Balyan et al. (1998) reported that pre-emergence application of fluchloralin at 1.5 kg/ha and metribuzin at 0.5 kg/ha by hand-weeding twice at 30 and 60 days after sowing gave effective control of weeds in chickpea field. These treatments also resulted in more branches and pods/chickpea plant and higher grain yields equivalent to that of the weed free control. Senthoxynil at 0.5–1.0 kg/ha and metribenmethiazuron at 0.75–1.5 kg/ha post and pre-emergence did not control weeds effectively.
Fig. 4.28: Land equivalent ratio as influenced by intercropping systems and weed management practices.
C. EFFECT OF WEED MANAGEMENT PRACTICES ON WEED AND GROWTH AND YIELD OF MUSTARD:

Rar et al. (1990) reported that the application of herbicides [Isoproturon, Pendimethalin, fluchloralin and Oxadiazon at 0.5 kg] + one hoeing gave the greatest reduction in weed population with Oxadizon being the most effective herbicide. Oxadiazon at 0.75 kg/ha gave the highest seed yield (1920 kg/ha, compared to 1620 and 1330 kg in twice hoed and unweeded control, respectively).

Singh and Sharma (1992) conducted a field trial using different weed control treatments in mustard (Brassica juncea cv. Pusa Bold) and reported that seed yield was 1.53 t/ha without weed control, 2.56 t in weed free control, 1.82-1.83 t when weeded 30 DAS with a small hand tool or a blade hoe, 1.83 t with 0.75 kg isoproturon/ha applied 30 DAS, 2.27 t with 0.75 kg pre-em. oxadiazon/ha, 2.13 t with 1 kg pre-em. pendimethalin/ha and 2.41 t with 1 kg pre-sowing fluchloralin/ha. Other than the weed free control, the weed count was lowest (6 cm²) after treatment with fluchloralin.

Singh et al. (1993) reported that all weed control treatment (hand-weeding once 30 DAS, repeated weeding, pendimethalin at 1 kg/ha and isoproturon at 0.75 kg) decreased weed DW from untreated control values of 22.1 g/1000 cm² to 9.5-9.1 g and increased mustard yield from 700-950 kg/ha to 1040-1820 kg. Repeated weeding resulted in the greatest yield. Weed control treatments effected the oil content of mustard variably.

Rajput et al. (1993) observed that all treatments of weed control (Physical methods like hand-weeding once 30 DAS, hoeing once 30 DAS, and hand-weeding twice at 30 and 45 DAS and chemical methods like methabenzthiazuron, 2,4-D and metoziuron at 1 kg/ha and pendimethalin and isoproturon 0.75-1.0 Kg) increased crop yield. Hand-weeding twice resulted in the greatest weed control (70.12 - 83.65%) and crop yield (1667.2320 kg/ha). Hand-weeding twice also resulted in the greatest additional yield/return compared to the control (483.5 kg.) followed by isoproturon at 1 kg. (1261.0 kg)
C. EFFECT OF WED MANAGEMENT PRACTICES ON WEED AND GROWTH AND YIELD OF MUSTARD:

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Singh and Sharma (1992) conducted a field trial using different weed control treatments in mustard (Brassica juncea cv. Pusa Bold) and reported that seed yield was 1.51 t/ha without weed control, 2.56 t in weed free control, 1.82-1.83 t when weeded 30 DAS with a small hand tool or a blade hoe, 1.83 t with 0.75 kg isoproturon/ha applied 30 DAS, 2.27 t with 0.75 kg pre-em. oxadiazon/ha, 2.13 t with 1 kg pre-em. pendimethalin/ha and 2.41 t with 1 kg pre-sowing fluchloralin/ha. Other than the weed free control, the weed count was lowest 7 days after treatment with fluchloralin.

Singh et al. (1993) reported that all weed control treatment (hand-weeding once 30 DAS, repeated weeding, pendimethalin at 1 kg/ha and isoproturon at 0.75 kg) decreased weed DW from untreated control values of 22.4 g/1000 cm² to 9.5-21 g and increased mustard yield from 700-970 kg/ha to 1010-1890 kg. Repeated weeding resulted in the greatest yield. Weed control treatments affected the oil content of mustard variably.

Rajput et al. (1993) observed that all treatments of weed control (Physical methods like hand weeding once 30 DAS, hoeing once 30 DAS, and hand weeding twice at 30 and 45 DAS and chemical methods like methabenzthiazuron, 2.4 D and metazachlor at 1 kg/ha and pendimethalin and isoproturon 0.75-1.0 Kg) increased crop yield. Hand-weeding twice resulted in the greatest weed control (70.12 - 83.65%) and crop yield (1667-2320 kg/ha). Hand-weeding twice also resulted in the greatest additional yield/return compared to the control (183.5 kg) followed by isoproturon at 1 kg (126.0 kg).
Ghosh et al. (1993) observed that all weed control methods – hand weeding twice at 20 and 40 DAS, mulching with black polyethylene, mechanical weeding twice at 20 and 40 DAS, isoproturon at 1 kg/ha alone or in combination with mulching or mechanical weeding 10 DAS and hand weeding 20 DAS + mechanical weeding 40 DAS in mustard increased seed yield from untreated control values of 190-630 kg/ha to 210-1030 kg. Isoproturon + mulching resulted in the greatest yield.

Ahuja et al. (1993) observed that pendimethalin and fluchloralin both at 0.75 kg resulted in the greatest pod and grain yield resp. (30.2 g/plant and 1280 kg/ha) in rapeseed mustard.

Pahuja et al. (1993) reported that all weed control treatments (hoesing twice 3 and 6 WAS, pre-em. pendimethalin at 1.0 and 1/5 kg/ha and post-em. (30 DAS) isoproturon at 0.5 and 0.75 kg/ha) reduced weed DW and increased crop seed yield. Of the weed control treatments, isoproturon at 0.75 kg/ha resulted in the greatest yield.

Chauhan et al. (1993) observed that all weed control treatments (pre-plant incorporated fluchloralin and pendimethalin applied 2 DAS at 1.0 kg/ha alone or at 0.75 kg. In combination with hand weeding once at 30 or 40 DAS, hand weeding twice 30 + 10 DAS and isoproturon at 0.5 - 0.75 kg for weed control in mustard) decreased weed DW from untreated control values of 259-280 kg/ha to 32-72 Kg and increased crop seed yields from 1109-1328 kg/ha to 1217-1872 kg. Pendimethalin + hand - weeding once resulted in the greatest crop yields.

Kaneria and Patel (1994) reported that lower dry weed weight was recorded under continuous weeded plots and 2 hand - weeding at 25 and 45 days after sowing followed by herbicidal treatment compared with weedy check and hand weeding at 45 days after sowing or intercultural at 25 DAS or both. The maximum yield was registered with weed free conditions but remained at par with 2 hand - weeding at 25, 45 days after sowing, pendimethalin alone and with hand - weeding at 45 days after sowing.
Bhadoria and Chauhan (1995) reported that all the parameters except primary branches, seeds, silique and oil content were significantly affected by weed control treatments. Weed free treatment recorded higher values of growth and yield attributes, followed by one hand weeding 25 DAS. All the weed control treatments recorded significantly higher seed yield over the control.

A field experiment carried out at Gwalior to study cultural and chemical weed control in Indian mustard (*Brassica juncea*) and reported that all the herbicides and cultural treatments significantly reduced dry matter production by weeds over the control. The highest seed yield was obtained in weed free treatment, followed by two hand weeding (at 30 and 45 DAS) and in plots treated with fluchloralin @ 0.75 kg a.i./ha at pre-planting (Sharma and Chauhan, 1995).

A field experiment carried out at Gwalior, to evaluate the weed control efficacy of Basalin, Stomp, Tolkam and Bonstar, and of hand weeding in Indian mustard and reported that all weed control treatment significantly reduced the weed density and biomass compared with the weed check. None of the herbicides and cultural operations significantly affected the plant height, 1000 grain weight and oil percentage. Basalin and stomp resulted in significantly higher number of primary and secondary branches per plant than the control. Hand weeding at 30 DAS was found significantly superior to the weedy check owing to better weed control by the treatments than weedy check. Though all the weed control treatments recorded higher number of silique per plant than weedy check, weed free check was found significantly superior to the control and the other treatments for yield and other parameters. (Bhadoria and Chauhan, 1995).

A field trial conducted at Morena with 12 treatments of weed control and observed that two hand weeding at 20 and 40 DAS and application of Matribusin @ 0.175 kg a.i./ha (P.E.) and isoproturon @ 0.75 kg a.i./ha (P.P.) to be at par with respect to minimising weed density, increasing yield
attributes and weed control measures, maximum yields were obtained with rest of the treatments under study (Yadav et al., 1997).

Singh et al. (2001) reported that the maximum seed yield (1825 kg/ha) was recorded in weed free, followed by two manual weedings at 25 and 45 days after sowing (1693 kg/ha). Among the herbicides, pre-emergence application of pendimethalin @ 1.0 kg a.i./ha recorded higher seed yield and found best substitute of repeated manual weeding where the labour costs are too high.

D. INFLUENCE OF WEED MANAGEMENT PRACTICES IN INTERCROPPING OF MUSTARD WITH CHICKPEA.

Ali (1993) conducted field trials to study the nature and magnitude of crop weed competition in intercropped chickpea and Indian mustard (4:1 row ratio) and observed that the loss in seed yields 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 benificial. On the basis of chickpea yields the plots which were kept weed-free until the time of crop maturity accrued losses of 1069 kg/ha (12% greater than weed-free plot). The critical period of crop weed competition was found to be the 14-8 weeks after sowing.

A field experiment conducted at Bichupuri (Agra) to study the effect of weed control measures and phosphatic fertilization on growth and yield of chickpea + Indian mustard (Brassica juncea) (2:1 row ratio) intercropping under dry land conditions and resulted that the most effective weed control treatment was 1.5 kg chlorotoluron / ha, which gave chickpea and mustard seed yields of 1.47 and 0.36 t / ha respectively and the highest net return. Seed yields of both crops increased with upto 40 kg P₂O₅ (Singh and Singh, 1997).