***Case study***

# Weed Smotheringin Mustard ( *Brassica spp*)by itsHigh DensityUniform Broadcast Sowing, a Case Study

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**ABSTRACT:** Manual weed control in mustard is very expensive because of its high labour requirement i.e., 150-250 labourers/ha. Chemical weed control again imposes environmental hazards. Mechanical weed control in mustard is not still that popular till date. Due to severe weed competition, the yield reduction in Indian mustard may go as high as 70per cent. Thus weed control in zero till mustard using its high density sowing (HDS) was studied indifferent farmers' field and at ICAR-CRIJAF, in North 24 PGS from 2018-2022. Fast growing and high densityuniform mustard canopy (100-200 $m^2$) developed at early stages hinders sunlight penetration (up to 99.98 percent) below its canopy (at 35- 40 days), leading to scanty and under developed growth of different composite weed species at harvest, those germinate or grow below mustard canopy. Weed population below mustard canopy was reduced by 92 to 97 per cent at mustard harvest. It was only 10-80/$m^2$at harvest over 350-1000/$m^2$ in weedy situation at initial germination. The reduction of dicot weed biomass below matured mustard at harvest was 81-99 percent (5-150g/$m^2$) percent over weedy plots (500-800/$m^2$). Reduction of effective flowers/pods of different weeds under matured mustard canopy were up to99.5 percent. Proper agronomic management practices of HDS mustard e.g., seed rate, date of sowing, uniformity of sowing, irrigation and fertiliser application will eliminate the herbicide application or manual weeding in mustard. Nearly 80 percentmustard plants remain active at harvest. It saves 150-250 labours /ha depending on weed species and its density of germination. Mustard grain yield ranged from 15-30 q/ha depending on management and varieties used. This weed smothering merit of mustard can be used for eco-friendly weed control in other wide spaced field/horticultural crops using its dwarf variety (Toria).

**Key words:** Weed smothering,light transmission, weed biomass, weed population, mustard yield.

## 1. INTRODUCTION

Manual weed control in mustard is almost impossible because it'sof high labour requirement (150-250 numbers/ha). Chemical weed control imposes environmental hazards. Mechanical weed control is not still that popular till date.
Unlike other oilseed crops, mustard suffers more from weed competition in early growth stag

es especially between 20-40 days after sowing (Singh *et al.,* 2015). Due to severe weed competition, the yieldreduction in Indian mustard may go as high as 70per cent (Tiwari and Kurchania, 1993). Proper agronomic management practices of high density broadcast sowing mustard with particular reference to seed rate, date of sowing, uniform sowing, irrigation and fertiliser application will eliminate the weeding problem in it and eliminate herbicide or manual weeding requirement in mustard.Mustard cover crops can suppress weeds through a variety of mechanisms both during growth. During cover crop growth, weed germination may be inhibited through shade-induced reduction in the ratio of red to far-red light, while subsequent growth and reproduction may be suppressed through competition for light, water, or nutrients (Holt, 1995).Kumar *et al*., 2009 found that yellow mustard reduced biomass and seed production of hairy galinsoga [*Galinsogaciliata* (Raf.) S.F. Blake] by more than 95%.Plant densities also have an effect on weeds.Increasing crop canopy per unit area bymanipulating plant density has significant impacton suppressing weed growth (Bhan, 1992). Singh(2006) reported that the lowest seed rate of 4 kg/ha recorded significantlyhigher weed density and dry matter accumulationthan higher seed rates of 5 and 6 kg/ha, respectively..

In hemp increase of plant density from 100 to 200 plants $m^{-2}$ markedly reduced weed weight from 23.2 to 6.5 g $m^{-2}$. Further reductions in weed weights in hemp field were observed at 300 plants $m^{-2}$ (2.6 g $m^{-2}$) and 400 plants $m^{-2}$ (1.5 g $m^{-2}$), Hall *et.al.*,2014.Fast growing dense jute canopy (200-348/$m^2$)at 25 days after sowing with mean height of 29 cm, reduces the light penetration at its canopy base by 90-95 per cent and dominated all C4 weeds and eliminated weeding in jute.It reduced the grass, broadleaf, sedges weed population and weed bio mass by 70, 98.5, 64.5 and 91.65 per cent respectively over manual weeding twice (Ghorai *et.al.*, 2022), produced jute fibre yield upto 38q/ha.In plots with the highest seeding rate (8 million/ha) of spring wheat, weed biomass was significantly lower, however lodging problem,especially in early seeded plots occurred (Auskalniene*et al.,* 2018) in Lithuania.Marin and Weiner (2014) reported on average, weed biomass was reduced by 72% in the first year and 58% in the second year, and maize grain yield was increased by 48% and 44% at the highest density in the grid pattern compared with standard sowing practices (medium density, row pattern). Increaseddensity and uniformity can contribute to weed managementin maize in many cases, potentially reducing theneed for herbicides or mechanical weed control.Thus weed control in zero till mustard field using its high density broadcast sowing was postulated and studied from farmers' field and at ICAR-CRIJAF from 2018-2022.

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## 2. MATERIALS AND METHODS

The observations were taken from large farmers' field in different blocks of North 24 PGS, WB and experiments from ICAR-CRIJAF, Barrackpore, West Bengal, 2018-22. Zero till pairamustard (mixed with sand 1:3 ratio)weresown (1st week of November) in double criss-cross pattern (for uniform stand) within matured rice (cv. Kshitish, Gotra etc) field 10 days before its harvest, in well drained muddy soil. Seed (viability > 90 per cent) rate used were 7.5 (3 g/1000 seeds) to 10 kg/ha (bold seed 5g/1000seeds). Mustard varieties used were Bullet, B-9, Agrani, Pusa bold, and Varuna etc in different locations. Basal fertiliser (N:P:K:: 25:65:65, through N:P:K:: 10:26:26@ 250 kg/ha)wereappliedbefore or after mustardseeding on muddy soil along with 15 kg nitrogen in urea form/ha.For conventional cultivated mustard, N:P:K:: 40:60:60 is appliedas basal dose. Forty kg N/ha is top dressed at 30 days after sowing (DAS) at branching stage. In zero tillpaira crop of mustard, 1st irrigation is applied at hair crack of soil/30 DAS at branching stage. For tilled soil, 1st irrigation is applied during sowing and 2nd irrigation at 30 DAS. The 3rd irrigation is applied at pod development stage. Observation of weed population (per $m^2$) and its biomass (per $m^2$) were taken after weed emergence and mustard harvest  Only 45 cm around the mustard field has to be manually weeded to prevent weed seed formation. Plant protection measures were taken as per recommendations. Light interception was measured at 35-40 days of crop growth by LX-102 Light Meter (Lutron) during 11 am.

## 3. RESULTS AND DISCUSSIONS

Prevalent Weed Population: i) Grass: *Cynodondactylon* ii) Dicot: *Chenopodium album, Solanum nigrum, Physalis minima, Ageratum conyzoides, Amaranthus viridis, Euphorbiamicrophyla, Euphorbia prostrate,Medicago lupulina, Alternanthera spp,Cleomviscosa , Melilotus spp, Digeraspp, Celosia spp, Vicia spp, Anagalis arvensis, Sonchus spp,Rumex spp, Taraxacum spp, Gnaphalium spp etc*(Table 1). and iii) Sedges: *Cyperus rotundus.*

Depending on species the weed population reaches up to 1000/$m^2$, *Chenopodium album* in particular.Fast growing high density mustard canopy (100-200/$m^2$ depending on

seed size and seed rates) developed at early stages (Photo 1) blocks sunlight penetration ( up to 99.98 per cent, Photo 2, Table 2 ) below its canopy (of average plant height 30 cm at 35-40 days), leading to smothering or under growth of composite weed species, those germinate or grow below it. Similar result was reported in jute by Ghorai*et al*, 2022.It hinders the poor and lanky weeds to produce seeds.Kumar *et al.*, 2009 found that yellow mustard reduced biomass and seed production of hairy galinsoga [*Galinsogaciliata* (Raf.) S.F. Blake] by more than 95%.

During cover crop growth, weed germination may be inhibited through shade-induced reduction in the ratio of red to far-red light, while subsequent growth and reproduction may be suppressed through competition for light, water, or nutrients (Holt, 1995). Un-uniform sowing or gappy stand allows composite weeds to germinate, grow and produce seeds for next generation (Photo 3). Weed population below mustard canopy was reduced by 92 to 97 per cent at mustard harvest. It was only 10-80/$m^2$ at harvest over 350-1000/$m^2$ in weedy situation at initial germination (Photo, 4). The reduction of dicot weed biomass below matured mustard at harvest was 81-99 percent (5-150g/$m^2$) percent over weedy plots (500-800/ $m^2$), table 3. Reduction of effective flowers/pods of different weeds under matured mustard canopy were up to 99.5 percent ( Table4,).However, many of the weeds perishes away before maturity or can not even produce fruits or seedsat all.Many of the initial mustard plants remain weak due to competition for light, space, moisture and nutrition arising out of population pressure.Near 80 percent of initial mustard plants remains effective at harvest, others become week seedlings and some of them perish eventually.

**Table. 1** Predominant dicotyledonousweeds of mustard fields at different locations across studies.

| | | | |
|---|---|---|---|
|  |  |  |  |
| *Chenopodium album* | *Solnum nigrum* | *Ageratum conyzoides* | *Amarnthusviridis* |
|  |  |  |  |

| | | | |
|---|---|---|---|
| *Euphorbia microphyla* | *Euphorbia prostrata* | *Medicago lupulina* | *Alternanthera sessilis* |
|  |  |  |  |
| *Cleom viscosa* | *Melilotus alba* | *Digeraspp* | *Celosia argentea* |
|  |  |  |  |
| *Vicia sativa* | *Anagalis arvensis* | *Rumex spp.* | *Spilanthesoleracea* |

Application of Pretilachlor 50% EC @ 0.9l/ha as post-emergence herbicide in mustard as paira crop and immediately after rice harvest controlled *Chenopodium album* only. However, many other weed species were suppressed, remain stunted, unproductive under dense and well developed tall growing mustard at 45 days after sowing and eventually produced 11 q mustard seed/ha at ICAR-CRIJAF (Ghorai*et al.*, 2022).


Photo 1. Weed free mustard field under zero till high density broadcast sowing (35-40 DAS), at ICAR-CRIJAF, Barrackpore and Jagannathpur, 24 PGS (N), WB

Most of the remaining weeds remain stunted (Photo 4) and similar results have been reported by Hall *et.al.* 2014; Auskalniene*et al.*, 2018; Marin and Weiner 2014,Ghorai*et.al,* 2022 in other field crops like hemp,corn, wheat and jute.Proper agronomic management practices of high density broadcast mustard sowing with particular reference to seed rate, date of sowing,uniform sowing, irrigation, and fertiliser application in mustard will eliminate the

weeding problem in it and eliminate herbicide or manual weeding in mustard and produce good crop with smothered and scanty weeds at harvest (Photo 4).

High density broadcast sowing of mustard saves 150-250 labours/ha depending on weed species and its density of germination. The mustard crop is harvested at maturity of pods and threshed in threshing floor. Nowadays the mustard is being threshed by multi-crop thresher to minimise cost. Mustard grain yield obtained varied from15to30 q/ha depending on varietiesgrown in different places (Table 3).


**Photo 2**. Light flux above (254,left ) and below (004,right)mustard canopy (in range 20000-50000 X100) in farmers field in Jagannathpur, North 24 PGS (2022).

**Table 2.** Light flux above and below mustard canopy under high density zero till broadcast sowing at 35-40 days after sowing.

| Observation number | Flux above mustard canopy at 11 am. Range : 20000-50000 X100 (Lux) | Flux below mustard canopy at 11 am Range : 20000-50000 X100 (Lux) | Reduction of light transmission below mustard canopy (%) |
|---|---|---|---|
| 1 | 250 | 8 | 99.97 |
| 2 | 240 | 10 | 99.95 |
| 3 | 220 | 12 | 99.94 |
| 4 | 250 | 10 | 99.96 |
| 5 | 254 | 4 | 99.98 |
| 6 | 260 | 6 | 99.98 |
| 7 | 270 | 12 | 99.95 |
| SD± | 15.86 | 3.032 | 0.84 |

**Photo 3.**Weedy mustard field under low density and scant plant population [24 PGS (N)]

Photo 4: Well grown mustard under zero till high density broadcast sowing [Swarupnagar, ICAR-CRIJAF & Jagannathpur, 24 PGS (N)] with smothered and scanty weeds at harvest.

**Table 3**: Zero till mustard yield its weed dynamics for some weed species

| Sl. No | Locations | Mustard yield (q/ha) | Initial weed population (Nos./$m^2$) in weedy plots | Weed population after mustard harvest (Nos./$m^2$) | Initial weed biomass ($g/m^2$) in weedy plots | Weed biomass after mustard harvest ($g/m^2$) | Per cent reuction of weed biomass at mustard maturity (%) |
|---|---|---|---|---|---|---|---|
| 1 | ICAR-CRIJAF | 15 | 400 | 45 | 500 | 50 | 90 |
| 2 | Jagannathpur | 30 | 400 | 20 | 700 | 5-20 | 97-99 |
| 3 | Najat | 15 | 350 | 10 | 500 | 10 | 98 |
| 4 | Goaldah | 22.5 | 500 | 60 | 500 | 66 | 87 |
| 5 | Mochpol | 15 | 1000 | 80 | 800 | 150 | 81 |

**Table 4.** Reduction of flowers/pods of weeds under mustard canopy after mustard harvest

| **Sl. No.** | Weed type | Flowers/podsof weeds under normal condition (Nos./plant) | Flowers/podsof weeds under mustard canopy after its harvest (Nos./plant) | Percent reduction of flowers/pods of weeds under canopy over normal growth (%) |
|---|---|---|---|---|
| 1 | *Physalis minima* | 50 | 5 | 90 |
| 2 | *Chenopodium album* | 375 | 25 | 93 |
| 3 | *Ageratum conyzoides* | 150 | 10 | 93 |
| 4 | *Medicago lupulina* | 120 | 15 | 88 |
| 5 | *Alternanthera spp,* | 100 | 8 | 92 |
| 6 | *Anagalis arvensis* | 150 | 10 | 93 |
| 7 | *Rumex spp* | 4000 | 80 | 98 |
| 8 | *Solanum nigrum* | 88 | 4 | 99.95 |

## 4.CONCLUSIONS

Fast growing andthick mustard canopy (100-200 $m^2$) developed at early stages hinder sunlight penetration (up to99.98 percent) below its canopy (at 35- 40 days), leading to under growth/suppression of different weed species those germinate or grow below it. Appropriate agronomic management practices e.g.,seed rate, date of sowing, irrigation and fertiliser application in high density broadcast sowing will eliminate weeding in mustard.For uniform distribution the seed should be broadcasted in double criss-cross pattern. Mustard plant population varies from150-250/$m^2$ depending on variety. It saves 150-250 labours /ha depending on weed species and its density of germination.Zero till mustard grain yield ranged from 15-30 q/ha. Only 45 cm around the mustard field has to be manually weeded to prevent weed seed formation. The same method can be used for conventional tilled mustard for its weed control. This weed smothering merit of mustard can be used for ecofriendly weed control in other wide spaced field/horticultural crops using its dwarf variety (e.g., Toria).



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