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Integrated Weed Management in Mustard (*Brassica juncea* L.)

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Abstract: To study the efficacy of different herbicides integrating with hand weeding in mustard, a field investigation was planned during *rabi* season of 2011-12 and 2012-13 at Research Farm of Department of Agronomy CCS Haryana Agricultural University, Hisar. Various treatments included were trifluralin 750 g/ha PPI (pre plant incorporation), trifluralin 750 g/ha PPI + 1 HW (hand weeding) 45 DAS (days after sowing), trifluralin 1000 g/ha PPI, trifluralin 1250 g/ha PPI, pendimethalin 750 g/ha PPI, pendimethalin 750 g/ha PPI + 1 HW 45 DAS, pendimethalin 1000 g/ha PPI, pendimethalin 1250 g/ha PPI, pendimethalin 750 g/ha PRE (pre emergence), pendimethalin 750 g/ha PRE + 1 HW 45 DAS, pendimethalin 1000 g/ha PRE, pendimethalin 1250 g/ha PRE, 1HW 30 DAS, 2 HW 30 and 60 DAS, weedy and weed free check. The seed yield and various yield attributes of irrigated mustard were increased when trifluralin (PPI) or pendimethalin (PPI & PRE), each at 750 g/ha integrated with 1 HW at 45 DAS, and these were comparable to the treatment of 2HW (30 and 60 DAS) and also to the weed free conditions. In mustard, the PPI application of pendimethalin was superior over PRE application, however there was no significant differences in yield. Weeds allowed to grow through the crop season reduced the seed yield of mustard to the extent of 30.4 and 33.9% during 2011-12 and 2012-13, respectively.
Keywords: Mustard, weeds, pendimethalin, trifluralin, hand weeding

Introduction:

India is one of the largest oilseeds producing country and oilseeds are the second largest agricultural commodity after cereals in India. Among oilseeds, Raya/Indian mustard (*Brassica juncea* L.) occupies a prominent crop and ranks second after groundnut in area and production, contributing about 23% of the total oilseed production. It is grown in 5.98 million hectare are in India, predominantly in states of Rajasthan, UP, Haryana, Madhya Pradesh and Gujarat both under irrigated and rainfed conditions with a production of 8.43 m tonnes (Anonymous, 2019). Though the average yield of mustard in Haryana (1596 kg/ha) is highest in the country, it is far below the average yield of mustard in Europian Union, Canada, Ukraine and Belarus. It is even below the world average yield of 2070 kg/ha. There is wide gap between the genetic potential of the released varieties and the actual average yield. Among various environmental and other constraints responsible for low productivity,

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management of weeds is of paramount importance. Crop is severely infested by both grassy and broadleaf weeds, particularly under irrigated conditions. Yield losses due to crop-weed competition in rapeseed and mustard have been estimated to the tune of 10-58% (Banga and Yadav, 2001 and Malik *et al.*¸ 2012) depending upon the type, intensity and duration of competition. Punia *et al.* (2006) reported that presence of weeds throughout growing period resulted in 36-42 per cent reduction in seed yield of mustard. Under All India Coordinated Project on Rapeseed-Mustard, from various locations 18.1% (Ludhiana) to 41.7% (Varanasi) mustard yield loss has been reported (Anonymous, 2011). Chauhan *et al*. (2005) reported that weed competition in mustard is more serious in early stage because crop growth during winter (rabi) season remains slow during the first 4-6 weeks after sowing and during later stage it grows vigorously and suppressing effect on weeds. With the increasing demand for food, cost reduction and high intensive management and increasing wages and scarcity of labour, the use of pesticide, particularly herbicides, has been increasing in modern agriculture. Traditional methods of weeding by khurpa or kasola is still the most common practice of weed control in mustard fields but non-availability and high wages of labor make it difficult and costly. We need some suitable method of weed management in mustard either with herbicide alone or in integration with mechanical/manual weeding for higher crop yield (Malik *et al.*¸ 2012). Keeping it in view, present investigation was planned to study the efficacy of different herbicides integrating with hand weeding in mustard.

Methodology:

A field experiment was conducted during the *rabi* seasons of 2011-12 and 2012-13 at Research Farm of Department of Agronomy, CCS Haryana Agricultural University, Hisar to find out the suitable method of weed management in mustard. The soil of the experimental field was sandy loam in texture, low in available N, medium in available P_2O_5 and high in K_2O with slightly alkaline in reaction (pH 8.1). Raya/mustard variety RH 30 was sown by drill at 30 cm row to row spacing on 19th October and 22nd October during 2011-12 and 2012-13, respectively. The experiment consisting of various treatments *viz.* trifluralin 750 g/ha PPI (pre plant incorporation), trifluralin 750 g/ha PPI + 1 HW (hand weeding) 45 DAS (days after sowing), trifluralin 1000 g/ha PPI, trifluralin 1250 g/ha PPI, pendimethalin 750 g/ha PPI, pendimethalin 750 g/ha PPI + 1 HW 45 DAS, pendimethalin 1000 g/ha PPI, pendimethalin 1250 g/ha PPI, pendimethalin 750 g/ha PRE (pre emergence), pendimethalin 750 g/ha PRE + 1 HW 45 DAS, pendimethalin 1000 g/ha PRE, pendimethalin 1250 g/ha PRE, 1HW 30 DAS, 2 HW 30 and 60 DAS, weedy and weed free check was laid out in randomized block design replicated thrice. The herbicides were applied by using knapsack sprayer fitted with flat fan nozzle in a spray volume of 500 liters/ha. The crop was raised with all the package of practice recommended by the state university. The data on density of individual weeds and dry weight of total weeds was recorded at 70 DAS by randomly placing two quadrates (0.5 × 0.5 m) per

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plot. The dry weight of weeds was recorded by keeping the weeds in oven at 70 ^{0} C till constant weight was achieved. The seed yield of crop along with other yield attributes were recorded at harvest to draw inference of results.

Results and Discussion:

Effects on Weeds

The experimental field of mustard was infested with various weeds like bathu (*Chenopodium album*), hirankhuri (*Convolvulus arvensis*), metha (*Melilotus indicus*) and kandai (*Cirsium arvense*) during the study. The density and dry weight of weeds reduced with the corresponding increase in the dose of each herbicide, however, such reactions were more pronounced when trifluralin (PPI) and pendimethalin (PRE), each at 750 g/ha were integrated with 1 HW at 45 DAS (Tables 1). Integration of 1 HW at 45 DAS with any of the herbicide reduced the dry weight of weeds similar to 2 HW (30 and 60 DAS). Trifluralin at 1000 and 1250 g/ha (PPI), pendimethalin 1250 g/ha (PRE) reduced the dry weight of weeds to the extent of about 85 % during two years. Trifluralin and pendimethalin each at 750 g/ha *fb* 1 HW (45 DAS) being as effective as 2 HW reduced the dry weight of weeds to the extent of about 90 %. These results are supported by Kumar *et al.* (2012).

Effect on Crop

Due to heavy weed infestation, the seed yield of mustard was minimum (1396 kg/ha in 2011-12 and 1486 kg/ha in 2012-13) in untreated weedy check and it was maximum in weed free check (2006 kg/ha in 2011-12 and 2249 kg/ha in 2012-13) during both years (Table 2). Among different herbicidal treatments, trifluralin 1000 and 1250 g/ha (PPI), pendimethalin 1250 g/ha (PRE), fluchloralin 750 g/ha fb 1 HW, trifluralin 750 g/ha (PPI) *fb* 1 HW and pendimethalin 750 g/ha *fb* 1HW being at par with each other produced seed yield of mustard statistically similar to 2 HW (30 & 60 DAS) and weed free check during both the years, and these treatments were superior to all other treatments. The seed yield and various yield attributes of irrigated mustard were increased when trifluralin (PPI) or pendimethalin (PPI & PRE), each at 750 g/ha integrated with 1 HW at 45 DAS, and these were comparable to the treatment of 2HW (30 and 60 DAS) and also to the weed free conditions. Singh (2006) and Singh *et al*. (2009) also have proved that integration of herbicides with hand weeding is the most effective and economical method of weed management in rapeseed-mustard. In mustard, the PPI application of pendimethalin was superior over PRE application; however there were no significant differences in yield. Weeds growing throughout the crop season reduced the seeds yield of mustard to the extent of 30.4 and 33.9% during 2011-12 and 2012-13, respectively. In general, integrated method of weed management involving lower dose of herbicides *fb* 1 HW (45 DAS) proved more effective and remunerative. Similar results were attained earlier also by Chauhan *et al*. (1993) and Malik *et al*. (2012). Chauhan *et al*. (2005)

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also observed that application of oxyfluorfen at 0.25 kg/ha as pre-emergence, fluchloralin 1.0 kg/ha as pre-plant application and two hand weedings (25 and 40 DAS) in Indian mustard drastically reduced weed density, weed biomass and increased the seed yield over other weed control treatments.

Conclusion:

Integration of one hand weeding at 45 DAS with pendimethalin (PPI & PRE) or trifluralin (PPI), each at 750g/ha, resulted into lower weed density and their dry weight along with higher mustard yield comparable to 2 HW and weed free conditions.

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Table 1: Effect of various weed management treatments on density of different weeds in mustard

Treatments	Density of different weeds (No./m^2) at 70 DAS								Dry weight of different weeds (g/m^2) at 70 DAS	
	C. album		*C. arvensis*		*M. indicus*		*C. arvense*			
	2011-12	2012-13	2011-12	2012-13	2011-12	2012-13	2011-12	2012-13	2011-12	2012-13
Trifluralin 750 PPI + 1 HW 45 DAS	1.9	2.1	1.0	1.1	1.7	2.8	2.1	2.6	4.9	6.5
Trifluralin 1000 PPI	3.1	4.0	3.2	4.1	6.2	8.3	8.3	10.1	18.5	23.6
Trifluralin 1250 PPI	2.1	2.8	3.0	4.1	4.8	6.0	8.1	9.5	16.4	20.1
Pendimethalin 750 PPI + 1 HW 45 DAS	1.6	1.7	1.0	0.0	2.8	2.1	2.1	2.7	4.8	5.8
Pendimethalin 1000 PPI	2.7	3.4	2.5	4.1	4.4	5.3	8.5	10.5	21.4	27.7
Pendimethalin 1250 PPI	2.0	1.5	2.1	3.5	3.4	4.3	7.1	9.8	18.7	24.1
Pendimethalin 750 PRE + 1 HW 45 DAS	1.8	2.0	1.0	1.0	3.0	2.4	2.2	3.0	5.1	6.2
Pendimethalin 1000 PRE	3.0	3.7	2.8	4.5	4.8	5.8	9.4	11.6	22.6	29.1
Pendimethalin 1250 PRE	2.2	1.7	2.3	3.9	3.7	4.7	7.8	10.8	19.6	25.9
1 HW 30 DAS	5.0	6.6	1.9	2.2	6.9	9.1	5.6	8.1	15.1	22.2
2 HW 30 & 60 DAS	1.3	1.5	1.0	0.0	1.6	2.8	2.1	2.7	5.2	6.9
Weedy	15.3	18.4	3.7	5.1	16.5	21.1	10.5	15.0	145.3	191.2
Weed free	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SEm±	0.29	0.31	0.20	0.18	0.39	0.42	0.53	0.47	1.28	1.35
CD (5 %)	0.91	0.99	0.62	0.56	1.21	1.34	1.61	1.46	3.91	4.12

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Table 2: Effect of various weed management treatments on yield and yield attributes of mustard

Treatments	No. of siliquae/ plant		No. of seeds/ siliqua		Test weight (g)		Seed yield (kg/ha)	
	2011-12	2012-13	2011-12	2012-13	2011-12	2012-13	2011-12	2012-13
Trifluralin 750 PPI + 1 HW 45 DAS	218	231	11.41	11.99	5.29	5.71	1886	2173
Trifluralin 1000 PPI	207	219	11.21	11.65	5.19	5.58	1797	2059
Trifluralin 1250 PPI	211	227	11.25	11.79	5.21	5.61	1829	2114
Pendimethalin 750 PPI + 1 HW 45 DAS	220	231	11.31	11.90	5.24	5.66	1903	2144
Pendimethalin 1000 PPI	201	209	11.23	11.51	5.20	5.47	1735	1943
Pendimethalin 1250 PPI	208	225	11.19	11.64	5.20	5.52	1799	2099
Pendimethalin 750 PRE + 1 HW 45 DAS	214	232	11.32	12.04	5.23	5.73	1874	2166
Pendimethalin 1000 PRE	196	207	11.29	11.57	5.24	5.49	1696	1924
Pendimethalin 1250 PRE	212	224	11.19	11.59	5.21	5.51	1833	2076
1 HW 30 DAS	179	186	10.61	10.61	4.93	5.05	1533	1735
2 HW 30 & 60 DAS	223	233	11.45	12.09	5.31	5.74	1926	2189
Weedy	162	167	10.21	10.39	4.74	4.94	1396	1486
Weed free	233	241	11.66	12.19	5.42	5.79	2006	2249
SEm±	4.9	6.1	0.17	0.22	0.08	0.11	44.1	39.2
CD (5 %)	15.1	18.2	0.54	0.69	0.25	0.33	133.2	119.1

