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Effect of different weed control practices on yield and returns of mustard (*Brassica juncea* L.)

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ABSTRACT

A field experiments was conducted during two consecutive rabi seasons of 2013-14 and 2014-15 to study the effect of weed management practices on yield, weed dynamics and economics of mustard and to find out the most effective and economic weed management practice for mustard under semi arid conditions of Rajasthan. Results of the study revealed that two hand weeding at 25-30 and 40-45 days after sowing recorded minimum mean weed dry weight (39.95g m^{-2}), highest weed control efficiency (80.94 %)and maximum mean plant height (165.4 cm), siliqua $plant^{-1}$ (153.7), seeds $siliqua^{-1}$ (13), test weight (4.33), mustard seed and stover yield(16.16 and 50.51 q ha^{-1}) during both years of study which was statistically at par with 1hand weeding(16.08 and 50.39 q ha^{-1}) and pre-emergence application of pendimethalin 38.7CS (15.86 and 48.49 q ha^{-1}). However, among chemicals pre emergence application of pendimethalin 38.7 CS (T3) proved superior as it recorded higher values of seeds per siliqua and test weight. The mean increases in seeds per siliqua and test weight due to treatment Pendimethalin 38.7CS were 20.0 & 3.63, 41.57 & 4.65 and 35.48 & 7.81 per cent. The maximum net returns (₹ 47178 ha^{-1}) and B:C ratio (3.75) were recorded under pre-emergence application of pendimethalin 38.7 CS. The least (₹ 24162 ha^{-1} and 2.39) were recorded under pre-emergence application of pendimethalin 30 EC+imazethapyr 2 EC @0.75 kg ha^{-1} due to its phytotoxic effect on mustard.

Keywords: Mustard, net returns, seed yield, weeds, weed control efficiency

India is the fourth largest oilseed economy in the world. Rapeseed-mustard is an important oilseed crop of Rajasthan and grown in 25.32 m ha , producing 32.58 m tones (Anon,2015-16) with an average productivity of 1287 kg ha^{-1}. However, the average yield of rapeseed-mustard in Rajasthan is far below from its potential yield because of low water availability. Being a cash crop, it is most popular among farmers of the state. Development of location specific technology in rapeseed –mustard resulted in increased productivity. But many biotic stresses such as weeds cause severe yield losses up to 45per cent in rapeseed-mustard. They reduce crop productivity and quality by competing with crop plants for available nutrients, water, land and light resources. Delayed or early weeding resulted into irreversible damage due to weed competition. For overall management of weeds with greater profitability and sustainability, chemical weed management is a viable and wise decision due to non availability of labour at critical periods at reasonable cost.

Keeping in view, the present study was undertaken to evaluate the effect of different weed control practices on weed dynamics, yield along with their economics.

MATERIALS AND METHODS

The field experiment was carried out at research farm of Rajasthan Agricultural Research Institute, Durgapura, Jaipur (Raj.) during two consecutive *rabi* seasons of 2013-14 and 2014-15. Durgapura, Jaipur is located at 26º51' N latitude and 75º47' E longitude at an elevation of 390 M above mean sea level. The soil type of the experimental site was sandy loan with sand (86.8%), silt (5.6%), clay (7.6%), pH 7.9, 0.18% organic carbon and 138.8, 36.7 and 232.0 kg ha^{-1} available N, P_2O_5 and K_2O, respectively. The present experiment consist of 10 treatments *viz* T_1- weedy check,T_2- pendimethalian 30 EC @ 0.75 kg ha^{-1}, T_3- pendimethalian 38.7 CS @ 0.75 kg ha^{-1}, T_4- Oxadiargyl 6EC @ 0.09 kg ha^{-1}, T_5 – Pendimethlian 30 EC+ Imazethapyr 2 EC (ready mix) @ 0.75 k ha^{-1}, T_6 - Oxyflurofen 23.5 EC @ 0.15 kg ha^{-1}, T_7-Quizalofop-p- ethyl 5EC @ 0.06 kg ha^{-1}, T_8-Clodinafop-p- ethyl 15WP @ 0.06 kg ha^{-1}, T_9- one hand weeding (HW) at 25-30 DAS and T_{10}-Two HW at 25-30 and 40-45 DAS were evaluated in Randomized Block Design with three replications. The crop was sown on 19.10.2013 and 16.10.2014 at crop geometry of 30x15 cm. Treatment T_2, T_3, T_4, T_5 and T_6 were applied as pre emergence while treatment T_7 and T_8 were applied as post emergence. A uniform dose of fertilizer *i.e.* 30 kg N+30kg P_2O_5 +250 kg gypsum was applied as a basal dose and remaining 30 kg N ha^{-1} was applied at the time of Ist irrigation. Weed dry weight at harvest was recorded by using a quadrate of 0.25 m^2 and then weighted after oven drying. Weed control efficiency was calculated as per the formula suggest by the Patil and Patil (1983). Net monetary returns and B:C ratio for each treatment were also calculated.

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Table 1: Effect of weed management practices on yield attributes of mustard

Treatments	Plant height (cm)			Siliqua plant $^{-1}$			Seeds siliqua^{-1}			Test wt (g)		
	2013-14	2014-15	Mean	2013-14	2014-15	Mean	2013-14	2014-15	Mean	2013-14	2014-15	Mean
T_1	153.4	156.2	154.8	138.0	134.8	136.4	9.61	9.02	9.3	3.98	3.95	3.97
T_2	162.0	159.4	160.7	146.2	144.3	145.3	12.32	12.08	12.2	4.26	4.20	4.23
T_3	163.8	162.6	163.2	154.6	149.3	152.0	12.64	12.58	12.6	4.32	4.24	4.28
T_4	160.2	158.8	159.5	140.0	138.4	139.3	10.51	10.47	10.5	4.14	4.12	4.13
T_5	104.2	112.8	108.5	117.8	118.2	118.0	9.32	8.66	8.9	4.12	4.06	4.09
T_6	160.2	159.6	159.9	145.0	139.1	142.1	10.94	10.83	10.8	4.22	4.14	4.18
T_7	162.1	160.1	161.1	142.2	140.4	141.3	10.66	10.52	10.5	4.13	4.15	4.14
T_8	159.2	157.6	158.4	142.0	138.3	140.2	10.72	10.76	10.7	4.21	4.13	4.18
T_9	165.8	164.2	165	156.2	149.8	153.0	13.02	12.84	12.9	4.34	4.28	4.31
T_{10}	166.6	159.2	165.4	156.8	150.6	153.7	13.07	12.96	13.0	4.36	4.29	4.33
SEm±	**8.08**	**8.02**	**-**	**5.59**	**5.77**	**-**	**0.42**	**0.39**	**-**	**0.04**	**0.04**	**-**
CD at 5%	**24.18**	**24.01**	**-**	**16.74**	**17.26**		**1.26**	**1.17**	**-**	**0.12**	**0.11**	**-**
CV %	**8.98**	**8.66**		**6.72**	**7.12**		**6.44**	**6.09**		**1.69**	**1.5**	

Note: T_1- Weedy check, T_2- Pendimethalin 30 EC @ 0.75 kg ai ha^{-1} as PE, T_3- Pendimethalin 38.7 CS @ 0.75 kg ai ha^{-1} as PE, T_4- Oxadiargyl 6 EC @ 0.09 kg ai ha^{-1} as PE, T_5- Pendimethalin 30 EC+ Imazethapyr 2EC @ 0.75 kg ai ha^{-1} as PE, T_6- Oxyflurofen 23.5 EC @ 0.15 kg ai ha^{-1} as PE, T_7- Quizalofop ethyl 5 EC @ 0.06 kg ai ha^{-1} as POE, T_8- Clodinafop-p-ethyl 15 WP @ 0.06 kg ai ha^{-1} as POE ,T_9- One HW at 25-30 DAS , T_{10}- Two HW at 25-30 & 40-45DAS.

Table 2: Effect of weed management practices on yield, weed dynamics and economics of mustard

Treatments	Seed yield (q ha^{-1})			Stover yield (q ha^{-1})			Weed dry Wt. (g m^{-2})			Mean	Mean Gross	Mean Cost of	Mean Net	B:C ratio
	2013 -14	2014 -15	Mean	2013 -14	2014 -15	Mean	2013 -14	2014 -15	Mean	WCE %	Returns (≠ ha^{-1})	cultivation (≠ ha^{-1})	Returns (¹ ha^{-1})	
T_1	13.10	12.15	12.63	43.15	39.23	41.19	178.40	240.83	209.62	-	52055	15140	36915	2.95
T_2	15.52	14.30	14.91	49.11	44.90	47.01	86.60	94.80	90.70	56.73	60977	17120	43855	3.57
T_3	16.52	15.19	15.86	50.60	46.37	48.49	78.40	82.60	80.50	61.60	64389	17210	47178	3.75
T_4	13.99	13.30	13.65	44.64	42.50	43.57	108.2	136.30	122.25	41.68	56001	17540	38455	3.19
T_5	9.67	10.48	10.08	31.25	33.73	32.49	30.00	42.00	36.00	82.83	41544	17380	24162	2.39
T_6	14.44	14.05	14.25	46.13	44.97	45.55	98.90	115.60	107.25	48.84	58508	17030	41472	3.21
T_7	14.13	13.64	13.89	45.63	43.67	44.65	102.40	124.90	113.65	45.78	57096	17820	39268	3.53
T_8	14.59	13.85	14.22	46.13	44.10	45.12	97.20	127.30	112.25	46.45	58272	16530	41736	3.44
T_9	16.67	15.49	16.08	52.58	48.20	50.39	70.80	81.40	76.10	63.70	65666	19140	46526	2.85
T_{10}	16.96	15.36	16.16	53.08	47.93	50.51	38.60	41.30	39.95	80.94	65936	23140	42796	2.95
SEm(±)	**0.81**	**0.68**	-	**2.52**	**1.50**	-	**3.22**	**8.96**	-	-	-		-	-
LSD(0.05)	**2.41**	**2.02**	-	**7.53**	**4.49**	-	**9.64**	**26.82**	-	-	-		-	-
CV %	**9.57**	**8.48**	-	**9.42**	**5.97**	-	**6.27**	**14.27**	-	-	-		-	-

Note: Sale price of mustard seed –¹ 3000 & ¹ 3300 qt^{-1}. during 2013-14 &2014-15,respectively, mustard strover @¹ 300 qt^{-1},Cost-pendimethalin30 EC@ ¹ 500 l^{-1}, pendimethalin38.7 CS@¹ 690 l^{-1},Oxadiargyl 6EC @¹ 1116 l^{-1}, pendimethalin30 EC+Imazethapyr2EC @¹ 645 l^{-1},Oxyflurofen 23.5EC @1830 l^{-1},Clodinafop-p-ethyl @¹ 1660 l^{-1},1 HW @¹ 5200 (20 mandays @¹ 210 manday^{-1})

RESULTS AND DISCUSSION

The predominant weeds observed in the experimental area were *Chenopodium album* (Bathua), *Thithonia diversifolia* L. (wild sunflower), *Anagallis arvensis* (Krishan neel), *Melilotus alba* (Senji), *Cyperus rotundus* (motha) and *Cynodon dactylon* (Doob) during both the years of experimentation. All the weed management treatments resulted into significant reduction in weeds dry weight (g m^{-2}) at harvest compared to unweeded check during both the years of experiment (Table 2). The least weeds dry weight of 30.00 and 42.00 g m^{-2} and highest WCE (83.18 and 82.56 %) were recorded under pre emergence application of pendimethalin 30 EC+Imazethapyr 2 EC (T_5) during 2013-14 and 2014-15 respectively. But it severely hampered germination of mustard crop closely followed by two hand weeding at 25-30 and 40-45 DAS while highest weeds dry weight of 209.62 was recorded under weedy check. . Further, among the other chemicals, pre-emergence application of pendimethalin 38.7 CS proved superior as it recorded mean weed dry weight of 80.50 g m^{-2} and mean weed control efficiency of 61.60 per cent closely followed by pre emergence application of pendimethalin 30EC. Similar findings were also reported by Kumar *et al.* (2012) and Patel *et al.* (2013).

In general, the plant height of mustard improved slightly due to application of weed management treatments over weedy check. The mean maximum plant height of 165.4 cm was recorded under 2 HW, which was statistically at par with other treatments and significantly superior over treatment T_5 during both the years. The mean increases in plant height due to treatment T_3 were 8.4 and 54.7 cm respectively over weedy check (T_1) and treatment T_5 (Table 1). Similarly, siliqua per plant was influenced significantly due to weed management practices during both the years. The mean increases in siliqua per plant due to treatment T_3 were 11.44 and 28.81 per cent respectively over treatment T_1 and T_5. Further, the maximum number of seeds per siliqua and test weight were recorded under under 2 HW (T_{10}) which were statistically at par with treatment T_9, T_3 and T_2 and significantly superior over rest treatments during both the years. However, among chemicals pre emergence application of pendimethalin (T_3) 38.7 CS proved superior as it recorded higher values of seeds per siliqua and test weight which were significantly superior over T_1, T_4 and T_5 during both the years. The mean increases in seeds per siliqua and test weight due to treatment T_3 were 20.0 and 3.63, 41.57 and 4.65 and 35.48 and 7.81 per cent over treatment T_4, T_5 and T_1 respectively. The increases in growth and yield attributing characters under hand weeding and treatment T_2 and T_3 might be due to better suppression of weeds which might have maintained greaer availability of nutrients and moisture content due to less removal by weeds. This might have increased nutrient and water uptake by crops leading to increase rate of photosynthesis and ultimately better supply of photosynthates to various sinks. Similar findings have also been reported Tomar (2015).

Maximum seed and stover yield of mustard was recorded under one or two hand weeding closely followed by pre emergence application of pendimethalin 38.7 CS @ 0.75 kg ha^{-1} (T_3) and treatment T_2 and they were statistically at par with each other and significantly superior over weedy check during both the years of experiment. Further, the least seed yield (9.67 and 10.48 q ha^{-1}) and stover yield (31.25 and 33.73 q ha^{-1}) was recorded under pre emergence application of treatment T_5 (Table 2) due to its phytotoxic effect on mustard crop. Ahuja and Jaduraju (1992) also observed phytotoxic effect of herbicide on mustard. Further the treatment T_4, T_6 and T_7 though slightly improved the seed and stover yield of mustard during both the years but were statistically at par with each other and with weedy check. However, the highest mean net monetary returns (≠ 47178 ha^{-1}) and B:C ratio (3.75) were recorded under pre-emergence application of pendimethalin 38.7 CS closely followed by pendimethalin 30 EC (≠ 43855 ha^{-1} and 3.57) and 1 HW (≠ 46526 ha^{-1} and 3.44) while the least mean net returns (≠ 36915 ha^{-1}) was recorded under weedy check. Further, the least B:C ratio of 2.85 was recorded under two hand weedings. The increases in yield under treatment T_2, T_3, T_8 and T_9 could be ascribed to effective weed suppression during critical period of crop weed competition which might have favoured better utilization of available resources. Similar findings have also been reported by Mukherjee (2014).

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