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Effect of integrated weed management on growth, yield and weed parameters in mustard

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ABSTRACT

An experiment was conducted at Agronomy Instructional Farm, Chimanbhai Patel College of Agriculture, Sardarkrushinagar Dantiwada Agricultural University, Sardarkrushinagar (Gujarat) to integrated weed management studies in mustard [*Brassica juncea* (L.) Czern and Coss. ex Coss. during **rabi** season of 2011-12. The experiment comprising 12 treatments viz., weedy check, interculturing+1 HW at 25 DAS, pendimethalin @ 0.5 and 0.75 kg/ha PE alone and along with HW at 25 DAS with each level, oxadiargyl @ 75 and 90 g/ha PE alone and along with HW at 25 DAS with each level, oxyfluorfen @ 100 g/ha as PE and weed free was conducted in a randomized block design with three replications. The results of the experiment indicated that higher values of plant growth characters viz., dry matter production per plant (51.00 g) and yield attributing characters viz., number of siliquae per plant (280.37), number of seeds per siliqua (14.70) and test weight (4.25 g) were recorded under weed free treatment. Pendimethalin @ 0.5 kg/ha PE+1 HW at 25 DAS, oxadiargyl @ 75 g/ha PE+1 HW at 25 DAS and pendimethalin @ 0.5 kg/ha PE were found equally effective in respect to these characters which were significantly higher than rest of the treatments. Among the treatments, weed free treatment recorded significantly higher seed yield (1738 kg/ha), stover yield (4937 kg/ha) and harvest index (26.03%) of mustard than rest of the treatments. Among the treatments tried in this experiment, pendimethalin @ 0.5 kg/ha PE+1 HW at 25 DAS was found the best treatment by recording maximum net realization (Rs. 46,277/ha) and benefit : cost ratio (3.55). Besides weed free condition, pendimethalin @ 0.5 kg/ha PE+1 HW at 25 DAS was found more effective in reducing the total weed population resulting in less dry weight of weeds (147.67 kg/ha). Oxadiargyl @ 75 g/ha PE+1 HW at 25 DAS was found equally effective with this respect.

Key words : Growth, integrated weed management, mustard, yield

INTRODUCTION

Mustard is one of the major **rabi** oilseed crops of India. It occupies a prominent place being next to groundnut both in area and production. Among the different states, Rajasthan and Uttar Pradesh together produce about 53.06% of the total mustard production in India. India is one of the largest producers of mustard in the world. India's contribution in the world production is 11.00% with fourth position in the world, next to China, Canada and Germany. Among the different oilseeds, mustard occupies an area of 6.18 million hectares with 7.36 million tonnes of total production and productivity of 1190 kg/ha (Anonymous, 2010). In Gujarat, area under mustard crop is about 2.23 lakh ha with 3.49 lakh tonnes of total production with the productivity of 1568 kg/ha (DOE, 2010-11).

Among the various factors, which influence the crop production, weed flora is a single negative factor and serious menace which plays key role against achieving high yield potential of the crop. The weeds cause substantial losses to agricultural production. Estimates show that in India, weeds cause an annual monetary loss of Rs. 1980 million (Mukhopadhyay, 1992). Weed problem is one of the major barriers which is responsible for low productivity of mustard because weeds compete with the crop and severely for growth resources viz., moisture, nutrients, sunlight and space during entire vegetative and early reproductive stage of crop. They also transpire lot of valuable conserved moisture and absorb large quantities of nutrients from the soil. Presence of weeds reduces the photosynthetic efficiency, dry

matter production and distribution of photosynthesis to economical parts thereby adversely affecting source and sink relationship resulting in reduction of mustard yield besides these, they increase production cost, create the pests and plant disease problem and decrease the quality of farm produce as well as value of the land.

The use of herbicide has revolutionized in weed control, reducing the cost of cultivation and has resulted in the revolution of many conventional weed control practices. Unfortunately till now, majority of the cultivators are ignorant about the proper dose of herbicide, their time and method of application and their economics. Practically inadequate information is available to evaluate new herbicides for the weed control in Indian mustard. Therefore, there is a need to have more emphasis on these aspects. Keeping these considerations in view, an investigation was planned.

MATERIALS AND METHODS

An experiment was conducted at Agronomy Instructional Farm, Chimanbhai Patel College of Agriculture, Sardarkrushinagar Dantiwada Agricultural University, Sardarkrushinagar (Gujarat) to integrated weed management studies in mustard [*Brassica juncea* (L.) Czern and Coss. ex Coss.] during **rabi** season of 2011-12. The soil of experimental plot was loamy sand in texture, low in organic carbon and available nitrogen, medium in available phosphorus and rich in available potassium status. The experiment comprising 12 treatments viz., weedy check, interculturing+1 HW at 25 DAS, pendimethalin @ 0.5 and 0.75 kg/ha PE alone and along with HW at 25 DAS with each level, oxadiargyl @ 75 and 90 g/ha PE alone and along with HW at 25 DAS with each level, oxyfluorfen @ 100 g/ha as PE and weed free was conducted in a randomized block design with three replications. Mustard variety GM-3 was sown on 20 October 2011 by keeping 45 cm distance between two rows in all the treatments. A uniform basal dose of NPS (37.5 : 50 : 40 kg/ha) was applied at the time of sowing in the form of DAP, urea and gypsum and remaining 37.5 kg N was applied at 40 DAS. Mustard crop was irrigated six times (including two common irrigations for germination and seeding establishment). Pre-emergence herbicide viz., pendimethalin and oxadiargyl was applied after sowing. Interculturing and hand weeding was carried out at 25 DAS in respective treatments. All the recommended package of practices was followed for the crop. Weed population/m^2 was recorded with the help of 0.5 x 0.5 m^2 quadrant at 25, 50 DAS and at harvest. Dry weight of weeds (g/m^2) was recorded at harvest. Weed control efficiency and weed index were calculated from the related observations. The observations on crop growth and yield parameters were also recorded at harvest. Economics were worked out according to prevailing market price of produce. No any insect/pest incidence and disease infestation was observed throughout the experimentation.

RESULTS AND DISCUSSION

Effect of Treatments on Crop

Significantly higher dry matter production per plant (51.00 g) was recorded by weed free treatment than other treatments, but it remained at par with treatments pendimethalin @ 0.5 kg/ha PE+1 HW at 25 DAS, oxadiargyl @ 75 g/ha PE+1 HW at 25 DAS and pendimethalin @ 0.5 kg/ha PE having 50.00, 46.33 and 45.33 g dry matter production per plant, respectively. It might be due to the results of the maximum utilization of nutrients and resources on account of competitions free atmosphere available under weed free and other treatments.

The maximum number of siliquae per plant (280.37), number of seeds/siliqua (14.07), length of siliqua (4.58 cm) and test weight (4.25 g) were obtained under weed free treatment. It might be due to complete removal of weeds throughout crop growth period by hand weeding which might have resulted in maintaining high soil fertility status by way of removing less plant nutrients through weeds which might have favourable effect on yield attributes. Pendimethalin @ 0.5 kg/ha PE+1 HW at 25 DAS, oxadiargyl @ 75 g/ha PE+1 HW at 25 DAS, pendimethalin @ 0.5 kg/ha PE, pendimethalin @ 0.75 kg/ha PE+1 HW at 25 DAS and oxadiargyl @ 90 g/ha PE+1 HW at 25 DAS were found statistically at par with weed free treatment in respect of number of siliquae/plant. Increase in number of siliquae per plant of mustard under treatments weed free, pendimethalin @

0.5 kg/ha as PE+1 HW at 25 DAS, oxadiargyl @ 75 g/ha+1 HW at 25 DAS, pendimethalin @ 0.5 kg/ha as PE, pendimethalin @ 0.75 kg/ha as PE+1 HW at 25 DAS and oxadiargyl @ 90 g/ha as PE+1 HW at 25 DAS over weedy check to the tune of 23.84, 22.50, 18.37, 15.28, 13.13 and 11.87%, respectively, while number of seeds/ siliqua and length of siliqua (cm) were not influenced significantly due to different weed management treatments. The results are in accordance with those of Kul Bhooshan and Vaishya (2002) and Sharma and Jain (2002). Similarly, weed free treatment established its superiority by recording significantly higher test weight (4.25 g) than rest of the treatments. However, it remained statistically at par with treatments pendimethalin @ 0.5 kg/ha as PE+1 HW at 25 DAS, oxadiargyl @ 75 g/ha+1 HW at 25 DAS, pendimethalin @ 0.75 kg/ha as PE, pendimethalin @ 0.5 kg/ha as PE, oxadiargyl @ 90 g/ha as PE+1 HW at 25 DAS, oxyfluorfen @ 100 g/ha as PE and pendimethalin @ 0.75 kg/ha as PE+1 HW at 25 DAS. These findings are in close conformity with those reported by Omprakash (2002).

Weed free treatment established its superiority by recording significantly higher seed yield (1738 kg/ha) as compared to rest of the treatments. However, it was found statistically at par with treatments pendimethalin @ 0.5 kg/ha PE+1 HW at 25 DAS, oxadiargyl @ 75 g/ha PE+1 HW at 25 DAS, pendimethalin @ 0.5 kg/ha PE and pendimethalin @ 0.75 kg/ha PE+1 HW at 25 DAS. Higher seed yield obtained under these treatments might be due to effective control of weeds at initial stage which in turn significantly increased the values of growth and yield attributes under these treatments. In addition to this, the higher yield under weed free and chemical weed control treatments may be attributed to lower dry matter accumulation by weeds and decrease in their population which resulting weeds were unable to compete with the crop plants and resulted in better expresson of growth and yield attributing characters viz., plant height, dry matter production/plant, number of silique/ plant and test weight. These findings are in accordance with those reported by Rana (2006) and Patel *et al.* (2007).

Stover yield (4937 kg/ha) was recorded significantly higher under weed free plot as compared to other treatments. However, it remained statistically at par with treatments pendimethalin @ 0.5 kg/ha PE+1 HW at 25 DAS, oxadiargyl @ 75 g/ha PE+1 HW at 25 DAS, pendimethalin @ 0.5 kg/ha PE, pendimethalin @ 0.75 kg/ha PE+1 HW at 25 DAS, oxadiargyl @ 90 g/ha PE+1 HW at 25 DAS, pendimethalin @ 0.75 kg/ha PE and oxadiargyl @ 75 g/ha PE. Favourable effect on growth characters viz., plant height, dry matter production per plant, number of primary and secondary branches per plant by avoiding crop-weed competition was responsible for higher stover yield. These findings are in conformity with those reported by Chauhan *et al.* (2005). Harvest index was not influenced significantly due to different weed management treatments.

The maximum net realization of Rs. 46277/ha was secured under treatment pendimethalin @ 0.5 kg/ha PE+1 HW at 25 DAS followed by treatments weed free, oxadiargyl @ 75 g/ha PE+1 HW at 25 DAS and pendimethalin @ 0.5 kg/ha PE under which net realization recorded was Rs. 44997, 43771 and 42685/ha, respectively. The highest seed and stover yield (Table 1) as a result of better weed control coupled with lower cost of production under treatment pendimethalin @ 0.5 kg/ha PE+1 HW at 25 DAS may be responsible for higher net realization per hectare. In respect of benefit : cost ratio, the highest BCR value (3.55) was recorded with application of pendimethalin @ 0.5 kg/ha PE+1 HW at 25 DAS followed by treatments pendimethalin @ 0.5 kg/ha as PE, oxadiargyl @ 75 g/ha+1 HW at 25 DAS and weed free having 3.44, 3.34 and 3.17 BCR value, respectively.

Effect of Treatments on Weeds

Besides treatment weed free, treatment pendimethalin @ 0.5 kg/ha PE+1 HW at 25 DAS recorded minimum number of total number of weeds at 25 DAS (2.66/m^2), 50 DAS (3.22/m^2) and at harvest (3.73/m^2) followed by oxadiargyl @ 75 g/ha PE+1 HW at 25 DAS and pendimethalin @ 0.75 kg/ha PE+1 HW at 25 DAS, treatment pendimethalin @ 0.5 kg/ha as PE, oxadiargyl @ 75 g/ha PE+1 HW at 25 DAS and pendimethalin @ 0.75 kg/ha PE+1 HW at 25 and 50 DAS and treatments pendimethalin @ 0.75 kg/ha PE+1 HW at 25 DAS, oxadiargyl @ 75 g/ha PE+1 HW at 25 DAS and pendimethalin @ 0.5 kg/ha as PE at harvest. The less number of total weed counts at 25 and 50 DAS as well

Table 1. Effect of different weed management treatments on growth attributes, yield attributes and yield of mustard

Treatment	Dry matter production (g/plant)	No. of siliquae/ plant	No. of seeds/ siliqua	Length of siliqua (cm)	Test weight (g)	Grain yield (kg/ha)	Stover yield (kg/ha)	Harvest index (%)
T_1–Weedy check	34.67	226.4	11.20	4.10	4.29	1168	4099	22.17
T_2–IC at 25 DAS+one HW at 25 DAS	38.67	240.5	11.53	4.21	4.58	1298	4192	23.64
T_3–Pendimethalin @ 0.5 kg/ha as PE	45.33	261.0	11.47	4.34	4.88	1585	4678	25.31
T_4–Pendimethalin @ 0.5 kg/ha as PE+1 HW at 25 DAS	50.00	277.3	13.80	4.61	5.23	1702	4875	25.88
T_5–Pendimethalin @ 0.75 kg/ha as PE	41.67	250.8	12.00	4.29	4.92	1402	4419	24.09
T_6–Pendimethalin @ 0.75 kg/ha as PE+1 HW at 25 DAS	44.33	256.1	12.00	4.35	4.73	1496	4637	24.39
T_7–Oxadiargyl @ 75 g/ha as PE	42.67	247.5	11.93	4.27	4.57	1366	4413	23.64
T_8–Oxadiargyl @ 75 g/ha+1 HW at 25 DAS	46.33	268.0	12.53	4.40	5.00	1649	4788	25.62
T_9–Oxadiargyl @ 90 g/ha as PE	40.33	245.4	11.93	4.26	4.57	1345	4342	23.65
T_{10}–Oxadiargyl @ 90 g/ha as PE+1 HW at 25 DAS	43.33	253.3	11.80	4.20	4.80	1424	4444	24.27
T_{11}–Oxyfluorfen @ 100 g/ha as PE	37.00	238.4	11.00	4.16	4.76	1254	4127	23.30
T_{12}–Weed free	51.00	280.4	14.07	4.58	5.25	1738	4937	26.03
S. Em±	2.20	9.31	0.79	0.22	0.19	1738	4937	1.26
C. D. (P=0.05)	6.46	27.31	-	NS	0.54	95.26	182.56	-
C. V. (%)	8.88	6.36	11.30	8.84	6.68	279.39	535.43	9.00

Selling price of mustard=Rs. 35.00/kg, Stover=Re. 1/kg.
PE–Pre-emergence, IC–Interculturing, HW–Hand weeding, DAS–Days after sowing, BCR–Benefit : cost ratio.
NS : Not Significant.

Table 2. Effect of different weed management treatments on economics and weed parameters in mustard

Treatment	Gross return (Rs./ha)	Net return (Rs./ha)	BCR	Total number of weeds			Weed dry weight (kg/ha)
				25 DAS	50 DAS	At harvest	
T_1–Weedy check	44979	28209	2.68	4.96 (24.44)	5.85 (34.11)	6.88 (46.89)	579.00
T_2–IC at 25 DAS+one HW at 25 DAS	49622	31452	2.73	3.68 (13.22)	45.3 (20.00)	5.39 (28.55)	318.33
T_3–Pendimethalin @ 0.5 kg/ha as PE	60153	42685	3.44	3.17 (9.56)	3.59 (12.44)	4.13 (16.67)	200.33
T_4–Pendimethalin @ 0.5 kg/ha as PE+1 HW at 25 DAS	64445	46277	3.55	2.66 (6.67)	3.22 (9.89)	3.73 (13.44)	147.67
T_5–Pendimethalin @ 0.75 kg/ha as PE	53489	35750	3.02	3.37 (10.89)	3.86 (14.44)	4.35 (18.44)	281.00
T_6–Pendimethalin @ 0.75 kg/ha as PE+1 HW at 25 DAS	56997	38557	3.09	3.08 (9.00)	3.64 (12.78)	4.07 (16.11)	249.67
T_7–Oxadiargyl @ 75 g/ha as PE	52223	34191	2.90	3.53 (12.00)	4.35 (18.45)	4.85 (23.11)	233.33
T_8–Oxadiargyl @ 75 g/ha+1 HW at 25 DAS	62503	43771	3.34	2.91 (8.00)	3.60 (12.44)	4.07 (16.11)	193.67
T_9–Oxadiargyl @ 90 g/ha as PE	51417	33165	2.82	3.67 (13.00)	4.26 (17.67)	4.80 (22.56)	277.33
T_{10}–Oxadiargyl @ 90 g/ha as PE+1 HW at 25 DAS	54284	35332	2.86	3.45 (11.44)	3.86 (14.44)	4.34 (18.33)	246.33
T_{11}–Oxyfluorfen @ 100 g/ha as PE	48017	30245	2.70	4.14 (16.67)	4.69 (21.56)	5.16 (26.33)	346.67
T_{12}–Weed free	65767	44997	3.17	0.71 (0.00)	0.71 (0.00)	0.71 (0.00)	0.0
S. Em±	-	-	-	0.16	0.19	0.20	13.36
C. D. (P=0.05)	-	-	-	0.48	0.55	0.60	39.17
C. V. (%)	-	-	-	8.64	8.42	8.05	9.03

Original data given in parentheses were subjected to square root transformation ($\sqrt{x+0.5}$) before analysis.

as at harvest was observed which might be due to herbicidal effect in these weeds. In addition to this, dense crop canopy might have smothering effect on weeds. These findings corroborate the results reported by Sharma and Jain (2002), Sharma and Singh (2003) and Yadav (2004).

Weed free and pendimethalin @ 0.5 kg/ ha PE+1 HW at 25 DAS were most effective in minimizing weed infestation and recorded significantly the lowest dry weight of weeds (Table 2). These findings are in close conformity with those reported by Rathi *et al.* (2005) and Sharma *et al.* (2005).

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