Chemical Science Review and Letters ISSN 2278-6783

www.chesci.com Research Article

Evaluating the Effects of Chemical Herbicides on Growth and Yield of Indian Mustard in Integrated Weed Management Systems

Ranjan Kumari, Babu Lal Choudhary, Mahaveer Prasad Ola*, Arjun Lal Choudhary and Priyanka Priyadarshini

Department of Agriculture, Vivekananda Global University, Jaipur-303012

Abstract

A field experiment was conducted on research farm, Department of Agronomy, Vivekananda Global University, Jaipur (Rajasthan) to find out the response of integrated weed management on growth and productivity of Indian mustard (Brassica juncea L.). The experiment consisted 9 treatment combinations i.e., T1- Unweeded check (Control), T2- Weed Free, T3- Two hand weeding at 25 and 45 DAS, T4- Clodinafop @ 0.06 kg a.i. ha^{-1} at 20 DAS, T5- Clodinafop @ 0.06 kg a.i. ha^{-1} at 15 DAS + Hand weeding at 45 DAS, T6- Pendimethalin 30% EC (PE) @ 1.0 kg a.i ha^{-1} (5 DAS), T7- Pendimethalin 30% EC (PE) @ 1.0 kg a.i ha^{-1} (5 DAS) + Hand weeding at 45 DAS, T8- Quizalofop-p-ethyl 5% EC (PoE) @ 0.06kg a.i ha^{-1} (20-25 DAS) and T9- Quizalofop-p-ethyl 5% EC (PoE) @ 0.06kg a.i ha^{-1} (20-25 DAS) + Hand weeding at 45 DAS. The experiment was laid out in Randomized Block Design and replicated thrice. Results show that the maximum grain yield of mustard was obtained with T2- Weed Free, very followed by T7- Pendimethalin 30% EC (PE) @ 1.0 kg a.i. ha^{-1} (5 DAS) + Hand weeding at 45 DAS treatments and found significantly superior over rest of the treatments. T2- Weed Free, and integrated method of weed control (T7- Pendimethalin 30% EC (PE) @ 1.0 kg a.i ha^{-1} (5 DAS) + Hand weeding at 45 DAS were found most promising to minimize the weed infestation in Indian mustard. Comparable to T2- Weed Free, pre-emergence application of T7- Pendimethalin 30% EC (PE) @ 1.0 kg a.i ha^{-1} (5 DAS) + Hand weeding at 45 DAS was found most favourable to enhance the plant height, dry weight and number of siliquae per plant as well as the grain yield of mustard. On the basis of Weed control efficiency T2- Weed Free and T7- Pendimethalin 30% EC (PE) @ 1.0 kg a.i ha^{-1} (5 DAS) + Hand weeding at 45 DAS was found most favourable.

Keywords: Chemical herbicides, Growth, Yield, Indian Mustard, Integrated Weed Management Systems.

***Correspondence**

Author: Mahaveer Prasad Ola

Email: mahaveerprasadola37@gmail.com

Introduction

Indian mustard [Brassica juncea (L.) Czernj. & Cosson] is the third most important source of edible oils in the world after soybeans and oil palms. There is a great deal of variation in Brassica sedge species in Central Asia- the Himalayas, with migration into India and China taking place [1]. Indian mustard (Brassica juncea) is one of the major rabi oilseed crops of India. Mustard (Brassica juncea L.) is one of the most important oil seed crops. Mustard commonly called as 'Sarson' or 'Rai' is an important edible rabi oilseed crop of India, widely grown on large area. The mustard oil is utilized for human consumption throughout northern India in cooking and frying purposes. It is also used in the preparation of hair oils and medicines [2]

Among the many aspects of production technology that needs to be carefully considered in Indian mustard is weed management. Since this crop is grown on poor soil and with poor management practices, weed infestation is one of the primary causes of its low yield. The amount of mustard seed produced was decreased by 36-42% when weeds were present for the whole growing season. Indian farmers are likely to their crops quite well, especially when it comes to irrigation, manuring, and seed bed preparation. But not enough focus has been placed on weed control, which remains a barrier to raising crop productivity. As per [3], weed-free fields yielded higher net returns/rupee investments than fields where weeds were controlled solely by herbicide and human weeding at 40 DAS. In two-hand weeding at 20 and 40 DAS, [4] found the lowest weed density and dry weight as well as the maximum weed control effectiveness.

Controlling weeds with the appropriate timing and technique can help reduce the amount of yield loss in mustard. Weed control is a significant constraint on mustard productivity, among other factors that contribute to its low productivity. Weed infestation is one of the main causes of low productivity because this crop is grown in poor soils with poor crop management practices [5]. The two-hand weeding being at par with the herbicides coupled with hand weeding increased the pooled mean seed yield of mustard significantly by 46.3% over the weedy check [6]. During the

Rabi season, some weeds emerged very early and some weeds in the later stage of crop growth. Under such conditions, the sequential application of herbicides is most important to control weeds.

Materials and Methods

The experiment was conducted at research farm, Department of Agronomy, Vivekananda Global University, Jaipur (Rajasthan). There are 9 treatments were laid out in Randomized Block Design with 3 replication (Table 1).

Table 1 Details of the treatments.

Treatments	Symbol
Unweeded check (Control)	T_1
Weed Free	T_2
Two hand weeding at 25 and 45 DAS	T_3
Clodinafop @ 0.06 kg a.i. ha-1 at 20 DAS	T_4
Clodinafop @ 0.06 kg a.i. ha-1 at 15 DAS + Hand weeding at 45 DAS	T_5
Pendimethalin 30% EC (PE) @ 1.0 kg a.i ha-1 (5 DAS)	T_6
Pendimethalin 30% EC (PE) @ 1.0 kg a.i ha-1 (5 DAS) + Hand weeding at 45 DAS	T_7
Quizalofop-p-ethyl 5% EC (PoE) @ 0.06kg a.i ha-1 (20-25 DAS)	T_8
Quizalofop-p-ethyl 5% EC (PoE) @ 0.06kg a.i ha-1 (20-25 DAS) + Hand weeding at 45 DAS	T_9

Fertilizer application

All the treatments were applied in each plot as per treatment. The crop fertilized with 60kg N, 30kg P_2O_5 and 30 kg K_2O per ha. Uniformly half nitrogen full phosphorus and potash, sulphur and zinc where apply as basal and remaining nitrogen top dressed at 30-35 days after sowing. Statistical analysis: In order to test the significance of variation in experimental data obtained for various treatment effects, the data were statistically analyzed as described by [7]. The critical differences were calculated to assess the significance of treatment mean wherever the F' test was found significant at 5 per cent level of probability. To elucidate the nature and magnitude of treatment effects, summary tables along with SEm+ and CD (P=0.05) were prepared.

Results and Discussion

Growth parameters

Initial plant population per unit area at 20 DAS was found minor growth due to different weed control treatments. Plant height recorded at 30th, 60th, 90th DAS and at harvest stage of crop is presented (Table 2). Plant height increased progressively with increase in duration of mustard crop. The plant height was significantly influenced by various weed management practices. The maximum plant height at harvest stage was recorded with T2- Weed Free followed by T7-Pendimethalin 30% EC (PE) @ 1.0 kg a.i. ha-1 (5 DAS) + Hand weeding at 45 DAS and the minimum plant height was recorded in the treatment weedy check. However, at 30th, 60th 90th and at harvest higher plant height in T2- Weed Free followed by T7-Pendimethalin 30% EC (PE) @ 1.0 kg a.i. ha-1 (5 DAS) + Hand weeding at 45 DAS might be due to plot remain low weed density in initial stage during critical period of crop life cycle therefore, no more competition between crop and weed for nutrient, moisture, space and any other accessory requirement which resulted in vigorous growth and development of the plant. Weed management increased the uptake of nutrients also which had possibly contributed to more vegetative growth. The maximum number of primary and secondary branches plant-1 at harvest stage growth stages was recorded with T2- Weed Free followed by T7-Pendimethalin 30% EC (PE) @ 1.0 kg a.i. ha-1 (5 DAS) + Hand weeding at 45 DAS. Whereas at 30th 60th, 90th DAS and at harvest growth stages was recorded with T2- Weed Free followed by T7- Oxadiargyl @ 0.25 kg a.i. ha-1 as pre-emergence + Hand weeding at 40 DAS. The minimum number of branches was recorded in the weedy check treatment. Weed management practices increased the uptake of nutrients which had possibly contributed to more vegetative growth. The results are in conformity with those of [8]. The maximum dry matter accumulation plant-1 at harvest stage was recorded with T2- Weed Free followed by Pendimethalin 30% EC (PE) @ 1.0 kg a.i. ha-1 (5 DAS) + Hand weeding at 45 DAS. Whereas at 30th, 60th, 90th DAS and at harvest growth stages was recorded with T2- Weed Free followed by Pendimethalin 30% EC (PE) @ 1.0 kg a.i. ha-1 (5 DAS) + Hand weeding at 45 DAS. The minimum plant height was recorded in weedy treatment. Increase in plant heightand branches plant-1 were the major factors for higher dry matter accumulation. The results are in conformity with those of [9].

ISSN 2278-6783

Table 2 Effect of weed management on plant population, plant height and dry matter accumulation of mustard.

Treatments	Plant population (m^{-2})		Plant height (cm)			
	20 DAS	harvest stage	30 DAS	60 DAS	90 DAS	At harvest stage
T_1-Un-weeded check (Control)	18.11	15.74	19.75	55.18	127.58	129.26
T_2-Weed Free	27.44	19.37	24.74	68.68	161.32	162.67
T_3-Two hand weeding at 25 and 45 DAS	24.44	18.77	23.52	65.39	153.10	154.53
T_4-Clodinafop @ 0.06 kg a.i. ha^{-1} at 20 DAS	22.67	18.26	22.97	63.51	148.40	149.88
T_5-Clodinafop @ 0.06 kg a.i. ha^{-1} at 15 DAS + Hand weeding at 45 DAS	21.74	17.75	22.83	62.29	145.33	146.84
T_6-Pendimethalin 30% EC (PE) @ 1.0 kg a.i. ha^{-1} (5 DAS)	19.64	17.24	22.63	61.08	142.32	143.86
T_7-Pendimethalin 30% EC (PE) @ 1.0 kg a.i. ha^{-1} (5 DAS) + Hand weeding at 45 DAS	26.27	19.25	24.25	67.35	157.99	159.37
T_8-Quizalofop-p-ethyl 5% EC (PoE) @ 0.06kg a.i. ha^{-1} (20-25 DAS)	25.64	18.95	23.77	66.04	154.73	156.14
T_9-Quizalofop-p-ethyl 5% EC (PoE) @ 0.06kg a.i. ha^{-1} (20-25 DAS) + Hand weeding at 45 DAS	23.75	18.56	23.29	64.77	151.53	152.98
SEm±	2.12	0.54	0.55	1.93	1.92	2.31
C.D. at 5%	6.37	1.63	1.64	5.79	5.76	6.93

ISSN 2278-6783

Table 3 Effect of weed management on yield attributes of mustard.

Treatments	Number of primary branches/ plant	Number of secondary branches/ plant	Number of siliqua/plant	Length of siliqua (cm)	Number of seeds/ siliqua	1000 seed weight (g)
T1-Un-weeded check (Control)	8.58	15.72	130.77	3.95	8.90	4.31
T2-Weed Free	11.83	23.66	254.79	6.69	13.09	4.86
T3-Two hand weeding at 25 and 45 DAS	11.43	22.86	226.22	5.78	12.06	4.72
T4-Clodinafop @ 0.06 kg a.i. ha-1 at 20 DAS	10.74	21.48	208.29	5.38	11.10	4.60
T5-Clodinafop @ 0.06 kg a.i. ha-1 at 15 DAS + Hand weeding at 45 DAS	10.52	21.05	197.76	5.10	10.54	4.54
T6-Pendimethalin 30% EC (PE) @ 1.0 kg a.i. ha^{-1} (5 DAS)	10.31	20.62	187.76	4.84	10.01	4.46
T7-Pendimethalin 30% EC (PE) @ 1.0 kg a.i. ha^{-1} (5 DAS) + Hand weeding at 45 DAS	11.59	23.19	240.78	6.22	12.76	4.78
T8-Quizalofop-p-ethyl 5% EC (PoE) @ 0.06kg a.i. ha^{-1} (20-25 DAS)	11.54	23.09	230.88	5.90	12.31	4.74
T9-Quizalofop-p-ethyl 5% EC (PoE) @ 0.06kg a.i. ha^{-1} (20-25 DAS) + Hand weeding at 45 DAS	11.35	22.72	219.37	5.66	11.45	4.68
SEm±	0.15	0.24	2.68	0.08	0.17	0.08
C.D. at 5%	0.45	0.73	8.03	0.25	0.50	0.24

ISSN 2278-6783

Table 4 Effect of weed management on yields, net returns and B: C ratio of mustard.

Treatments	Grain yield (Kg ha^{-1})	Straw yield (Kg ha^{-1})	Biological yield (Kg ha^{-1})	Harvest index (%)	Net returns (Rs ha^{-1})	B: C ratio
T1-Un-weeded check (Control)	1597	4938	6535	24.44	54,912	1.66
T2-Weed Free	2278	6457	8735	26.08	79,382	1.75
T3-Two hand weeding at 25 and 45 DAS	2050	6055	8105	25.29	73,461	1.88
T4-Clodinafop @ 0.06 kg a.i. ha-1 at 20 DAS	1967	5880	7847	25.07	71,583	1.96
T5-Clodinafop @ 0.06 kg a.i. ha-1 at 15 DAS + Hand weeding at 45 DAS	1914	5770	7684	24.91	71,189	2.09
T6-Pendimethalin 30% EC (PE) @ 1.0 kg a.i. ha-1 (5 DAS)	1809	5547	7357	24.60	65,348	1.90
T7-Pendimethalin 30% EC (PE) @ 1.0 kg a.i. ha-1 (5 DAS) + Hand weeding at 45 DAS	2164	6189	8353	25.91	80,490	2.11
T8-Quizalofop-p-ethyl 5% EC (PoE) @ 0.06kg a.i. ha-1 (20-25 DAS)	2078	6097	8174	25.42	78,442	2.20
T9-Quizalofop-p-ethyl 5% EC (PoE) @ 0.06kg a.i. ha-1 (20-25 DAS) + Hand weeding at 45 DAS	2002	5941	7943	25.20	74,155	2.07
SEm±	30.46	73.36	77.35	0.39	54,912	1.66
C.D. at 5%	91.32	219.94	231.90	1.17	79,382	1.75

Yield contributing characters

Yield contributing characters are the resultant of vegetative development of the crop which determine yield. All the yield attributes viz., number of siliqua plan-1, length of siliqua, number of seed siliqua-1 and test weight were influenced by various weed management practices. Number of siliquae plant-1, length of siliqua (cm) and number of seeds siliqua-1 were recorded maximum in T2-Weed Free followed by Pendimethalin 30% EC (PE) @ 1.0 kg a.i. ha-1 (5 DAS) + Hand weeding at 45 DAS found superior over rest of the weed management practices (Table 3). The test weight did not affected significantly, due to weed management practices. The increase in yield attributing characters might be due to the increase in vegetative as well as reproductive attributes under proper nourishment through weed Management. In addition, the increase in yield attributes was mainly due to increase in photosynthesis activity of leaves, translocation of photosynthate from source to sink and nutrients uptake under higher nutrients availability in weed management. The minimum values of the entire yield attributes were observed in the treatment received lower amount of nutrients in weedy check because plants did not absorb sufficient amount of nutrients which resulted in poor yield attributes. Yield is the resultant of coordinated interplay of growth characters and yield attributes. Seed and Straw yield influenced significantly by applying various weed management practices. The maximum grain yield of mustard was recorded with T2- Weed Free followed by Pendimethalin 30% EC (PE) @ 1.0 kg a.i. ha-1 (5 DAS) + Hand weeding at 45 DAS observed superiority rest of the weed management practices. More or less similar trend was observed in straw yield of mustard. This might be due to adequate nutrient availability and less competition to weeds, which contributed to better growth parameters and yield attributes. Productivity of crop collectively determined by vigor of the vegetative growth and yield attributes which resulted in higher seed and straw yield. The increase in yield was further attributed to better translocation of photosynthates from source to sink due to higher uptake of nutrients which are responsible for quick and easy translocation of photosynthates. Contrary to this, nutrients stress and moisture due to reduced absorbed of nutrients in weedy check provided minimum seed and straw yield due to poor growth and yield attributing characters. The results are in close confirmedly with the findings of [10, 11, 12 and 13].

B: C Ratio

Data pertaining to B: C ratio of mustard as influenced by different weed control treatments are presented in (table 4) observed that T2- Weed Free (1.75 B:C ratio) more effective and followed T7-Pendimethalin 30% EC (PE) @ 1.0 kg a.i. ha-1 (5 DAS) + Hand weeding at 45 DAS (2.11 B:C ratio) recorded significantly superior over rest of the weed management practices factors are similar with [13].

Conclusion

On the basis of above experimental results the following conclusions may be suggested that- Comparable to T2- Weed Free, pre-emergence application of T7- Pendimethalin 30% EC (PE) @ 1.0 kg a.i ha-1 (5 DAS) + Hand weeding at 45 DAS was found most favourable to enhance the plant height, dry weight and number of siliquae per plant as well as the grain yield of mustard. On the basis of Weed control efficiency T2- Weed Free and T7- Pendimethalin 30% EC (PE) @ 1.0 kg a.i ha-1 (5 DAS) + Hand weeding at 45 DAS was found most favourable.

Acknowledgement

Authors are thankful to Coffee Board of India for providing all the facilities to carry out this experiment.

References

[1] J. S. Hemingway. Mustards in Evolution of Crop plants. Edited- N. W. Summonds Longman, London of New York, 1976.

[2] P. D. Singh, A. Pathak, A. Singh and P. Kumar. Effect of different levels and sources of sulphur on growth, yield attributes and nutrient removal by mustard (Brassica juncea L.). The Pharma Innovation Journal, 2021, 10(4): 521-524.

[3] P. C. Ved, P. K. Pandey, S. K. Sharma. Energy requirement of different weed management practices for aerobic rice in India. Ama, Agricultural Mechanization in Asia, Africa & Latin America, 2008, 39(2):39-46.

[4] S. D. Bamboriya, M. K. Kaushik, S. D. Bamboriya and R. C Tiwari. Weed dynamics and weed control efficiency under different weed management practices for increased productivity of mustard. Indian Journal of Weed Science. 2016, 48(4): 458-459.

[5] S. S. Singh. Effect of fertilizer application and weed control on the yield of mustard (Brassica juncea L.). Indian Journal of Agronomy, 1992, 37: 196-198.

[6] M. L. Degra, B. L. Pareek, R. Shivran, R. D. Kand Jat. Integrated weed management in Indian mustard and its residual effect succeeding fodder pearl millet. Indian J. Weed Sci., 2011, 43(1&2): 73-76.

[7] R.A. Fisher. Statistical methods for research workers. Oliver and Boyd Edinburg. London.1950.
[8] R. Jangir, L. K. Arvadia and S. Kumar. Growth and yield of mustard (Brassica juncea L.), dry weight of weeds and weed control efficiency influence by different planting methods and weed management. International J. of Current Microbiology and Applied Sci., 2017, 6(7) pp. 2586-2593.
[9] P. V. Kumar and Barkha. Integrated weed management in mustard. The Pharma Innovation Journal, 2022, SP-11(6): 2483-2486.
[10] D. Mukherjee. Influence of weed and fertilizer management on yield and nutrient uptake in mustard. Indian J. of Weed Sci., 2014, 46(3): 251-255.
[11] H. K. Gill G. and Singh. Weed Flora in Mustard- A review. International Journal of Chemical Studies, 2020, 8(6): 1023-1026.
[12] P. Raj, R. P. Singh, R. K. Pal, P. Rajput and S. S. Rana. 2020. Integrated Weed Management in Indian Mustard (Brassica juncea L.). Int. J. Curr. Microbiol. App. Sci. 2020, Special Issue-10: 271-276.
[13] H. M. Chishi, K. Zhimo, M. Khiamn, A. Zhimomi. Integrated weed management in mustard. Indian Journal of Weed Science, 2021, 53(3): 310-312.

Publication History
Received 14.09.2024
Revised 23.12.2024
Accepted 23.12.2024
Online 29.12.2024