Journal of Pharmacognosy and Phytochemistry

Available online at www.phytojournal.com

E-ISSN: 2278-4136
P-ISSN: 2349-8234
JPP 2019; 8(3): 2451-2454
Received: 20-03-2019
Accepted: 22-04-2019

Shweta Gupta
Assistant Professor, Division of Agronomy, Rajasthan Agricultural Research Institute, Durgapura, Jaipur, Rajasthan, India
Sri Karan Narendra Agriculture University, Jobner, Rajasthan, India

PK Sharma
Professor, Agronomy, Division of Agronomy, Rajasthan Agricultural Research Institute, Durgapura, Jaipur, Rajasthan, India
Sri Karan Narendra Agriculture University, Jobner, Rajasthan, India

Sudesh Kumar
Professor, Agronomy, Division of Agronomy, Rajasthan Agricultural Research Institute, Durgapura, Jaipur, Rajasthan, India
Sri Karan Narendra Agriculture University, Jobner, Rajasthan, India

Surendra Singh
Professor, Agronomy, Division of Agronomy, Rajasthan Agricultural Research Institute, Durgapura, Jaipur, Rajasthan, India
Sri Karan Narendra Agriculture University, Jobner, Rajasthan, India

Shailendra Singh
Assistant Professor, Division of Agronomy, Rajasthan Agricultural Research Institute, Durgapura, Jaipur, Rajasthan, India
Sri Karan Narendra Agriculture University, Jobner, Rajasthan, India

HL Yadav
Senior Research Fellow, RARI, SKNAU, Division of Agronomy, Rajasthan Agricultural Research Institute, Durgapura, Jaipur, Rajasthan, India
Sri Karan Narendra Agriculture University, Jobner, Rajasthan, India

Correspondence
Shweta Gupta
Assistant Professor, Division of Agronomy, Rajasthan Agricultural Research Institute, Durgapura, Jaipur, Rajasthan, India
Sri Karan Narendra Agriculture University, Jobner, Rajasthan, India

Effect of herbicides and fertilizers on the phytotoxicity, growth and yield of Indian mustard [*Brassica juncea* (L.) Czern and Coss.]

Shweta Gupta, PK Sharma, Sudesh Kumar, Surendra Singh, Shailendra Singh and HL Yadav

Abstract
The field experiment was conducted at research farm, RARI, Durga Pura for two consecutive years during *Rabi* seasons 2014-15 and 2015-16 on loamy sand soil. The twenty four treatment combinations consisting of 3 fertility levels {100% RDF; 100% RDF+K+Zn and 125% (RDF+K +Zn)} and 8 herbicides (Weedy check, Weed free, Pendimethalin 30 EC, Pendimethalin 38.7 CS, Pyrazosulfuron-ethyl 10 WP, Oxadiargyl 6 EC, Propaquizafop 10% EC and Fluazifop-p-butyl 13.4% EC were tested in factorial randomized block design with three replications. Results showed that, after weed free and weedy check, minimum phytotoxicity rating on crops was observed in pendimethalin 30 EC pre-emergence @ 750g a.i./ha treatment and maximum phytotoxicity was observed in pyrazosulfuron-ethyl 10 WP pre-emergence @ 150g a.i./ha treatment, however maximum weed control rating, after weed free was observed in pendimethalin 38.7 CS pre-emergence @ 750g a.i./ha treatment. Plant height and number of branches per plant at 30 DAS increases with increase in fertility levels. So, the maximum pooled plant height and number of branches per plant were recorded under 125% (RDF + K + Zn) treatment. Plant height of all the treatments were significantly superior over pyrazosulfuron-ethyl 10 WP pre-emergence @ 150g a.i. /ha treatment at 30 DAS. There was no significant variation in plant height was recorded in between other herbicidal treatments at 30 DAS. No significant variation due to herbicides was found in number of branches per plant. Maximum seed and stover yields were obtained under weed free, which was at par with pendimethalin 38.7 CS @ 750g a.i./ha. The seed and stover yields were significantly higher in fertility level 125% (RDF+K+Zn).

Keywords: Pendimethalin, oxadiargyl, propaquizafop, fluazifop-p-butyl, phytotoxicity rating, weed control rating

Introduction
Rapeseed-mustard is the third most important edible oilseed crop in India after soybean and groundnut. Mustard is one of the major sources of oil in the meal in India. Indian mustard [*Brassica juncea* (L.) Czern & Coss.] is the most important winter season oilseed crop, which thrives best in light to heavy loam soil in areas having 25-40cm of rainfall. Due to the gap between domestic availability and actual consumption of edible oils, India has to resort to import of edible oils. Rapeseed-mustard is the major source of income especially to the marginal and small farmers in rain fed areas. Since these crops are cultivated mainly in the rain fed and resource scarce regions of the country, their contribution to livelihood security of the small and marginal farmers in these regions is also very important. By increasing the domestic production, substantial import substitution can be achieved.

Globally, India account for 17.27 % and 9.07 % of the total acreage and production of rapeseed-mustard (USDA 2016) [10] respectively. During the last nine years, there has been a considerable increase in productivity from 1750kg/ha in 2006-07 to 1850kg/ha in 2014-15 and production has also increased from 46.27mt in 2006-07 to 68.37mt in 2014-15 (USDA, 2016) [10]. India is the third largest rapeseed-mustard producer in the world after Canada and China. This crop accounts for nearly one-third of the oil produced in India, making it the country's key edible oilseed crop. During 2014-15, rapeseed-mustard contributed 22.83% to the total oilseeds production of India. (Anonymous, 2014-15) [1]. Rajasthan is the major mustard producing states in the country, contributing 46.2% of total production of India. National and state yield of mustard in 2014-15 are 1010kg/ha and 1183kg/ha, respectively. (Anonymous, 2014-15) [1]. Although, yield of mustard in Rajasthan is more than its national average yield, but we are still lagging behind by 840kg/ha. as compared to the world's productivity. Among the various constraints attributing to low productivity of mustard in arid and semi-arid region, the erratic nature of climate, inefficient irrigation water, weed infestation,

fertilizer management and poor soil physical conditions are the most important factors which lead to the low crop yield. Among various components of production technology, weed control in Indian mustard needs due attention. As this crop is grown in poor soils with poor management practices, weed infestation is one of the major causes of low productivity. Competition by weeds at initial stages is a major limiting factor to its productivity. Manual weeding at 3-4 weeks after sowing is the most common practice to control weeds in Indian mustard. But increasing wages and scarcity of labor compel to search for other alternatives. The most common herbicidal weed control measure recommended in Indian mustard is the pre-emergence application of herbicide. Farmers and extension functionaries require information on post-emergence herbicidal weed control due to one or other reason, if pre-emergence application of herbicide was not made. Under situations when weeds are not taken care completely by pre-emergence application of herbicides, post-emergence herbicides may have an added economic advantage over super imposition of hand weeding. Therefore, it is imperative to find out an alternative weed management strategy for achieving season long weed control in Indian mustard. Development of effective method of weeds control in mustard, and knowing effective herbicide in controlling specific type of weed flora present in the region is the need of the hour. Nutrient management is the key technology in maintaining and sustaining the production potential of rapeseed-mustard. Balanced fertilization is more essential even at low levels of fertilizer usage for maintaining long term fertility. The present emphasis on the production and promotion of fertilizers containing N, P, K and S has to be modified to include the fifth major plant nutrient Zn.

Material and methods

The treatment consisted of three fertility levels and eight levels of weed management practices. The experiment was laid out in Factorial Randomized Block Design (RBD). The treatments were randomly allotted to different plots using random number table of Fisher and Yates (1963) [4].

Phytotoxicity rating (0-10) scale

Herbicides on application to crop field produce certain injury symptoms mainly on weeds and in some cases on crop plant too. Phytotoxicity to crop indicates the degree of herbicide's selectivity to crop and tells about whether it could safely be used in that crop. For convenience in recording phytotoxicity in the field, first percent injury compared over control may be judged or apprehended visually and then rating was executed on the scale. Phytotoxicity scale of 0-10 was adopted, in which 0 as 0%, 1 as 10%, 2 as 20% injury and so on was considered.

Weed control rating (0-10) scale

Weed control rating indicates the degree up to which weeds are controlled by the herbicides spray. It was calculated after 15 days of spray and was compared over control and and then rating was executed on the scale. Weed control scale of 0-10 was adopted, in which 0 as 0%, 1 as 10%, 2 as 20% injury and so on was considered.

Plant Height

Five plants were selected randomly from each plot and tagged permanently. Height of individual plant was measured at 30 DAS. The height was measured from base of the plant to the top of the main shoot by meter scale and averaged to express in cm.

Number of branches per plant

The total number of branches was counted on five randomly selected and tagged plants in each plot at 30 DAS and then mean was recorded as total number branches plant^{-1}.

Seed and Stover yield

The seed yield of each net plot (inclusive of tagged plants) was recorded in kg plot^{-1} after cleaning the threshed produce was converted as qha^{-1}. Stover yield was obtained by subtracting the seed yield (q ha^{-1}) from biological yield (qha^{-}).

Result and discussion

Phytotoxicity rating (0-10) scale

Data pertaining to effect of herbicides treatments on phytotoxicity rating on crop presented in Table 1 indicated that, after weed free and weedy check, pendimethalin 30 EC pre-emergence @ 750 g a.i./ha treatment was found the most superior treatment that recorded lowest mean phytotoxicity rating of 0.5. It was very closely accompanied by pendimethalin 38.7 CS pre-emergence @ 750 g a.i. /ha treatment, that registered lower mean phytotoxicity rating of 0.78. Oxadiargyl 6 EC pre-emergence @ 90 g a.i./ha., propaquizafop 10% EC @ 100 g a.i./ha at 20-25 DAS and, fluazifop-p-butyl 13.4% EC @ 134g a.i./ha at 20-25 DAS treatments also registered lower mean phytotoxicity rating of 1.17, 1.17 and 1.33, respectively. Highest mean phytotoxicity rating was observed in pyrazosulfuron-ethyl 10 WP pre-emergence @ 150g a.i./ha treatment that recorded mean phytotoxicity rating of 8.33. Pyrazosulfuron-ethyl 10 WP exhibits phytotoxic effect on mustard crop due to its incompatibility with the crop which results into the necrotic effect on mustard just after 10-15 days of its emergence.

Weed control rating (0-10) scale

Data pertaining to effect of herbicides treatments on weed control rating presented in Table 1 indicated that, after weed free, pendimethalin 38.7 CS pre-emergence @ 750g a.i./ha treatment was found the most superior treatment that recorded highest mean weed control rating of 7.67. It was very closely accompanied by pendimethalin 30 EC pre-emergence @ 750g a.i./ha treatment, that registered higher pooled weed control rating of 6.89. Fluazifop-p-butyl 13.4 % EC @ 134g a.i./ha at 20-25 DAS, propaquizafop 10% EC @ 100 g a.i./ha at 20-25 DAS and Oxadiargyl 6 EC pre-emergence @ 90g a.i./ha., treatments also registered higher pooled weed control rating of 6.28, 5.39 and 4.73, respectively. Lowest weed control rating was observed in pyrazosulfuron-ethyl 10 WP pre-emergence @ 150g a.i./ha treatment that recorded pooled herbicides rating of 0.89.

Table 1: Effect of treatments on phytotoxicity rating and weed control rating (after 15 days of spray)

Treatments	Phytotoxicity rating (0-10)			Weed control rating (0-10)		
	2014-15	2015-16	Mean	2014-15	2015-16	Mean
Weedy check	0.00	0.00	0.00	0.00	0.00	0.00
Weed free	0.00	0.00	0.00	10.00	10.00	10.00
Pendimethalin 30 EC pre-emergence @ 750 g a.i./ha	0.56	0.44	0.50	6.78	7.00	6.89
Pendimethalin 38.7 CS pre-emergence @ 750 g a.i./ha	0.78	0.78	0.78	7.67	7.67	7.67
Pyrazosulfuron-ethyl 10 WP pre-emergence @ 150 g a.i./ha.	8.33	8.33	8.33	0.78	1.00	0.89
Oxadiargyl l 6 EC pre-emergence @ 90 g a.i./ha.	1.22	1.11	1.17	5.22	5.56	5.39
Propaquizafop 10% EC @ 100 g a.i./ha at 20-25 DAS	1.22	1.11	1.17	4.56	4.89	4.73
Fluazifop-p-butyl 13.4 % EC @ 134 g a.i./ha at 20-25 DAS	1.33	1.33	1.33	6.22	6.33	6.28

Plant height

Result indicated that all the treatments are significantly superior over pyrazosulfuron-ethyl 10 WP pre-emergence @ 150g a. i. /ha treatment at 30 DAS during both the years of study and in pooled analysis. There was no significant variation in plant height of mustard was recorded in other treatments during both the years of experimentation and in pooled analysis. On the basis of pooled mean, pyrazosulfuron-ethyl 10 WP reduced the plant height by 43.0 per cent at 30 DAS in comparison to weedy check (Table 2).

Data further revealed that different fertility levels bought significant variation in plant height. It was recorded during both the years of experimentation and in pooled analysis. Also 100 % RDF + K + Zn significantly increased the plant height in comparison to 100 % RDF at 30 DAS during both the years of experimentation and in pooled analysis. On the basis of pooled mean, application of 125 % (RDF + K + Zn) increased the plant height by 14.4 per cent at 30 DAS in comparison to 100 % RDF treatment.

In regard to plant height, all the treatments were significantly superior over pyrazosulfuron-ethyl 10 WP pre-emergence @ 150 g a.i./ha treatment at 30 DAS. Due to the phytotoxic effect of pyrazosulfuron-ethyl 10 WP on mustard, many of the crop plants died after 10-15 days of their emergence. And that is why there was significant variation in plant height in comparison to pyrazosulfuron-ethyl 10 WP. Although pendimethalin 30 EC and pendimethalin 38.7 CS recorded maximum plant height at 30 DAS, but they were not significantly superior over any other treatments, except pyrazosulfuron-ethyl 10 WP. The result of maximum plant height in pendimethalin is strongly in support of the findings of Kumar *et al.* (2012) [5] in mustard.

Number of branches per plant

A perusal of data presented in Table 2 indicated that there was no significant variation in number of branches per plant due to herbicides methods, during both the years of experimentation and in pooled analysis.

Data further revealed that at 30 DAS, application of 125 % (RDF + K + Zn) significantly increased the number of branches per plant during both the years of experimentation and in pooled analysis. Also 100 % RDF + K + Zn significantly increased the number of branches per plant in comparison to 100 % RDF at this stage during both the years of experimentation and in pooled analysis. On the basis of pooled mean, application of 125 % (RDF + K + Zn) increased the number of branches per plant by 44.8 per cent at 30 DAS in comparison to 100 % RDF treatment.

Seed and Stover Yield

Weed free produced the maximum seed and stover yield which was at par with pendimethalin 38.7 CS pre-emergence @ 750g a.i./ha during both the years of experimentation and in pooled analysis. After weed free, the maximum seed yield was obtained with application of pendimethalin 38.7 CS @ 750g a.i./ha treatment remained at par with pendimethalin 30 EC @ 750g a.i./ha during both the years of experimentation and in pooled analysis. On the basis of pooled mean, pendimethalin 38.7 CS resulted an increase in seed yield by 3.8, 8.9, 15.2, 30.6 and 38.1 per cent in comparison to pendimethalin 30 EC, fluazifop-p-butyl 13.4% EC, propaquizafop 10% EC, Oxadiargyl 6 EC and weedy check treatments, respectively. The maximum stover yield was obtained with the application of pendimethalin 38.7 CS @ 750g a.i./ha treatment which was significantly superior over all the other treatments during both the years of experimentation and in pooled analysis. These results were in close conformity with the finding of Chaudhary *et al.* (2011) [2] in canola.

It was recorded that application of 125 % (RDF + K + Zn) significantly increased the seed and stover yield during both the years of experimentation and in pooled analysis. These results are in close conformity with the finding of Tomar (2015) [8] in mustard. The higher seed and stover yields of mustard with higher fertility levels was because of better growth more translocation of photosynthates from source to sink (Tripathi *et al.*, 2006) [9].

Table 2: Effect of treatments on plant height, number of branches, seed and stover yield of mustard

Treatments	Plant height at 30 DAS			No. of branches at 30 DAS			Seed Yield (q/ha)			Stover Yield (q/ha)		
	2014-15	2015-16	Pooled	2014-15	2015-16	Pooled	2014-15	2015-16	Pooled	2014-15	2015-16	Pooled
Fertility levels												
100 % RDF*	27.35	26.23	26.79	2.13	1.93	2.03	14.58	13.94	14.26	35.03	33.36	34.20
100 % RDF + K + Zn	29.17	28.17	28.67	2.50	2.28	2.39	15.83	15.12	15.48	36.13	35.03	35.58
125 % RDF + K + Zn	31.25	30.02	30.64	3.06	2.81	2.94	17.72	16.83	17.28	39.14	37.86	38.50
SEm±	0.430	0.483	0.457	0.060	0.077	0.070	0.250	0.190	0.200	0.450	0.410	0.370
CD (P=0.05)	1.240	1.375	1.301	0.190	0.219	0.200	0.710	0.550	0.570	1.280	1.170	1.060
Herbicides												
Weedy check	30.37	29.63	30.00	2.64	2.42	2.53	14.30	13.76	14.03	35.48	32.99	34.24
Weed free	31.07	29.59	30.33	2.41	2.18	2.30	20.41	19.43	19.92	45.96	44.29	45.13
Pendimethalin 30 EC pre-emergence @ 750 g a.i./ha	31.14	30.27	30.71	2.62	2.33	2.48	18.89	18.45	18.67	42.26	42.84	42.55
Pendimethalin 38.7 CS pre-emergence @ 750 g a.i./ha	30.87	29.57	30.22	2.76	2.54	2.65	19.74	19.00	19.37	44.11	43.87	43.99
Pyrazosulfuron-ethyl 10 WP pre-emergence @ 150 g a.i./ha.	17.68	16.51	17.10	2.38	2.20	2.29	4.52	3.43	3.98	10.96	7.98	9.47
Oxadiargyl 6 EC pre-emergence @ 90 g a.i. /ha.	30.83	29.29	30.06	2.60	2.40	2.50	14.92	14.73	14.83	35.44	33.54	34.49
Propaquizafop 10% EC @ 100 g a.i./ha at 20-25 DAS	30.94	30.09	30.52	2.52	2.30	2.41	17.26	16.36	16.81	38.71	37.67	38.19
Fluazifop-p-butyl 13.4 % EC @ 134 g a.i./ha at 20-25 DAS	31.14	30.17	30.66	2.60	2.32	2.46	18.33	17.22	17.78	41.19	40.18	40.69
SEM±	0.710	0.789	0.746	0.100	0.125	0.115	0.410	0.320	0.330	0.730	0.670	0.610
CD (P=0.05)	1.240	2.246	2.124	N.S.	N.S.	N.S.	1.160	0.900	0.930	2.080	1.910	1.720

Conclusion

Maximum phytotoxicity was observed in pyrazosulfuron-ethyl 10 WP pre-emergence @ 150g a.i./ha treatment and it should not be recommended in mustard crop, whereas pendimethalin 38.7 CS pre-emergence @ 750g a.i./ha recorded maximum weed control rating. Plant height of all the treatments were significantly superior over pyrazosulfuron-ethyl 10 WP pre-emergence @ 150g a.i./ha treatment, however, there was no significant variation in plant height was found in between other treatments. There was no significant variation found in number of branches per plant due to herbicides, but these growth parameters increases with increase in fertility levels. So, the maximum plant height and number of branches at 30 DAS were recorded in 125 % (RDF + K + Zn). Weed free produced the maximum pooled seed yield and stover yield, followed by pendimethalin 38.7 CS pre-emergence @ 750g a.i./ha treatment. Maximum seed and stover yields were obtained under weed free, which was at par with pendimethalin 38.7 CS @ 750g a.i./ha. The seed and stover yields were significantly higher in fertility level 125% (RDF + K+ Zn).

References

1. Anonymous. Directorate of Economics and Statistics, Department of Agriculture and Cooperation DAC, 2014-15.
2. Chaudhary SU, Hussain M, Iqbal J. Effect of different herbicides on weed control and yield of canola *Brassica napu*s. Journal of Agricultural Research. 2011; 49(4):483-490.
3. Erlingson M. Fusilade- a strategy for long-term control of couch *Elymus repens*. Weeds and Weed Control. 1988; 1:158-165.
4. Fisher RA, Yates F. Statistical tables. Oliver and Boyd, Edinburgh, London, 1963.
5. Kumar S, Kumar A, Rana SS, Chander N, Angiras NN. Integrated weed management in mustard. Indian Journal of Weed Science. 2012; 44(3):139-143.
6. Mukherjee D. Influence of weed and fertilizer management on yield and nutrient uptake in mustard. Indian Journal of Weed Science. 2014; 46(3):251-255.
7. Sukhadia NM, Ramani BB, Asodaria KB, Modhwadia MM. Comparative efficacy of pre and post–emergence herbicide application in spreading groundnut. *Indian Journal of Weed Science*, 1998; 30(3-4).
8. Tomar J. Irrigation, fertilizers and weed management for improving productivity and nutrient uptake of mustard. In: proc. 25th Asian-Pacific Weed Science Society Conference on Weed Science for Sustainable Agriculture, Environment and Biodiversity, Hyderabad, India during, 2015; 214.
9. Tripathi AK. Effect of varying doses of nitrogen on oil content and oil production in different branches of Indian mustard *Brassica juncea* under different cropping system. *Farm Science Journal.* 2006; 15(1):56-58.
10. US Department of Agriculture. Agricultural Research Service, Nutrient Data Laboratory. USDA National Nutrient Database for Standard Reference, Release 28 Current, 2016.
11. Wang B, Grooma S, Frans RF. Response of soybean mitochondria to substituted dinitroaniline herbicides. Weed Science. 1974; 22:64-66.