International Journal of Chemical Studies

P-ISSN: 2349–8528
E-ISSN: 2321–4902
IJCS 2017; 5(5): 1585-1588

Received: 07-07-2017
Accepted: 08-08-2017

Sontara Kalita
Rajasthan College of Agriculture, Maharana Pratap University of Agriculture and Technology, Udaipur, Rajasthan, India

SL Mundra
Rajasthan College of Agriculture, Maharana Pratap University of Agriculture and Technology, Udaipur, Rajasthan, India

Correspondence
Sontara Kalita
Rajasthan College of Agriculture, Maharana Pratap University of Agriculture and Technology, Udaipur, Rajasthan, India

Herbicidal weed management and nitrogen nutrition impact on growth parameters of Indian mustard [*Brassica juncea*]

Sontara Kalita and SL Mundra

Abstract
A field experiment carried out during the *rabi*, 2014-2015 in Rajasthan College of Agriculture, Udaipur in factorial randomized block design with three replications and 15 treatment combinations to study the effect of weed management and nitrogen application on growth parameters of Indian mustard. The treatment combinations consisted of 5 weed management practices and 3 nitrogen levels. The results show that pre-emergence application of oxadiargyl 0.09 kg ha^{-1} recorded the highest dry matter accumulation (6.03, 28.93, 38.99 and 56.24 g $plant^{-1}$ at 30, 60, 90 DAS and at harvest, respectively), leaf area index (2.47, 4.43 and 3.80 at 30, 60 and 90 DAS, respectively), primary and secondary branches $plant^{-1}$ (6.17 and 17.30, respectively) compared to other herbicide treatments and weedy check but was comparable to hand weeding at 25 DAS. Among three different N levels, the highest dry matter accumulation (5.93, 30.62, 41.81 and 58.14 g $plant^{-1}$ at 30, 60, 90 DAS and at harvest, respectively), leaf area index (2.55, 4.25 and 3.72 at 30, 60 and 90 DAS, respectively), primary and secondary branches $plant^{-1}$ (6.21 and 16.54, respectively) were recorded due to application of 75 kg N ha^{-1}.

Keywords: Indian mustard, pre-emergence, oxadiargyl, dry matter, leaf area index, primary and secondary branches

Introduction
As the second most important oilseed crop, rapeseed and mustard contributes about one quarter of total oilseeds production in India. The crop is grown in winter season as rainfed and in irrigated situation as well. In irrigated situation weeds come up with the crop plants and compete with crop for various growth factors viz. water, nutrients, space, solar energy besides providing harbour for insects and pests. Thus, if crop is severely infested with both grassy and broad leaved weeds and if not managed at proper time it may result in declined growth of the crop and thus the crop yield to a great extent depending on the type, intensity and duration of competition. Optimum nitrogen dose ensures good growth and yield of this crop. It enhances the yield by influencing a variety of growth and yield parameters (Al-Barrak, 2006) [1]. Nitrogen favourably influences the plant growth and protein synthesis, protoplasm, cell size and photosynthetic activity and thus provides a huge frame for more flowers and pods (Yasari and Patwardhan, 2006) [9].

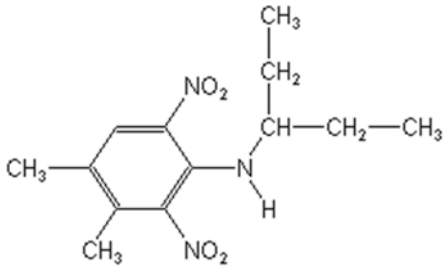
Material and methods
The field experiment was conducted on clay loam soil of Instructional farm, Rajasthan College of Agriculture, Udaipur. The soil of the experimental field was alkaline in reaction (pH 8.2), medium in available N (287.00 kg/ha) and P_2O_5 (20.51 kg/ha) and high in K_2O (286.88 kg/ha). The experiment involved 15 treatment combinations consisted of 5 weed management practices (pendimethalin 0.75 kg ha^{-1} as pre-emergence, oxadiargyl 0.09 kg ha^{-1} as pre-emergence, quizalofop-ethyl 0.05 kg ha^{-1} 25 days after sowing (DAS), hand weeding at 25 DAS and weedy check) and 3 nitrogen levels (45, 60 and 75 kg N ha^{-1}). Indian mustard variety '*BIO-902*' ('Pusa Jaikisan') was sown with seed rate of 2.5 kg ha^{-1} on 2nd November 2014 at 30 x 10 cm spacing using package of practices available for Sub-Humid Southern Plain and Aravalli Hills'' of Rajasthan. Herbicides were sprayed with knapsack sprayer fitted with flat-fan nozzle using 500 liter of water ha^{-1}. The required doses of N for different treatments were applied both through urea and DAP after adjusting the quantity of nitrogen supplied by DAP applied for supplying 35 kg P_2O_5 ha^{-1}. Observations on parameters were taken following standard procedure.

Weed control efficiency (WCE)

WCE was calculated at 30, 60 and 90 DAS using the following formula where weeds dry matter was in kg ha^{-1}.

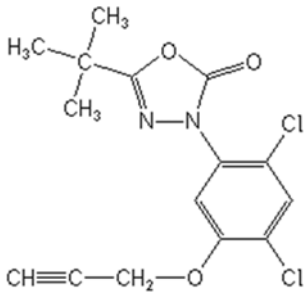
$$WCE\ (\%) = \frac{(\text{Dry matter of weeds in control plot} - \text{Dry matter of weeds in treated plot})}{\text{Dry matter of weeds in control plot}} \times 100$$

(i) Physical and chemical properties of pendimethalin
Chemical structure



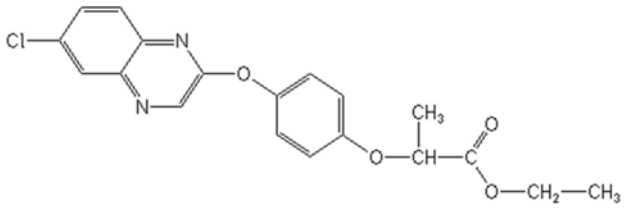
IUPAC : N-(1-ethylproyl)-3, 4-dimethyl-2, 6- dinitro benzenamine
Formula : $C_{13}H_{19}N_3O_4$
Activity : Herbicide
Chemical family : Dinitroanilines
Physical form : Liquid
Types of formulation : Liquid, contains 30% a.i. (EC)
Mode of Action : Pendimethalin is a versatile pre-emergence herbicide, rapidly absorbed by germinating weeds and inhibit both cell division and cell elongation in the roots and shoot meristems of the susceptible plants. The growth is inhibited directly following absorbing through hypocotyls and shoot regions. The plants die shortly after germination or emergence from the soils
Application time : It is an exclusively a pre-emergent herbicide although could be used as early post-emergence and pre-plant incorporation depending upon crops.

(ii) Physical and chemical properties of oxadiargyl
Chemical structure



IUPAC : 5-tert-butyl-3-[2,4-dichloro-5-(propynyl) phenyl]-1,3,4-oxadiazole-2-(3H)-one
Formula : $C_{15}H_{14}Cl_2N_2O_3$
Activity : Herbicide
Chemical family : Azole derivative (Oxadiazoles)
Physical form : Liquid
Types of formulation : Liquid, contains 6% a.i (EC)
Mode of action : Oxadiargyl is a selective herbicide, controls annual grasses, annual sedges and broad-leaved weeds. Its mode of action is inhibition of protoporphyrinogen oxidase (PPO). It is active by contact action with emerging or recently emerged shoots coming in contact with treated soil particles.
Application time : A pre-emergence herbicide for grasses, sedges and some broad-leaved weeds control.

(iii) Physical and chemical properties of Quizalofop-ethyl
Chemical structure



IUPAC : Ethyl 2-[4-[(6-chloro-2-quinoxalinyl)oxy] phenoxy] propionate
Formula : $C_{19}H_{17}ClN_2O_4$
Activity : Herbicide
Chemical family : Aryloxyphenoxy-propionates
Physical form : Liquid
Types of formulation : Liquid, contains 5% a.i.(EC)
Mode of Action : Translocated herbicide and used to control grassy weeds in broad leaf crops. Weeds turn yellow quickly after absorption and translocation within 4-7 days after application. Up to 10-20 days after application, the grasses are completely killed.
Application time : It is an exclusively a post-emergence herbicide and it can effectively control grassy weeds in broad-leaved crops.

Results and discussions
Effect on plant height and dry matter accumulation

One hand weeding recorded the maximum plant height (19.0, 159.3, 181.9 and 182.5 cm) and was at par with oxadiargyl 0.09 kg ha^{-1} at each successive stages of observation which was followed by weedy check at all the stages (Table 1). The possible reason for more height of plants in weedy check plots might be due to phototropism in plants as weeds cover the entire crop resulting into lean and thin growth with least crop dry matter under weedy check. Moreover, there was a significant difference in plant height due to pendimethalin as

compared to one hand weeding and oxadiargyl treatments. Lesser plant height resulted lesser dry matter accumulation in this treatment. The possible reason for such result might be due to the fact that pendimethalin became phytotoxic to mustard on account of its leaching due to rain and become non-selective in action which is in close agreement with the finding of Sarkar and Mukherjee (2006) [7]. The maximum dry matter accumulation in oxadiargyl at 30, 60, 90 and harvest (6.03, 28.93, 38.99 and 56.24 g plant^{-1}, respectively) among different herbicidal treatments was attributed to the greater penetration of solar radiations in the crop canopy which can be resulted for greater rate of photosynthesis and more accumulation of dry matter. Again, this could also be ascribed due to direct effect of the highest WCE of this herbicide which provided cleaner and conducive environment for growth and nutrient uptake by the crop. Indian mustard was significantly affected by application of nitrogen. Application of 75 kg N ha^{-1} significantly increased plant height by 34.7, 11.9 and 10.7 % and dry matter by 14.0, 52.5 and 45.8 % over 45 kg N ha^{-1}, respectively at 30, 60 and 90 DAS (Table 1). Sandhu *et al.* (2015) [8] also found the higher values of different growth parameters with increase in nitrogen levels.

Effect on LAI, primary and secondary branches plant^{-1} of Indian mustard

Oxadiargyl recorded the highest LAI (2.47) at 30 DAS whereas at subsequent stages of observation (60 and 90 DAS) the highest value of this parameter was recorded for one hand weeding (4.44, 3.89 respectively) with an insignificant difference with the later (Table 2). The lesser LAI at 30 DAS in one hand weeding might be possible due to the reason that hand weeding was done only 5 days ahead of first observation and thus this treatment get only few days for full expression of leaf growth under almost weed free environment as compared to oxadiargyl. The highest weed control efficiency was recorded under pre-emergence application of oxadiargyl compared to other herbicidal treatments at 30, 60 and 90 DAS (75.83, 74.11 and 67.01 %, respectively) (Table 1). The increment in other growth parameters such as leaf area index (LAI), primary and secondary branches plant^{-1} in all the weed contol treatments might be due to a quite weed free environment compared to weedy check which avail non-competitive sites for extending branches and expansion of leaves under reduced weed problem. Results so obtained for different growth parameters are in close conformity with the findings of Meena *et al.* (2009) [5], Sah *et al.* (2013) [6], Awal and Fardous (2014) [2] and Mankar (2015) [4]. The highest leaf area index (2.55, 4.25 and 3.72 at 30, 60 and 90 DAS, respectively), primary and secondary branches plant^{-1} (6.21 and 16.54, respectively) was recorded under 75 kg N ha^{-1} (Table 2). Dongarkar *et al.* (2005) [3] also reported that increase in nitrogen levels significantly increased plant height, number of branches plant^{-1}, leaf area index and dry matter accumulation of Indian mustard.

Table 1: Effect of weed management and nitrogen levels on plant height, dry matter accumulation and weed control efficiency

Treatment	Plant height (cm)			Dry matter accumulation (g plant^{-1})				Weed control efficiency (%)			
	30 DAS	60 DAS	90 DAS	Harvest	30 DAS	60 DAS	90 DAS	Harvest	30 DAS	60 DAS	90 DAS
Weed Management											
Pendimethalin 0.75 kg ha^{-1}	16.2	134.9	155.2	156.4	5.58	25.04	35.55	49.57	66.18	63.22	51.67
Oxadiargyl 0.09 kg ha^{-1}	17.0	157.3	180.5	181.9	6.03	28.93	38.99	56.24	75.83	74.11	67.01
Quizalofop-ethyl 0.05 kg ha^{-1}	16.9	156.6	178.2	179.6	5.31	24.23	34.84	48.18	23.92	20.69	19.71
One Hand weeding 25 DAS	19.0	159.3	181.9	182.5	6.07	29.04	39.25	56.60	79.55	76.35	69.50
Weedy Check	18.1	157.5	180.6	181.0	4.85	20.76	29.73	35.59	-	-	-
SEm±	0.6	5.6	6.1	6.21	0.15	0.85	1.12	1.99	-	-	-
CD (P=0.05)	1.8	16.3	17.7	18.0	0.45	2.47	3.25	5.77	-	-	-
Nitrogen levels (kgha^{-1})											
45	14.7	144.1	166.2	167.2	5.20	20.08	28.68	37.82	-	-	-
60	17.9	154.0	175.6	175.8	5.58	26.10	36.53	51.74	-	-	-
75	19.8	161.3	184.0	185.8	5.93	30.62	41.81	58.14	-	-	-
SEm±	0.5	4.4	4.7	4.8	0.12	0.66	0.87	1.54	-	-	-
CD (P=0.05)	1.4	12.6	13.7	13.9	0.35	1.91	2.52	4.47	-	-	-

Table 2: Effect of weed management and nitrogen levels on LAI, primary and secondary branches plant^{-1} of Indian mustard.

Treatment	LAI			Branches plant^{-1} at harvest	
	30 DAS	60 DAS	90 DAS	Primary	Secondary
Weed Management					
Pendimethalin 0.75 kg ha^{-1}	2.37	4.09	3.69	5.86	15.27
Oxadiargyl 0.09 kg ha^{-1}	2.47	4.43	3.80	6.17	17.30
Quizalofop-ethyl 0.05 kg ha^{-1}	2.16	3.91	3.32	5.50	15.17
One Hand weeding 25 DAS	2.40	4.44	3.89	6.78	18.17
Weedy Check	1.92	2.51	2.28	4.76	10.20
SEm±	0.08	0.15	0.13	0.22	0.56
CD (P=0.05)	0.24	0.43	0.37	0.65	1.62
Nitrogen levels (kg ha^{-1})					
45	1.92	3.46	3.03	5.27	13.84
60	2.31	3.92	3.45	5.95	15.27
75	2.55	4.25	3.72	6.21	16.54
SEm±	0.06	0.11	0.10	0.17	0.43
CD (P=0.05)	0.18	0.33	0.28	0.50	1.26

Conclusion

Although different herbicidal treatments resulted into the higher plant growth characteristics compared to weedy check oxadiargyl 0.09 kg ha^{-1} recorded the highest plant growth characteristics which was comparable to hand weeding treatment. Again, among the three levels of nitrogen the

highest level (75 kg N ha^{-1}) recorded more values of the growth parameters of Indian mustard as compared to other two levels and recorded significant increase in all these parameters as compared to 45 kg N ha^{-1}.

References

1. Al-Barrk KM. Irrigation interval and nitrogen level effects on growth and yield of canola (*Brassica napus* L.). Scientific Journal of King Faisal Univercity (*Basic and Applied Sciences*). 2006; 7:87-103.
2. Awal MA, Fardous T. Effect of a single weeding on growth and yield of two *Brassica* species. American Journal of Biology and Life Sciences. 2014; 2:166-172.
3. Dongarkar KP, Panwar WS, Khawale VS, Khutate NG, Gudadhe NN. Effect of Nitrogen and Sulphur on Growth and Yield of Mustard (*Brassica juncea* L.). Journal of Soil and Crops. 2005; 15:163-167.
4. Mankar DD. Study on effective weed management in Indian mustard (*Brassica juncea* L.). Journal of Oilseed Brassica. 2015; 6:279-288.
5. Meena SS, Kakani RK, Mehta RS. Economic feasibility of weed management practices in cumin (*Cuminum cyminum* L.). Journal of Spices and Aromatic Crops. 2009; 18:9-12.
6. Sah D, Sewak R, Singh AK, Swami S. Growth, yield and profitability of Indian mustard (*Brassica juncea*) with different weed control measures and sulphur levels. Agricultural Science Digest. 2013; 33: 15-20.
7. Sarkar A, Mukherjee PK. Phytotoxicity of pendimethalin in mustard and effect of weed control on plant nutrients' Conservation in Soil. Annal of Agricultural Research. 2006; 27:283-287.
8. Sandhu PS, Mahal SS. Sardana V. Performance of promising hybrids of Indian mustard (*Brassica juncea* L. Czern & Coss) under varying levels of nitrogen and row spacing. Journal Crop and Weed. 2015; 11:204-207.
9. Yasari E, Patwardhan AM. Physiological analysis of the growth and Asian Journal of Plant Sciences. 2006development of canola (*Brassica napus* L.).; 5:745-752.