



Weed management and nitrogen application for improved yield of mustard

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Rapeseed and mustard is the second major oilseed crop after groundnut in India, accounting nearly 25-30% of total oilseeds production. As an irrigated crop in North-West India, Indian mustard suffers more from weed competition especially at the early stage of crop growth. Weeds caused yield reduction to the tune of 10-58% (Banga and Yadav 2001 and Malik *et al.* 2012) depending on the type, intensity and duration of competition. Uncontrolled weed reduced mustard yield by 68% as compared to weed free condition (Degra *et al.* 2011). Moreover, competition of weeds with crop plant causes severe nutrition deprivation in general (Roshdy *et al.* 2008) and nitrogenous fertilizer in particular on small, marginal and rocky areas of tribal dominated population. The most common practice of weed management in Indian mustard is manual weeding at 3-4 weeks after sowing. But, increasing wages, scarcity of labour at peak periods and high cost involvement compel to search other alternatives which are technically feasible and economically viable so that these measures can manage the weed below the economic threshold level and allow harnessing the yield potential of this crop. Optimum nitrogen dose enhances the yield by influencing a variety of growth and yield parameters and also provides lush green colour of the crop canopy and concurrently increasing the competitive ability of the crop. Considering these facts, a field experiment was carried out to find out the most effective weed management practice and nutrient level in Indian mustard.

Field experiment was conducted during Rabi, 2014-2015 on clay loam soil of Instructional farm, Rajasthan College of Agriculture, Udaipur, (Rajasthan). The soil of the experimental field was alkaline in reaction (pH 8.2), medium in available N (287.00 kg/ha) and P₂O₅ (20.51 kg/ha) and high in K₂O (286.88 kg/ha). The experiment involved 15 treatment combinations consisted of 5 weed

management practices (pendimethalin 0.75 kg/ha as pre-emergence, oxadiargyl 0.09 kg/ha as pre-emergence, quizalofop-ethyl 0.05 kg/ha 25 days after sowing (DAS), hand weeding at 25 DAS and weedy check) and 3 nitrogen levels (45, 60 and 75 kg/ha). Indian mustard variety 'BIO-902' ('Pusa Jaikissan') was sown with seed rate of 2.5 kg/ha 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. The required doses of N for different treatments were applied both through urea and DAP after adjusting the quantity of nitrogen supplied by DAP for supplying 35 kg P₂O₅/ha. In each plot, weeds were counted category wise (monocot and dicot) from two predetermined randomly selected area of 0.25 m² using 0.5 x 0.5 m quadrat at 60 DAS and their average were subjected to square root transformation. At 90 DAS, weeds were removed and categorized as monocot and dicots and then were oven dried to obtain the weed biomass. Weed control efficiency at 90 DAS was calculated on the basis of weed biomass using the standard formula. Observations on other parameters were taken following standard procedure.

Weed flora

Monocot and dicot weeds predominant in the experimental sites were *Cynodon dactylon*, *Cyperus rotundus*, *Phalaris minor*, *Asphodelus tenuifolius*, *Anagallis arvensis*, *Chenopodium murale*, *Chenopodium album*, *Convolvulus arvensis*, *Fumaria parviflora* and *Melilotus indica*.

Weed density, dry matter and weed control efficiency

In general, the weed density of dicot weed was dominating at the site of experimentation. All the weed management practices except density and dry matter of dicot weeds due to quizalofop-ethyl 0.05 kg/ha, significantly reduced density as well as dry matter of monocot, dicot and total weeds compared to weedy

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Table 1. Effect of weed management and nitrogen levels on weed density, weed dry matter and weed control efficiency in Indian mustard

Treatment	Weed density/m ² at 60 DAS			Weed dry matter (kg/ha) at 90 DAS			Weed control efficiency (%) at 90 DAS		
	Monocot	Dicot	Total	Monocot	Dicot	Total	Monocot	Dicot	Total
<i>Weed management</i>									
Pendimethalin 0.75 kg/ha	4.35(18.4)	7.03(48.9)	8.24(67.3)	78.8	238.6	317.4	58.4	48.7	51.7
Oxadiargyl 0.09 kg/ha	3.94(15.0)	6.99(48.5)	7.99(63.5)	55.1	162.5	217.5	70.9	65.4	67.0
Quizalofop-ethyl 0.05 kg/ha	4.87(23.2)	10.60(112.1)	11.65(135.3)	71.9	458.9	530.9	62.1	2.5	19.7
One hand weeding 25 DAS	3.60(12.5)	4.23(17.6)	5.52(30.1)	50.2	151.1	201.2	73.5	67.8	69.5
Weedy check	9.39(87.7)	10.97(120.0)	14.43(207.7)	190.5	470.8	661.3	-	-	-
LSD (p=0.05)	0.16	0.45	0.35	9.7	30.8	33.9	-	-	-
<i>Nitrogen levels</i>									
45 kg/ha	5.21(31.5)	7.80(67.0)	9.43(98.5)	83.4	278.6	362.0	52.5	35.8	40.7
60 kg/ha	5.30(31.8)	7.93(69.4)	9.57(101.3)	91.2	294.2	385.4	52.5	37.7	42.1
75 kg/ha	5.37(32.5)	8.02(70.1)	9.69(102.6)	93.3	316.3	409.6	54.0	37.1	42.0
LSD(p=0.05)	NS	NS	NS	7.5	23.8	26.3	-	-	-

Figures in parentheses are original values, while outside are transformed values ($\sqrt{x + 0.5}$)

check. Among weed management treatments, one hand weeding treatment resulted in minimum density of monocot, dicot and total weeds at 60 DAS compared to rest of the treatments which was followed by oxadiargyl 0.09 kg/ha and pendimethalin 0.75 kg/ha (Table 1). However, one hand weeding and oxadiargyl 0.09 kg/ha treatments were at par in reducing weed dry matter at 90 DAS. Oxadiargyl effectively controlled density of *Phalaris minor*, sedges, *Melilotus indica* and *Chenopodium* spp. and this result was in the line of findings of Punia *et al.* (2006) and Kumar *et al.* (2012). The highest weed control efficiency at 90 DAS (69.5%) was recorded under one hand weeding treatment closely followed by oxadiargyl 0.09 kg/ha (67.01%) in this regard. Thus, both these treatments provided the crop better environment for luxuriant growth and later on the crop itself acted as smoother crop and curbed the growth of weeds beneath the crop coverage. Application 75 kg N/ha increased dry matter of monocot, dicot and total weeds at 90 DAS compared to 45 kg N/ha.

Yield parameters and yield

Among different weed management treatments, one hand weeding at 25 DAS and oxadiargyl 0.09 kg/ha were found statistically at par in recording different yield attributes such as siliqua/plant, seeds/siliqua and weight of 1000 seeds as well as stover and biological yield (Table 2). One hand weeding at 25 DAS recorded maximum seed, stover and biological yields of 2.24, 5.59 and 7.83 t/ha, respectively, which was found statistically at par with pre-emergence application of oxadiargyl 0.09 kg/ha (2.23, 5.46 and 7.70 t/ha, respectively). The higher yield attributes

and yield under these two treatments were attributed to minimum weed infestation and thus resulting into an overall favourable conditions for crop growth due to better availability of light, water, space and nutrients to the plant. Maximum harvest index (29.03%) was registered with oxadiargyl 0.09 kg/ha, which was statistically at par with one hand weeding at 25 DAS and pendimethalin 0.75 kg/ha with respective harvest index values as 28.5 and 27.8% (Table 2). It is evident from results that uncontrolled weeds reduced yield of mustard by 26.1 to 70.7% due to vigorous growth of weeds and thus hampered the crop growth. Seed yield of the crop increased with each level of nitrogen application from 45 kg/ha to 75 kg/ha and was the manifestation of increase in yield attributes *i.e.* number of siliqua/plant, number of seeds/siliqua and weight of 1000 seeds (Table 2). Alike seed yield, stover yield was also increased significantly with increasing dose of N up to 75 kg/ha (Table 2). This result could be confirmed with the finding of Dongarkar *et al.* (2005). Harvest index was not affected significantly with different levels of nitrogen. It was well emphasized that application of 75 kg N/ha markedly improved overall growth of the crop in terms of dry matter/plant by virtue of its impact on morphological and photosynthetic components. The improvement in these growth parameters resulted competitive ability of crop with unwanted plants. This reflects great availability of nutrients and metabolites for different biosynthesis process of growth and development of both vegetative (source) and reproductive (sink) part, which resulted into increase in different yield attributes and yield.

Table 2. Effect of weed management and nitrogen levels on yield attributes, yield and economics in Indian mustard

Treatment	Siliqua/ plant	Seeds/ siliqua	Weight of 1000- seed (g)	Seed yield (t/ha)	Stover yield (t/ha)	Biological yield (t/ha)	Harvest index (%)	Net returns (x10 ³ ₹)	B-C ratio
<i>Weed management</i>									
Pendimethalin 0.75 kg/ha	251.06	13.95	5.46	1.85	4.84	6.69	27.76	52.86	2.45
Oxadiargyl 0.09 kg/ha	286.24	15.08	5.64	2.23	5.46	7.70	29.03	67.14	3.05
Quizalofop-ethyl 0.05 kg/ha	240.93	14.39	5.39	1.65	4.51	6.17	26.78	44.91	2.04
One hand weeding 25 DAS	291.91	15.22	5.82	2.24	5.59	7.83	28.49	65.76	2.76
Weedy check	213.05	13.81	4.99	1.31	4.00	5.31	24.65	33.66	1.68
LSD (p=0.05)	24.21	NS	0.19	0.21	0.51	0.67	1.75	-	-
<i>Nitrogen levels</i>									
45 kg/ha	233.33	13.76	5.34	1.61	4.35	5.96	26.86	43.26	1.97
60 kg/ha	257.28	14.64	5.43	1.89	4.94	6.83	27.52	54.00	2.46
75 kg/ha	279.31	15.07	5.60	2.08	5.35	7.43	27.65	61.33	2.75
LSD (p=0.05)	18.75	NS	0.15	0.16	0.39	0.52	NS	-	-

Economics

Economic evaluation of the treatments revealed maximum net returns and B-C ratio (₹ 67136/ha and 3.05, respectively) was recorded under pre-emergence application of oxadiargyl 0.09 kg/ha followed by one hand weeding 25 DAS (₹ 65757/ha and 2.76, respectively). Among the nitrogen levels maximum net returns (₹ 61333/ha) and B-C ratio (2.75) were recorded under application of 75 kg N/ha (Table 2) due to higher seed and stover yields with comparatively less additional cost of nitrogen under this treatment.

SUMMARY

Pre-emergence application of broad spectrum herbicide oxadiargyl 0.09 kg/ha in mustard recorded the highest net returns and B-C ratio with greater seed yield comparable to one hand weeding. It was found that oxadiargyl 0.09 kg/ha is the alternative option of costly hand weeding practice in gaining higher yield in mustard. Among the N treatments, application of 75 kg N/ha recorded the maximum net returns (₹ 61333/ha) and B-C ratio (2.75) with higher seed yield.

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