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Effect of Cropping Sequence, Seed Rate and Weed Management on Weed Growth and Yield of Indian Mustard in Western Rajasthan

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ABSTRACT

The major weed species observed in the weedy check plots of mustard field were *Chenopodium album, C. murale, Portulaca oleracea, Melilotus indica, Asphodelus tenuifolius* and *Rumex dentatus*. Inclusion of mungbean in mungbean-mustard cropping sequence caused 18.2% weed control efficiency over fallow-mungbean sequence. The system also gave 1597 kg ha^{-1} seed yield of mustard, besides additional mustard seed equivalent yield of 600 kg ha^{-1} by mungbean cultivation during **kharif** season, which provided 24.31% higher net return over fallow-mustard cropping sequence. Net return and benefit : cost ratio were improved with higher seed rate (5 and 6 kg ha^{-1}) than lower seed rate (4 kg ha^{-1}). Among the weed management practices, two hand weeding at 25 and 50 DAS and integration of fluchloralin at 0.75 kg ha^{-1} supplemented by one hand weedings at 25 DAS found significantly superior in terms of reducing weed density and dry weight of weeds over fluchloralin at 1.0 kg ha^{-1} and weedy check. However, maximum net profit and benefit : cost ratio were recorded with fluchloralin at 0.75 kg ha^{-1}+one hand weeding at 25 DAS.

INTRODUCTION

Indian mustard [*Brassica juncea* (L.) Czern & Coss] is a major **rabi** crop grown under conserved soil moisture and irrigated condition of Rajasthan. The crop has high potentiality in the western region of the state, which accounts for 33% of the total area and 35% of the total production in the state. Considering the congenial environment for the cultivation of mustard, there is further possibility to boost up its productivity upto a considerable level by manipulation of agronomical practices (Patidar *et al.*, 1996).

Among different cultivation practices, effective weed management is imperative for realizing desired level of productivity as weed infestation alone causes upto 56% yield reduction in Indian mustard (Patel *et al.*, 1997). Leaving land fallow during **kharif** season to restore soil fertility and growing **rabi** crops during succeeding season is a prevalent practice in the western Rajasthan. Increasing crop canopy per unit area by manipulating plant density has significant impact on suppressing weed growth (Bhan, 1992). Moreover integration of weed management is effective, economic and eco-friendly approach in improving and sustaining the agricultural productivity (Foy, 1993). Keeping these facts in view, a study was, therefore, undertaken to find out the effect of cropping sequence, seed rate and weed management on the productivity of Indian mustard in western Rajasthan.

MATERIALS AND METHODS

The experiment was conducted during 2003 to 2005 at Satheen, Jodhpur (Rajasthan). The soil of the experimental site was sandy loam in texture having pH 8. 1, low in organic carbon (0.32%) and available N (210 kg N ha^{-1}), medium in available phosphorus (14.2 kg ha^{-1}) and rich in available potassium (264 kg ha^{-1}). The treatments comprised two cropping sequences (fallow-mustard and mungbean-mustard) in main plots, three seed rates (4, 5 and 6 kg ha^{-1}) in sub-plots and four weed management measures (weedy check, fluchloralin at 1.0 kg ha^{-1}, two hand weedings at 25 and 50 DAS and fluchloralin at 0.75 kg ha^{-1}+one hand weeding at 25 DAS) in sub- subplots. The experiment was laid out in split split plot design with three

Table 1. Effect of cropping sequence, seed rate and weed management on weeds (Mean of two seasons)

Treatment	Weed density (m^{-2})								Weed dry weight (No. m^{-2})	
	Chenopodium sp.		*Portulaca oleracea*		Others		Total			
	60 DAS	At harvest	60 DAS	At harvest	60 DAS	At harvest	60 DAS	At harvest	60 DAS	At harvest
Cropping sequences										
Fallow-mustard	42	49	11	17	21	17	74	83	40.1	57.3
Mungbean-mustard	33	37	8	11	16	22	57	70	34.2	46.9
LSD (P=0.05)	8	10	NS	3	3	4	13	11	5.1	8.2
Seed rates (kg ha^{-1})										
4	44	46	13	18	29	27	86	91	44.2	65.1
5	37	42	9	15	15	17	61	74	36.3	54.0
6	32	41	7	9	10	15	49	65	31.0	46.0
LSD (P=0.05)	6	4	3	4	6	8	21	13	10.6	9.7
Weed management										
Weedy	80	88	19	29	49	62	148	179	96.0	134.0
HW at 25 and 50 DAS	17	19	5	6	4	4	26	29	9.3	18.2
Fluchloralin 1.0 kg ha^{-1}	34	41	9	13	12	5	55	59	31.5	42.0
Fluchloralin 0.75 kg ha^{-1}+ weeding at 25 DAS	19	24	5	8	10	2	34	34	12.0	20.3
LSD (P=0.05)	11	14	8	6	18	16	19	12	7.5	11.2

replications.

Mungbean was grown with all recommended package of practices and simultaneously fallow land was left during **kharif** season. Mungbean variety K-85 1 was sown on July 12, 2003 and July 7, 2004 in rows and harvested on September 18 and 20 during respective years. In subsequent **rabi** season, Indian mustard was succeeded to mungbean and fallow with recommended package of practices. Indian mustard variety Pusa Jai Kisan was sown on October 12, 2003 and October 18, 2004 and harvested on March 7, 2004 and March 14, 2005. Fluchloralin was sprayed a day before sowing with knapsack sprayer using 600 litre of water ha^{-1} and incorporated. Observation on weeds was recorded at 60 days after sowing and at harvesting from selected spot in each plot. The dry weight of weeds was recorded by keeping the weeds in oven at 120°C upto 72 h.

RESULTS AND DISCUSSION

Weed Dynamics

Broadleaf weed species dominated in the mustard crop and contributed 92% of total weed population. The weed flora recorded at 60 DAS in the mustard field were : *Chenopodium album* (37%), *C. murale* (22%), *Portulaca oleracea* (14.5%), *Melilotus indica* (6.5%), *Asphodelus tenuifolius* (5.6%), *Rumex dentatus* (5.6%) and some other species like *Amaranthus blitum, Cyperus rotundus, Heliotropium subulatum, Glinus lotoides* and *Cynodon dactylon* were recorded in minor abundance (8.8%) in mustard field during **rabi** season. The dominant weed species observed in the experimental field during **kharif** season were : *Digera muricata* (46%), *Amaranthus blitum* (27%), *Celocia argentia* (12%), *Heliotropium subulatum* (6%), *Glinus lotoides* (3%) and *Cynodon dactylon* (2%).

Mungbean-mustard cropping sequence caused 14.7 and 18.2% weed control efficiency compared to fallow-mustard cropping sequence recorded at 60 days after sowing and at harvest, respectively (Table 1).The highest weed control efficiency of 29.9 and 28.9% was observed with 6 kg seed ha^{-1} followed by 17.8 and 17.0% with 5 kg seed

ha^{-1} at 60 DAS and at harvest, respectively. However, lowest seed rate (4 kg ha^{-1}) recorded significantly higher weed density and dry matter accumulation than higher seed rate (5 and 6 kg ha^{-1}). Decrease in weed density, weed dry weight and increase in weed control efficiency under higher seed rates could be attributed to suppression of weeds due to increasing crop canopy by higher plant population per unit area. Walia and Brar (2001) also reported significant reduction in weeds due to higher seed rate.

Two hand weedings at 25 and 50 days after sowing being at par with fluchloralin at 0.75 kg ha^{-1} +one hand weeding at 25 DAS had significantly less weed density and weed dry matter accumulation over fluchloralin at 1.0 kg ha^{-1} and weedy check (Table 1). Thus, highest weed control efficiency (90.3% at 60 DAS and 86.4% at harvest) was observed under two hand weedings. Integration of fluchloralin+one hand weeding showed 87.5 and 85.8% weed control efficiency at 60 DAS and at harvest, respectively. Fluchloralin 1.0 kg ha^{-1} alone had less efficiency than its integration with hand weeding. Yadav (2004) also reported effective control of weeds in Indian mustard due to integrated use of fluchloralin and hand weeding compared to alone application of fluchloralin.

Effect on Crop

Cropping sequence did not influence significantly yield attributes and seed yield of Indian mustard (Table 2). An additional mustard equivalent seed yield (600 kg ha^{-1}) was obtained by mungbean cultivation during **kharif** season. Seed rate had significant influence on the yield attributes and seed yield of Indian mustard. Maximum values of branches $plant^{-1}$, siliquae $plant^{-1}$ and 1000-seed weight were recorded at lower seed rate (4 kg ha^{-1}) followed by higher seed rate (5 and 6 kg ha^{-1}). This may be attributed to reduced competition for essentials among the plants due to poor crop stand in lower seed rate. Use of 5 and 6 kg seed ha^{-1} produced on par seed yield; however, both the seed rates resulted in significantly higher seed yield by 15.8 and 14.6%,

Table 2. Effect of treatments on the yield attributes, yield and economic returns (Mean of two seasons)

Treatment	100-seed weight (g)	Branches $plant^{-1}$	Siliquae $plant^{-1}$	Seed yield (kg ha^{-1})	Cost of cultivation (Rs. ha^{-1})	Net returns (Rs. ha^{-1})	B : C ratio
Cropping sequences							
Fallow-mustard	4.33	5.3	12.4	1613	15189	12232	0.81
Mungbean-mustard	4.26	4.5	11.5	1597+(600)*	21189	16160	0.76
LSD (P=0.05)	NS	NS	NS	NS	-	-	-
Seed rates (kg ha^{-1})							
4	4.43	6.0	13.0	1440	18159	12251	0.62
5	4.32	5.0	12.0	1710	18189	15811	0.87
6	4.12	3.7	10.8	1686	18219	15443	0.85
LSD (P=0.05)	0.16	1.1	00.9	0230	-	-	-
Weed management							
Weedy	3.93	3.5	10.0	1262	17289	09265	0.54
Two hand weedings at 25 and 50 DAS	4.60	6.3	13.5	1896	19789	17543	0.89
Fluchloralin 1.0 kg ha^{-1}	4.23	4.5	11.3	1557	18289	13280	0.73
Fluchloralin 0.75 kg ha^{-1}+ hand weeding at 25 DAS	4.42	5.3	12.5	1761	17389	17291	0.99
LSD (P=0.05)	0.34	1.2	00.9	0182	-	-	-

*Obtained 600 kg ha^{-1} mustard seed equivalent yield due to mungbean cultivation during **kharif** season.
NS-Not Significant.

respectively, over 4 kg seed ha^{-1}. Adequate plant population per unit area and suppression of weeds due to higher plant stand and canopy development might have enhanced seed yield with higher seed rate than lower seed rate (Moorthy and Saha, 2001).

All the weed control treatments caused significant improvement in yield attributes and seed yield over weedy check. Maximum seed yield of 1896 kg ha^{-1} was recorded with two hand weedings given at 25 and 50 days after sowing followed by pre-plant incorporation of fluchloration at 0.75 kg ha^{-1}+ one hand weeding at 25 DAS (1761 kg ha^{-1}). Fluchloralin at 1.0 kg ha^{-1} alone produced significantly lower seed yield than two hand weedings and fluchloralin+one hand weeding. Poor crop weed competition under two hand weedings and fluchloralin+one hand weeding than fluchloralin alone might have increased seed yield with these treatments.

Economics

Mungbean-mustard cropping sequence resulted in net return of Rs. 16160 and benefit : cost ratio of 0.76, while fallow-mustard could provide Rs. 12232 as net return and 0.81 as benefit : cost ratio. Among the seed rates, maximum net return (Rs. 15811) and henefit : cost ratio (0.87) realized with 5 kg seed ha^{-1} followed by 6 kg seed ha^{-1} (Rs. 15443 as net return and 0.85 as benefit : cost ratio). However, minimum net return of Rs. 12251 and benefit : cost ratio of 0.62 was realized with 4 kg seed ha^{-1}. Among the weed management, integration of fluchloralin+ one hand weeding at 25 DAS proved its superiority by providing maximum net return (Rs.17291) and benefit : cost ratio (0.99). The lowest net return of Rs. 9265 ha^{-1} and benefit : cost ratio of 0.54 were realized with weedy check.

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