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Performance of Indian mustard (*Brassica juncea*) in sequential cropping systems under irrigated conditions

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ABSTRACT

A field experiment was conducted during the winter seasons of 1997–98 and 1998–99 on sandy-loam soil at National Research Centre on Rapeseed-Mustard, Sewar, Bharatpur, to study the performance of 5 Indian mustard [*Brassica juncea* (L.) Czernj. & Casson]-based cropping systems under irrigated conditions. Pearlmillet [*Pennisetum glaucum* (L.) R.Br. emend. Stuntz]–Indian mustard cropping system proved significantly superior to all other cropping systems, giving 20.7 and 25.29 q/ha Indian mustard-equivalent yield during 1997–98 and 1998–99, respectively, followed by blackgram (*Phaseolus mungo* L.)–Indian mustard cropping system (12.7 and 18.74 q/ha Indian mustard-equivalent yield). Though Indian mustard yield was highest at 160 kg N/ha, it was at par with 80 and 120 kg N/ha. Higher doses of nitrogen reduced the oil content and maximum oil content was recorded in pearl millet–Indian mustard cropping system.

Key words : Indian mustard, Yield, Nitrogen level, Cropping system

Rajasthan is a leading state in rapeseed–mustard production, which contributes 38% of total production in India and 40% of the state, is grown in Bharatpur region. Most of the acreage under this group of crops is monocropped, and generally the farmers follow fallow–Indian mustard cropping sequence, resulting in low cropping intensity and productivity. Therefore to increase the cropping intensity as well as profit per unit area, an experiment was conducted to study the performance of Indian mustard in sequential cropping system under irrigated conditions of eastern Rajasthan.

MATERIALS AND METHODS

The investigation was carried out in sandy-loam soil with pH 8.2, medium in available nitrogen (0.6% organic carbon), phosphorus (23.5) and rich in potash (320 kg/ha). Five Indian mustard-based cropping sequences, viz. pearlmillet–Indian mustard, blackgram–Indian mustard, sesame–Indian mustard, green-manuring with *dhaincha* (*Sesbania cannabina* Retz.)–Indian mustard, fallow–Indian mustard (common crop sequence of farmers), were taken in

main plots and 5 levels of nitrogen (0, 40, 80, 120 and 160 kg N/ha) were taken in subplots. The experiment was laid out in split-plot design with 4 replications. The rainy-season crops were grown with their recommended doses of fertilizers. In the winter season, Indian mustard crop ('PCR 7') was taken applying half dose of nitrogen (as per treatment) as basal at the time of sowing. Remaining half dose of N was applied after the first irrigation given 35 days after sowing. No pre-sowing irrigation was applied, due to occurrence of late rains in the first week of October which made sufficient availability of moisture. In the rainy *(kharif)* season green-manure crop at 50 days after sowing (DAS) and blackgram after first flush of pods harvesting were turned down into the soil.

RESULTS AND DISCUSSION

During the rainy season the grain and fodder yields of pearl millet (average of 2 years) were highest, followed by blackgram and sesame.

Cropping systems

Significantly higher seed yield of Indian mustard was obtained in green-manuring *dhaincha*–mustard cropping system than other systems in both the seasons with the exception that during 1997-98, green-manuring–Indian mustard remained at par with blackgram–Indian mustard and pearl-millet–Indian mustard (Table 1). On an average, green-manuring (*dhaincha*)–Indian mustard gave 6.2%, 7.0%, 13.9% and 21.7% more seed yield of Indian mustard over fallow–Indian mustard, blackgram–Indian mustard, pearlmillet–Indian mustard and sesame–Indian mustard respectively. It may be attributed owing to a highly favourable soil environment created by green-manure (*dhaincha)* resulting in better root growth and availability of nitrogen. The lowest yield of Indian mustard was obtained from the crop preceded by sesame, which was the lowest yielding cropping system for Indian mustard, due to heavy feeding nature of the sesame, as reported by Chandrakar *et al.* (1994). Similarly, the yield-contributing characters such as branches/plant, siliquae/plant and 1,000-seed weight in the second year were significantly affected by cropping systems. To compare the cropping systems as a whole, the yield of the rainy-season crops were converted into Indian mustard seed equivalent yield. Based on Indian mustard, equivalent yield pearl-millet–Indian mustard cropping sequence on an average recorded 35.3% higher mustard seed-equivalent yield over rest of the crop sequences. It may be attributed due to the contribution of pearlmillet seed (21.95 q/ha) and stover (194.2 q/ha) during the rainy season towards the total production of the sequence. However, fallow–Indian mustard sequence gave the lowest mustard seed-equivalent yield due to no contribution toward total production during the rainy seasons. Similar was the case with *dhaincha*–Indian mustard sequence. Blackgram–Indian mustard gave 2.5 q/ha more mustard seed-equivalent yield over sesame–Indian mustard. There was only 0.25 q/ha difference in Indian mustard-equivalent yield between sesame–Indian mustard and *dhaincha*–Indian mustard sequences. It may be due to low

Table 1. Effect of cropping systems on yield attributes, yield, harvest index and quality of Indian mustard

Treatment	Plant height (cm)		Branches/ plant		Silliquae/ plant		1,000-seed weight (g)		Yield of rainy-season crops (q/ha)				Seed yield (q/ha)		Mustard equivalent yield (q/ha)		Harvest index (%)		Oil content (%)	
	Y_1	Y_2	Y_1	Y_2	Y_1	Y_2	Y_1	Y_2	Y_1		Y_2		Y_1	Y_2	Y_1	Y_2	Y_1	Y_2	Y_1	Y_2
									Grain	Fodder	Grain	Fodder								
Cropping system																				
Blackgram–Indian mustard	164.0	192.0	10.8	12.2	152.6	177.3	4.5	4.9	2.38		5.2		10.4	13.6	12.7	18.7	24.3	20.6	41.7	40.5
Sesame–mustard	162.0	190.0	9.7	10.5	141.8	154.8	4.8	4.8	3.49		2.39		8.7	11.6	12.2	14.1	20.3	20.5	41.9	40.9
Pearlmillet–mustard	165.0	189.0	10.1	10.7	145.0	147.1	4.8	4.9	18.6	198.4	25.3	190	10.2	12.0	20.7	25.2	24.9	19.8	41.9	40.9
Dhaincha–mustard	169.0	190.0	11.1	12.7	157.7	190.7	4.7	5.2					11.2	14.6	11.2	14.6	22.3	21.2	41.3	40.6
Fallow–mustard	161.0	190.0	11.3	12.9	146.3	198.1	5.0	5.1					9.9	14.4	9.9	14.4	22.8	20.4	41.9	40.8
CD (P = 0.05)	NS	NS	1.1	1.8	41.7	44.5	NS	0.2					1.2	0.1			3.5	NS	NS	0.3
Nitrogen (kg/ha)																				
0	150.0	177.0	8.6	7.6	135.8	113.4	4.8	4.9					6.7	6.4	6.7	6.4	29.3	19.4	42.2	41.5
40	161.0	188.0	9.5	9.4	140.7	143.8	4.8	4.8					8.9	11.6	8.9	11.6	28.7	19.5	42.1	40.8
80	165.0	193.0	10.5	12.2	158.4	187.1	4.8	5.0					10.4	15.6	10.4	15.6	25.5	20.4	41.7	40.8
120	169.0	196.0	11.1	14.4	157.6	207.4	4.8	5.1					11.1	16.0	11.1	16.0	25.5	20.7	41.3	40.6
160	174.0	197.0	11.5	15.3	155.5	215.6	4.9	5.1					10.8	16.6	10.8	16.6	24.5	22.2	41.3	40.1
CD (P = 0.05)	7.0	5.0	1.0	1.5	14.1	16.2	NS	NS					0.8	1.2			2.1	1.7	0.5	0.3

Y_1, 1997–98; Y_2, 1998–99

yield of Indian mustard in sesame–Indian mustard sequence, because sesame is a heavy feeder in nature and less contribution of sesame towards total yield of the system. In case of *dhaincha*–Indian mustard, the contribution during the rainy season in terms of yield was nil, but the green-manure crop *(dhaincha)* improved the soil fertility, which was reflected in the Indian mustard seed yield. During 1997-98 the highest harvest index (24.9) was recorded in pearl millet–Indian mustard crop sequence, followed by blackgram–Indian mustard. The harvest index was not affected by cropping system in 1998–99. On an average, blackgram–Indian mustard registered 0.7% and 0.8% higher harvest index over green-manuring–Indian mustard and fallow–Indian mustard. The cropping system in 1997–98 did not influence the oil content. But during 1998–99 the oil content was significantly higher (40.9%) in pearlmillet–Indian mustard, followed by sesame–Indian mustard, fallow–Indian mustard and green-manuring–Indian mustard. On an average, sesame–Indian mustard and pearlmillet–Indian mustard system showed equal content of oil 41.4%, followed by green-manuring–Indian mustard (40.9%).

Nitrogen

The seed yield of Indian mustard significantly increased with increasing levels of N from 0 to 40 and 40 to 80 kg/ha (Table 2). Further addition of N from 80 to 120 and 120 to 160 kg/ha recorded statistically similar seed yield of Indian mustard. On an average, the application of N@40, 80, 120 and 160 kg/ha gave 36.3%, 50.0%, 51.8% and 52.5% higher seed yield of Indian mustard, respectively, the over control. A very little increase in the yield was recorded with 120 and 160 kg N/ha over 80 kg N/ha respectively. The same trend was noted in yield-attributing characters except 1,000-seed weight, which was not affected by nitrogen level. These findings are in agreement with those of Arthamwar *et al.* (1996) and Joshi *et al.* (1991). The harvest index was higher at 0 and 40 kg N/ha during 1997-98 but it was just reverse in the second year, which may be due to the fact that succulency in leaves increased with increase in nitrogen levels, but in the previous year due to unfavourable weather conditions succulent plants were affected more by white rust ultimately harvest index was low at higher doses of nitrogen. The oil content was adversely affected by nitrogen level and significantly higher oil content was recorded in the control plot, followed by 40 and 80 kg N/ha with the exception that all 0, 40 and 80 kg N/ha level recorded similar oil content.

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