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Performance of Indian mustard (*Brassica juncea*) under different cropping systems

A.K. TRIPATHI[1] AND K.S. RATHI

Department of Agronomy, Chandra Shekhar Azad University of Agriculture and Technology, Kanpur, Uttar Pradesh 208 002

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ABSTRACT

A field investigation was carried out during 1994–96 at Kanpur, to study the productivity and economic viability of Indian mustard [*Brassica juncea* (L.) Czernj. & Cosson] raised after different rainy-season crops. The yield of Indian mustard could be maximized in green-manured plot with *Sesbania cannabina* (Retz.) Pers. (32.73 q/ha). It was depressed (25.86 q/ha) under pearlmillet [*Pennisetum glaucum* (L.) R. Br. emend.] (fodder)–Indian mustard sequential cropping. Economics revealed that maize (*Zea mays* L.) – Indian mustard sequential cropping recorded the highest Indian mustard-seed equivalent (42.79 q/ha), more net returns (Rs 22.57 thousand/ha) with highest land-use efficiency (61.92%). Blackgram (*Phaseolus mungo* L.)–Indian mustard remained next in order.

Key words : Indian mustard, Productivity, Net returns, Cropping Systems

Indian mustard occupies second place in the edible oil scenario of India. It shares 26.94% in area and contributes 21.39% in production of total oilseeds in the country. It is grown during winter in succession of different rainy-season cereals, pulses and oilseed crops. The growth and productivity of Indian mustard crop are generally affected due to nature and duration of rainy-season crops. The availability of new high-yielding disease- and pest-resistant, short-duration varieties of rainy-season crops with increasing irrigation facilities has enabled the farmers to grow Indian mustard crop under double cropping system. It was, therefore, imperative to evaluate the productivity and economic viability of different cropping systems involving Indian mustard.

MATERIALS AND METHODS

A field experiment was conducted at Student's Instructional Farm of the University, Kanpur, during 1994–96 on sandy-loam soil, having 7.7 pH, 0.49% organic carbon, 13 kg/ha available phosphorus and 164 kg/ha available potassium. Seven cropping systems, viz.

Present address : [1]All India Co-ordinated Maize Improvement Project, CSAUA&T, Kanpur 208 002

fallow–Indian mustard, *Sesbania cannabina* (green-manure) – Indian mustard, maize – Indian mustard, sorghum [*Sorghum bicolor* (L.) Moench] fodder–Indian mustard, pearlmillet [*Pennisetum glaucum* (L.) R. Br.emend. Stuntz] for fodder – Indian mustard, blackgram – Indian mustard, cowpea [*Vigna unguiculata* (L.) Walp.] for fodder – Indian mustard, in main plot and 4 nitrogen levels in Indian mustard under subplots were tried in split-plot design with 3 replications. However, in the present paper, the productivity, economic viability, production and land-use efficiency of different cropping systems have been dealt only.

A description of varieties used and agronomic practices followed in raising different cropping sequences are given in Table 1. The rainy-season crops were sown during the first fortnight of July during the both years. *Sesbania cannabina* as green-manure crop was grown in the rainy season and incorporated in soil 7 weeks after sowing. The succeeding crop of Indian mustard was sown after pre-sowing irrigation to ensure good germination. Indian mustard was sown during the third week of October during both the years. The cropping systems were evaluated in terms of Indian mustard-seed equivalent, economic returns, production and land-use efficiency. Economic returns (Rs/ha) and cost of cultivation (Rs/ha) for individual crop in sequence were calculated on the basis of prevailing market rates of inputs and selling prices of produce. Land-use efficiency was expressed as percentage of days actually used in a year and was worked out by summation of duration of each crop in individual cropping system divided by 365 days. Production-efficiency value in terms of kg/ha/day was obtained by total production in a sequence divided by total duration of crop in that sequence, while net returns value in terms of Rs/ha/day was obtained by net monetary return of sequence divided by total duration of crops in that sequence (Tomar and Tiwari, 1990). For computation of productivity, the Indian mustard seed-equivalent yield was calculated on the basis of prevailing prices. The productivity of different cropping systems under study was evaluated after converting the yield of rainy-season crops into Indian mustard-seed equivalent.

RESULTS AND DISCUSSION

Crop productivity

The seed yield of Indian mustard was significantly higher in *Sesbania* green-manured plot (32.73 q/ha) than that received under maize – Indian mustard (30.69 q/ha) and blackgram – Indian mustard (28.31 q/ha) cropping system (Table 2). Indian mustard yield could be depressed to a minimum level when grown in pearlmillet – Indian mustard sequence (25.86 q/ha). Our findings substantiated the results of Sharma *et al.* (1992) and Singh *et al.* (1994). The poor yields of Indian mustard after pearlmillet could be attributed to the exhaustive and teletoxic nature of preceding crop. Giri and Saran (1986) also reported adverse effect of pearlmillet on Indian mustard yield.

In terms of Indian mustard-seed equivalent, the productivity of maize–Indian mustard (42.79 q/ha), followed by blackgram–Indian mustard (41.88 q/ha) cropping

Table 1. Varieties, seed rates, spacing and fertilizer dose applied to different crops

Crop	Variety	Seed rate (kg/ha)	Row spacing (cm)	NPK (kg/ha)
Indian mustard	'Varuna'	5	50	** : 60 : 40
Maize	'Azad Uttam'	20	50	80 :40:40
Blackgram	'Pant U 35'	15	40	100*
Sorghum	'T 22'	40	25	80 : 40 : 0
Pearlmillet	'WCC 75'	15	25	80 : 40 : 0
Cowpea	'T 2'	40	30	100*
Sesbania cannabina	'Local'	25	Broadcast	100*

Sesbania cannabina crop was buried in soil for green-manuring
**80, 120, 160 and 200 kg N/ha applied to Indian mustard
*DAP (kg/ha)

Table 2. Seed or fodder yield and Indian mustard-seed equivalent (q/ha) in Indian mustard-based cropping systems

Cropping system	1994–95		1995–96		Pooled mean	
	Rainy crop	Winter crop	Rainy crop	Winter crop	Rainy crop	Winter
	Seed or fodder yield (q/ha)					
Fallow – Indian mustard		27.90		31.83		29.86
Sesbania (GM) – Indian mustard	35.46*	30.94	37.10*	34.52	36.28*	32.73
Maize (G) – Indian mustard	38.54	25.54	34.22	32.83	36.38	30.69
Sorghum (F) – Indian mustard	454.17	23.37	408.79	28.37	431.48	26.87
Pearlmillet (F) – Indian mustard	393.04	24.10	426.30	27.62	409.67	25.86
Blackgram (G) – Indian mustard	9.78	26.79	10.58	29.83	10.18	28.31
Cowpea (F) – Indian mustard	326.48	26.21	288.85	29.62	307.67	27.92
CD (P=0.05)		0.94		1.34		0.77
	Mustard-seed equivalent (q/ha)					
Fallow-Indian mustard		27.90		31.83		29.86
Sesbania (GM) – Indian mustard	0.28	30.94	0.27	34.52	0.27	32.73
Maize (G) – Indian mustard	12.57	28.54	11.63	32.83	12.10	30.69
Sorghum (F) – Indian mustard	9.87	25.37	8.17	28.37	9.02	26.87
Pearlmillet (G) – Indian mustard	6.84	24.10	6.82	27.62	6.83	25.86
Blackgram (G) – Indian mustard	13.39	26.79	13.75	29.83	13.57	28.31
Cowpea (F) – Indian mustard	8.53	26.21	6.93	29.62	7.72	27.92

GM, Green-manure; G, Grain; F, fodder
*N kg/ha was computed on the basis of total green-manure produced

system was at par and significantly higher than of other cropping systems (Table 3). Keeping fallow during the rainy season and raising Indian mustard thereafter proved meaningless by virtue of low yield potential in the system (29.86 q/ha).

Land use and production efficiency

Maize – Indian mustard sequence registered the highest land-use efficiency (61.92%), followed by blackgram – Indian mustard (60.27%), cowpea – Indian mustard (59.18%) and sorghum – Indian mustard (59.18%) systems, because these sequences occupied the field for longest duration (216–226 days). Fallow – Indian mustard system had the lowest land-utilization efficiency. Production efficiency was the highest in fallow – Indian mustard system (20.74 kg/day/ha), followed by blackgram – Indian mustard (Table 3). Pearlmillet – Indian mustard cropping system had the lowest production efficiency (15.95 kg/day/ha).

Economic analysis

Computation of economics revealed that maize – Indian mustard system fetched highest net return, followed by blackgram – Indian mustard system (Table 3). It was worth mentioning that monetary advantage (net profit/ha/year) in these systems were also recorded Rs 4,720 and Rs 4,550/ha more than that received under fallow –

Table 3. Indian mustard-seed equivalent, cost of cultivation, returns and benefit : cost ratio as influenced by Indian mustard-based cropping systems

Cropping system	Indian mustard equivalent/year (q/ha)	Cost of sequence cultivation ($\times 10^3$ Rs/ha)	Mean net return ($\times 10^3$ Rs/ha/year)	Benefit : cost ratio	Net return (Rs/ha/day)	Land-use efficiency (%)	Production efficiency (kg/day/ha)*	Net profit over fallow-Indian mustard (Rs/ha year)
Fallow–Indian mustard	29.86	17.98	17.85	1.99	124	39.45 (144)	20.74	
Sesbania (GM) – Indian mustard	33.00	21.70	17.90	1.82	94	52.33 (191)	17.28	50
Maize (G) – Indian mustard	42.79	28.78	22.57	1.78	100	61.92 (226)	18.93	4,720
Sorghum (F) – Indian mustard	35.89	24.57	18.50	1.75	86	59.18 (216)	16.61	650
Pearlmillet (F) – Indian mustard	32.69	24.44	14.79	1.60	72	56.16 (205)	15.95	(-)3,060
Blackgram (G) – Indian mustard	41.88	27.86	22.40	1.80	102	60.27 (220)	19.04	4,550
Cowpea (F) – Indian mustard	35.64	24.24	18.53	1.76	86	59.18 (216)	16.50	680
CD (P=0.05)	1.78		0.77	0.10				

*Calculated on Indian mustard seed equivalent basis

Figures in parentheses are total duration of crops (days) in that sequence

Indian mustard system. Highest benefit : cost ratio was obtained from fallow – Indian mustard sequence. The lowest benefit : cost ratio was recorded with pearl-millet – Indian mustard cropping system. Tomar and Tiwari (1990) also reported similar results.

Considering the production, net return and land-use efficiency, maize – Indian mustard and blackgram – Indian mustard cropping systems proved most promising and remunerative.

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