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Effect of tillage operations on productivity and economic traits of soybean (*Glycine max*)-based rainfed cropping system

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The field experiment was conducted at research farm, Sehore, during 1990–91 and 1991–92 on Vertisols, slightly saline (pH 7.6), having available N, P and K 336, 13 and 575 kg/ha respectively. The treatments consisted of 3 tillage operations, i.e. no tillage, minimum and conventional tillage, as main plots and 4 winter-season (*rabi*) crops, viz. 'JSF 1' safflower (*Carthamus tinctorius* L.), 'R 17' linseed (*Linum usitatissimum* L.), 'JR 315' gram (*Cicer arietinum* L.) and 'JLS 1' lentil (*Lens culinaris* Medikus), were alloted to subplots. The treatments were arranged in split-plot design with 4 replications. All the *rabi* crops were grown after 'JS 71-05' soybean [*Glycine max* (L.) Merr.] and tillage operations given to only *rabi* crops. All the crops received recommended fertilizer doses, viz. 20, 80 and 20 kg/ha; 40, 40 and 20 kg/ha; 20, 50 and 0 kg/ha; 60, 30 and 20 kg/ha and 20, 50 and 0 kg/ha; of N, P and K to soybean, safflower, gram, linseed and lentil respectively The other recommended package of practices

Table 1. Production and economics as influenced by tillage and crop sequences (pooled data)

Treatment	Yield (kg/ha)		Cultivation cost (Rs/ha)	Net returns (Rs/ha)	Net returns (Rs/day)	Benefit : cost ratio	Land-use efficiency (g)	Production efficiency (kg/day/ha)	Sequence duration (days)
	Soybean	*Rabi*							
Tillage									
No	1,357	994	10,188	7,110	31.46	1.70	61.91	10.40	226
Minimum	1,621	1,195	10,488	10,209	45.17	1.97	61.91	12.46	226
Conventional	1,763	1,180	10,788	10,875	48.12	2.00	61.91	13.02	226
CD (P = 0.05)	119	120	98	817	3.61	0.61	NS	0.56	
Crop									
Safflower	1,519	1,163	10,650	8,100	34.47	1.76	64.38	11.41	235
Linseed	1,613	739	10,000	10,630	48.32	2.06	60.27	10.69	220
Gram	1,564	1,468	10,700	10,229	44.47	1.95	63.01	13.18	230
Lentil	1,623	1,121	10,600	8,704	39.56	1.82	60.27	12.47	220
CD (P = 0.05)	140	123	103	379	1.88	0.04	0.14	0.34	

Sale price of produce (Rs/kg) : Safflower, 6; gram, 6; lentil, 6; linseed 11

were followed. The *rabi* crops in no-tillage were sown at physiological maturity of soybean (10 days before harvesting), while in minimum tillage (1 harrowing) and in conventional tillage (2 cross-harrowing) the crops were sown after harvesting of soybean. The land-use efficiency and production efficiency were estimated. The economical traits were calculated on the basis of prevailing market price of produce.

The soybean yield increased with an increase in the number of tillage operations (Table 1) and remained unaffected due to preceding crops. During *rabi*, tillage operations caused greatest variation in production of different crops. The maximum yield was recorded in minimum tillage and remained at par with conventional tillage. Similar views were also extended by Edwards *et al.* (1988) in corn, soybean and wheat rotation. Among the *rabi* crops, gram was found to be the most productive, while safflower and lentil were remained identical. Linseed was the lowest yielder.

Among the treatments, conventional tillage and soybean–gram sequence were costly in production. When comparing the net returns, net returns/day and benefit : cost ratio, conventional tillage being maximum but remained at par with minimum tillage and both were superior than no tillage. Linseed was the most remunerative crop, followed by gram, lentil and safflower.

All the 3 tillage treatments were identical in land-use efficiency, while the production efficiency increased with the increase in number of tillage operations. The highest land-use efficiency was noted in soybean–safflower, followed by soybean–gram sequences. The lentil and linseed grown after soybean behaved identically for the land-use efficiency. However, the maximum production efficiency was recorded in soybean–gram, followed by soybean–lentil. The lowest production efficiency was associated with soybean–linseed. Similar views were extended by Tomar and Tiwari (1990).

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