

Effect of intercropping winter-season forage crops on their yield and nodulation

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ABSTRACT

In an experiment on intercropping of fodder crops, berseem [*Trifolium alexandrinum* (L.) Juslen.] plants in sole and intercropping were taller compared with lucerne (*Medicago sativa* L.). Among the different cropping systems berseem sole crop gave the highest yield of green and dry forage and economic return. A combination of oat (*Avena sativa* L.) either with berseem or lucerne in 2 : 2 or 4 : 4 row arrangements respectively gave more green-fodder yield than oat alone. Berseem in sole and intercropping systems produced more nodules/plant than lucerne. The nodule number started decreasing after second cut (80 days after sowing) both in berseem and lucerne. Hence under medium black-soil conditions berseem as sole and in intercropping gave maximum forage yield and economic return.

Key words: forage crops, intercropping, nodulation, winter season, yield attributes, economics

Livestock feed accounts for 60–70% of the total cost of milk production and the cost of feed concentrate is increasing and is costlier than of green forage (Fitzhugh *et al.* 1978). The area under winter-season (*rabi*) fodder crops like berseem [*Trifolium alexandrinum* (L.) Juslen.], lucerne (*Medicago sativa* L.) and oat (*Avena sativa* L.) needs to be increased to sustain the productivity of high-yielding milch cows. These fodders are not only highly nutritious and succulent but also available up to early summer. India is in short supply of fodders and also there is much pressure on the land for growing food crops; therefore the gap between demand and supply of green fodders could be narrowed down by maximizing the production per unit area per unit time. Intercropping of legume forage crops with non-legumes improves the yield and quality of green forages. An experiment was therefore conducted to find out the effect of intercropping berseem and lucerne with oat on forage yield and nodulation.

MATERIALS AND METHODS

The study was conducted during winters of 1993–94 and 1994–95 at Anjora, Madhya Pradesh, on medium black soil, being medium in available N, low in available P and high in available K, with pH 6.7. The treatment consisted of 7 intercropping systems, viz T₁, sole berseem; T₂, sole lucerne; T₃, sole oat; T₄, berseem + oat in 2 : 2 (row ratio);

T₅, berseem + oat 4 : 4; T₆, lucerne + oat 2 : 2; and T₇, lucerne + oat 4 : 4. The treatments were taken with 3 replicates each in randomized block design. Berseem in sole as well as in intercropping was sown by broadcasting, whereas lucerne and oat in sole and intercropping systems were sown in rows 30 cm apart. The crops were sown using 30 kg berseem seed, 30 kg lucerne seed and 80 kg oat seed/ha on 10 November 1993 and 18 November 1994. In all the crops recommended dose of fertilizers were applied, ie NP and K @ 30, 40 and 20 kg/ha respectively at sowing, and 30 kg N/ha after first cut and after the second cut. The forage yields were calculated from the net plot size of 10 m x 5 m. The first cut in all the crops was taken at 50 days after sowing and the subsequent cuts at 30-day intervals. In oat, berseem and lucerne, 3, 4, and 5–6 cuts respectively were obtained both in sole and intercropping systems. The data were analysed statistically, using standard methods as suggested by Snedecor and Cochran (1967).

RESULTS AND DISCUSSION

Yield attributes

Number of branches/plant of berseem and lucerne did not differ significantly among the treatments at first and third cut, except at second cut where sole berseem recorded significantly higher number of branches/plant (5.31) compared with sole crop of lucerne (4.08) during both the years. The number of tillers/plant of oat was non-significant during both the years of study.

At different stages of growth plant height of berseem

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and lucerne differed significantly. Berseem in sole as well as intercropping combination with oat attained significantly higher plant height in comparison with that of lucerne, except at fourth cutting. Highest plant height of sole berseem (76.2 cm) was recorded at second cutting, which was significantly different from plant height of lucerne (58.2 cm) in sole cropping. Plant height of oat in sole as well as intercropping systems was non-significant.

Forage yield

Green-forage yields of berseem, lucerne and oat varied at different growth stages (Table 1). Berseem recorded the highest total green-forage yield (74.6 tonnes/ha) than its intercropping and lucerne and oat (52.47 and 44.14 tonnes/ha respectively). Prasad *et al.* (1985) also reported higher green-fodder yield of berseem than of lucerne. Green-fodder yield of oat in intercropping was higher than of any other

Table 1 Mean green and dry forage yields of berseem, lucerne and oat in sole and intercropping

Treatment	I cut	II cut	III cut	IV cut	V cut	VI cut	Total
<i>Mean green-fodder yield (tonnes/ha)</i>							
Berseem sole	14.51	23.33	22.98	13.79			74.60
Lucerne sole	6.93	10.11	9.63	9.94	12.62	6.50	52.47
Oat sole	24.07	10.19	9.88				44.14
Berseem + oat (2 : 2)	21.08 (14.26)	20.07 (7.30)	17.98 (7.08)	6.85			65.99
Berseem + oat (4 : 4)	21.28 (13.55)	18.15 (6.39)	15.78 (5.94)	7.51			62.68
Lucerne + oat (2 : 2)	15.34 (12.36)	12.71 (7.59)	11.72 (6.73)	5.89	6.00	3.66	53.53
Lucerne + oat (4 : 4)	15.95 (12.64)	11.36 (6.63)	10.72 (5.89)	5.36	5.17	3.35	50.23
CD ($P = 0.05$)	7.50	7.34	8.35	6.71	9.22	6.44	14.66
<i>Mean dry-fodder yield (tonnes/ha)</i>							
Berseem sole	2.16	2.79	4.25	3.29			12.39
Lucerne sole	1.30	1.59	1.76	2.22	3.08	1.53	10.71
Oat sole	4.31	1.41	1.52				7.23
Berseem + oat (2 : 2)	3.57 (2.55)	2.54 (1.00)	3.06 (1.09)	1.64			10.79
Berseem + oat (4 : 4)	3.57 (2.42)	2.29 (0.88)	2.67	(0.91)	1.79		10.31
Berseem + oat (2 : 2)	2.77 (2.20)	1.85 (1.05)	1.95 (1.03)	1.31	1.47	0.86	9.78
Berseem + oat (4 : 4)	2.88 (2.26)	1.65 (0.91)	1.78 (0.91)	1.20	1.25	0.78	9.16
CD ($P = 0.05$)	1.37	1.11	1.72	1.53	2.19	1.53	2.68

Figures in parentheses indicate oat yield

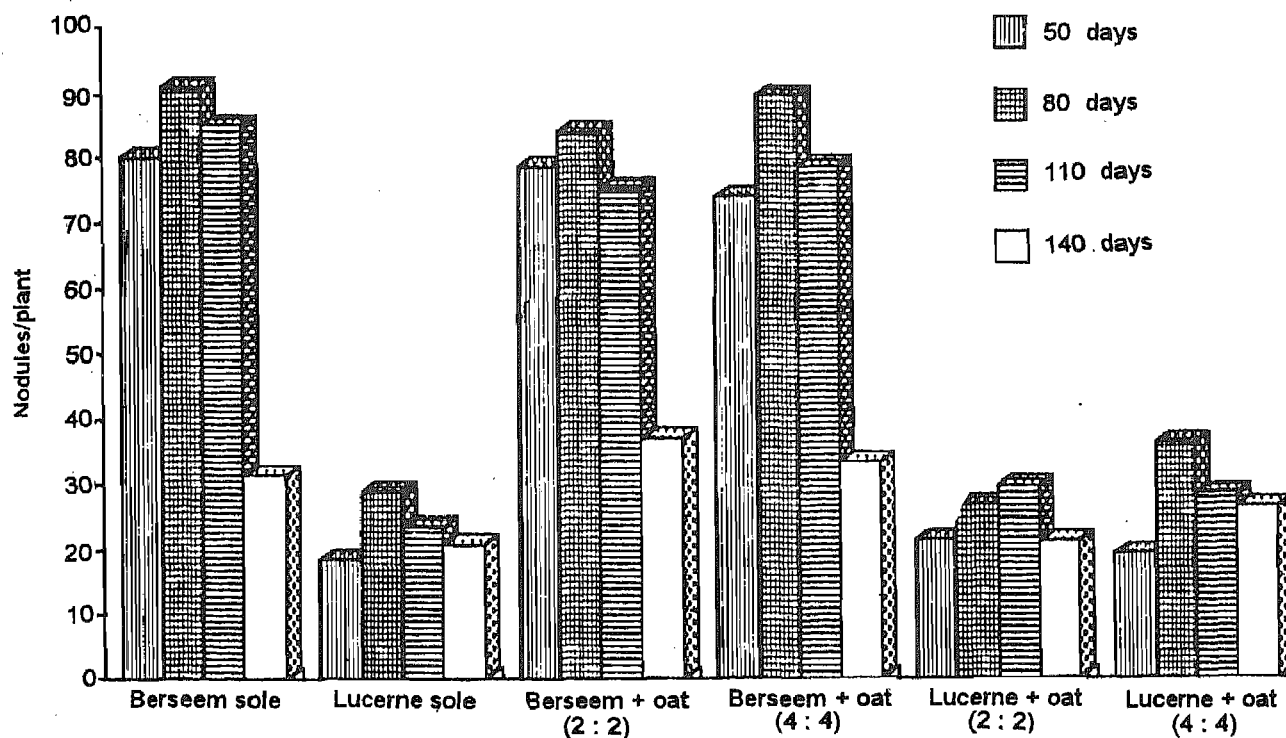


Fig 1 Effect of intercropping on mean nodule number/plant in fodder crops

Table 2 Effect of sole and intercrops on net return, land-equivalent ratio (LER), monetary advantage and benefit : cost (B : C) ratio (mean data of 2 years)

Treatment	Net return (Rs/ha)	LER	Monetary advantage (Rs)	B : C
Berseem sole	13 909			2.64
Lucerne sole	8 186			2.08
Oat sole	5 746			2.09
Berseem + oat (2 : 2)	11 385	1.18 (0.51 + 0.67)	2 808	2.63
Berseem + oat (4 : 4)	10 616	1.10 (0.50 + 0.60)	1 594	2.54
Lucerne + oat (2 : 2)	8 103	1.16 (0.51 + 0.65)	2 011	2.22
Lucerne + oat (4 : 4)	7 280	1.09 (0.49 + 0.60)	1 121	2.11

Price of green forage (Rs/100 kg) : berseem and lucerne, 30; oat 25

intercropping system as well as sole one, due to transfer of nitrogen to the root rhizosphere from the legume to non-legume component. Ledgard *et al.* (1985), Ta *et al.* (1986). Haystead *et al.* (1988), Ledgard and Steele (1992) and Russele *et al.* (1994) also reported similar results. A combination of oat either with berseem or lucerne in 2 : 2 or 4 : 4 planting ratios respectively gave higher green-fodder yield than oat alone, but the total fodder production was less than of sole berseem or lucerne. Similar trend was also observed for dry-fodder yields under different cropping systems (Table 1).

Nodulation

Dry weight and number of nodules/plant of berseem and lucerne varied significantly at different stages of growth (Fig 1). The highest number of nodules/plant (90.9) of berseem was observed at second cutting (80 days after sowing) and a decreasing trend was found afterward. This result confirms the finding of Nagre and Keshkar (1990). Lucerne also showed trend similar to that of berseem. Dry weight of nodules/plant of berseem and lucerne decreased after third cutting (110 days after sowing). At fourth cut the number and dry weight of nodules/plant of berseem and lucerne were higher in intercropping with oat than of the respective sole crops.

Net return

Sole crop of berseem recorded the highest net return among the different cropping systems, followed by berseem + oat (2 : 2 planting ratio) (Table 2).

Land-equivalent ratio

All the treatments showed land-equivalent ratio greater than 1, indicating advantage in yield (Table 2). However, the highest value was recorded by berseem + oat (2 : 2) and the lowest value by lucerne + oat (4 : 4). Our result corroborates the finding of Rao *et al.* (1979).

Monetary advantage

Berseem + oat (2 : 2) recorded the highest monetary advantage, whereas lucerne + oat (4 : 4) the lowest (Table 2).

On the basis of benefit : cost ratio, the highest benefit was obtained from sole berseem (2.64), followed by berseem + oat 2 : 2 and berseem + oat 4 : 4 planting ratio (Table 2).

REFERENCES

- Fitzhugh H A, Hodgson H J, Scovill O J, Nguyen, Thanh D and Byerly T C. 1978. The role of ruminants in support of man. Winrock Report.
- Haystead A, Malajczuk N and Grove T S. 1988. Underground transfer of nitrogen between pasture plants infected with vesicular arbuscular mycorrhizal fungi. *New Phytology* 108 : 417-23.
- Ledgard S and Steele K W. 1992. Biological nitrogen fixation in mixed legume/grass pastures. *Plant and Soil* 141 : 137-53.
- Ledgard S F, Freney J R and Simpson J R. 1985. Assessing nitrogen transfer from legumes to associated grasses. *Soil Biological Biochemistry* 17 : 575-7.
- Nagre P K and Keshkar P B. 1990. Effect of irrigation and phosphorus levels on nodulation of berseem. *Research Journal, Punjabrao Krishi Vidyapeeth, Akola* 14 (2) : 195-6.
- Prasad N K, Bhagat R K and Singh A P. 1985. Comparative production potential of berseem and lucerne under oxisols of Chotanagpur plateau. *Indian Journal of Agronomy* 30 (2) : 167-71.
- Rao Y Y, Khan M S, Raghavaiah C V and Reddy D N. 1979. Intercropping of berseem with oats for higher forage production. *Indian Journal of Agronomy* 24 (3) : 367-9.
- Russelle M P, Allan D L and Gourley C J P. 1994. Direct assessment of symbiotically fixed nitrogen in the rhizosphere of alfalfa. *Plant and Soil* 159 : 233-43.
- Snedecor G M and Cochran W G. 1967. *Statistical Methods*, edn 6, 593 pp. Oxford & IBH Publishing Co. Pvt. Ltd, Calcutta.
- Ta T C, Macdowall F D H and Faris M A. 1986. Excretion of nitrogen assimilated from N₂ fixed by nodulated roots of alfalfa (*Medicago sativa*). *Canadian Journal of Botany* 64 : 2063-7.