Indian Journal of Agronomy **55** (4): 282–285 (December 2010)

Fodder yield and quality of ryegrass (*Lolium perenne*) grown pure and in mixture with different seed rates of oat (*Avena sativa*) and sarson (*Brassica campestris*)

K.P. PURI, U.S. TIWANA* AND D.P. CHAUDHARY**

Department of Plant Breeding and Genetics, Punjab Agricultural University, Ludhiana, Punjab 141 004

Received: May, 2010

ABSTRACT

The experiment was conducted during *rabi* 2002-03 to 2005-06 to get higher fodder yield of ryegrass in the first cut and to see the effect of oat and sarson crops sown at different seed rates on the succeeding cuts. The experiment consisted of nine treatment combinations viz., ryegrass-monoculture, ryegrass + oats (22.5, 30.0, 37.5 and 45.0 kg/ha), and ryegrass + *sarson* (0.625, 1.25, 1.875 and 2.5 kg/ha) conducted in a randomized block design with four replications. The addition of oats at the rate of 22.5, 30.0, 37.5 and 45.0 kg/ha and sarson at the rate of 0.625 kg, 1.25 kg, 1.875 kg and 2.50 kg/ha with full seed rate of ryegrass increased green fodder yield by 14.3, 21.1, 25.1 and 27.2% and; 22.6, 33.7, 54.5 and 63.1%, respectively over the ryegrass monoculture. The addition of different seed rates of oats and sarson had no adverse effect on the fodder yield of subsequent cuttings. Sarson contributed 60 to 81% in the first cutting and oats contributed 22 to 60% in first cutting and 7 to 15% in second cutting in mixture with ryegrass. The highest net returns (Rs 49,398/ha) and benefit: cost ratio (2.12) were obtained with berseem + 2.5 kg/ha sarson mixture. The uptake of N by ryegrass + oats/sarson mixtures were higher than pure ryegrass. Crude protein and *in vitro* dry matter digestibility contents were higher in pure crop of ryegrass in first cutting and the trend was reverse in subsequent cuttings.

Key words: Crude protein, Dry matter, Green fodder, Oats, Ryegrass, Sarson

Ryegrass (*Lolium perenne* L.) is the non-legume grass grown during *rabi* which provides succulent, palatable and nutritious fodder to milch animals in 5 to 6 cuttings from November to mid-May. In Punjab, ryegrass is usually grown in mixture with berseem. In previous studies, Puri *et al.* (2001) observed that ryegrass sown in mixture with berseem/shaftal, not only gave the higher fodder production but also provided a green fodder in a ratio of 60:40 of legume : non-legume which is considered to be the balanced ration for milch animals. In mixture with berseem/shaftal, it is not possible to prepare the seed of ryegrass and the farmers have to grow ryegrass as a pure crop for seed production. But during the first cutting, the fodder yield of ryegrass pure crop is very low due to less tillering. To get more fodder of first cut of ryegrass, oats and sarson can be grown in mixture but the information is lacking. Therefore, the present study was undertaken to see the effect of mixing of different seed rate of oats and *sarson* in ryegrass on the fodder production and its quality.

***Corresponding author** (E mail: ustiwana@pau.edu)
****Correspondence address:** Senior Scientist, Directorate of Maize Research, New Delhi

MATERIALS AND METHODS

The experiment was conducted during *rabi* of 2002-03 to 2005-06 on a loamy soil tested medium in available nitrogen (280 kg/ha) and phosphorus (15 kg/ha) and high in available K (232 kg/ha). The experiment consisted of nine treatment combinations viz., ryegrass-monoculture, ryegrass + oats (22.5, 30, 37.5 and 45.0 kg/ha), and ryegrass + *sarson* (0.625, 1.25, 1.875 and 2.50 kg/ha) conducted in a randomized block design with four replications. In the last year, highest seed rates of oats and sarson were omitted. Fifty tonnes of FYM/ha was applied before preparation of the field and was mixed thoroughly with the soil. All P and K requirement of the crop is met from FYM. Nitrogen @ 75 kg/ha was applied in two splits, half at the sowing and remaining half 30 days afterwards. In subsequent cuttings, 75 N/ha was applied immediately after each cutting. The sowing was done in the last week of September in each year. A seed rate of 10 kg/ha was used in ryegrass 'Punjab Rygrass No.1' in monoculture as well as in mixture with different seed rates of oats 'OL-9'

and *sarson* 'RLM-668'. The first irrigation was given immediately after sowing and subsequent irrigations were given at an interval of 10 to 15 days. First cutting was taken 55 days after sowing and subsequent cuttings were taken at an interval of 30 days. Five cuttings were taken in each year. The green fodder yield of each cutting was recorded immediately after harvesting the crop. Half kg sample was used to work out the ratio (component of each crops) of different crops at the time of harvesting. The dry matter yield was worked out after drying the green sample in an oven to a constant weight. These dried samples were used to determine the nitrogen content and *in vitro* dry matter digestibility of fodder as prescribed by Tilley and Terry (1963).

RESULTS AND DISCUSSION

Forage yield

Ryegrass monoculture produced the lowest green fodder and dry matter yields than mixtures of ryegrass + oats/*sarson* (Table 1). The fodder yield of mixture of ryegrass + oats/*sarson* increased with the increase in seed rate of oats from 22.5 to 45.0 kg/ha and of *sarson* from 0.625 kg/ha to 2.50 kg/ha in mixture with ryegrass (10 kg/ha) in the first cutting in each year. Similarly the components of oats and *sarson* increased with the increase in seed rates. On an average of four years data, the addition of oats at the rate of 22.5, 30.0, 37.5 and 45.0 kg/ha in ryegrass increased green fodder yield by 14.3, 21.1, 25.1 and 27.2% and dry matter yield by 10.6, 16.4, 19.1 and 24.1% over ryegrass in monoculture in the first cutting which supplies green fodder during the scarcity period of November-December. Similarly the addition of *sarson* @ 0.625, 1.25, 1.875 and 2.5 kg/ha with ryegrass gave 22.6, 33.7, 54.5 and 63.1 % higher green fodder yield; and 4.1, 12.0, 25.8 and 29.6 % higher dry matter yield over ryegrass monoculture. The addition of different seed rates of oats and *sarson* had no adverse effect on the fodder yield of subsequent cuttings. From the total of five cuttings, addition of oats @ 45 kg/ha gave maximum green fodder yield (129.2 t/ha) and dry matter yield (16.4 t/ha) which was closely followed by 37.5 kg seed of oats/ha (124.7 t/ha green fodder and 17.3 t/ha dry matter yield) and 30 kg seed of oats/ha (123.2 t/ha green fodder and 16.2 t/ha dry matter yield). *Sarson* at the rate of 2.50 kg/ha gave the highest green fodder (130.7 t/ha) and dry matter yield (17.2 t/ha). Similar results have also been reported by Puri *et al.* (2001) in berseem + ryegrass mixtures and Puri *et al.* (2005) in shaftal + ryegrass.

Forage ratio

Oats gave green fodder along with ryegrass in the first 2 cuts, whereas, *sarson* gave fodder yield in the first cut only (Table 1). The proportion of *sarson* was higher (60-81%) than the proportion of oats (22 to 60%) in mixture with ryegrass in first cut. In the second cut, the proportion of oats decreased to 7 to 15% but *sarson* did not contribute to the fodder. These proportions of fodder in ryegrass + oats/*sarson* mixtures provide balanced nutrients to animals for their growth, production and reproduction particularly during November to December when there is acute shortage of green fodder. Puri *et al.* (2001) also observed similar results in berseem + oats/*sarson* mixtures.

Economics

The net returns and benefit: cost ratio were influenced highly with ryegrass + oats/*sarson* mixtures (Table 2). The highest net returns (Rs 49,398/ha) and benefit: cost ratio (2.12) were obtained with berseem + 2.5 kg/ha *sarson* mixture followed by ryegrass + 45 kg/ha oats and ryegrass + 1.875 kg/ha *sarson* mixtures. Puri *et al.* (2005) also reported higher net returns with shaftal + ryegrass mixture.

Table 1. Effect of mixing of different seed rates of oats and sarson with ryegrass on the fodder yield and economics (Mean of 4 years)

Treatment	Green fodder yield (t/ha)			Dry matter yield (t/ha)			Forage ratio	
	First cut	Subsequent cuts	Total	First cut	Subsequent cuts	Total	1st cut	2nd cut
Ryegrass (RG) pure	24.1	91.8	115.8	3.00	12.44	15.41	100:00	100:00
RG+oats 22.5 kg/ha	27.7 (6.1)	93.9	121.6	3.32 (0.73)	12.73	16.05	78:22	93:07
RG+oats 30.0 kg/ha	29.5 (11.8)	93.8	123.2	3.51 (1.40)	12.69	16.20	60:40	92:08
RG+oats 37.5 kg/ha	30.9 (15.5)	93.9	124.7	3.65 (1.83)	12.79	16.44	50:50	90:10
RG+oats 45.0 kg/ha	35.5 (21.3)	93.7	129.2	4.14 (2.48)	12.92	17.06	40:60	85:15
RG+sarson 0.625 kg/ha	29.4 (17.6)	89.7	119.2	3.15 (1.69)	12.40	15.55	40:60	100:00
RG+sarson 1.25 kg/ha	32.9 (25.6)	89.2	122.1	3.48 (2.01)	12.46	15.84	22:78	100:00
RG+sarson 1.875 kg/ha	37.3 (29.8)	91.7	126.6	3.85 (2.51)	12.21	16.06	20:80	100:00
RG+sarson 2.50 kg/ha	45.5 (36.9)	93.2	130.7	4.42 (2.88)	12.87	17.20	19:81	100:00
SEm±	1.4	0.8	2.4	0.17	0.52	0.34		
CD (P=0.05)	4.1	NS	7.1	0.51	NS	0.99		

Figures in parenthesis are values of green fodder and dry matter yields of oats and *sarson* irrespective of the treatments

Nitrogen uptake

The nitrogen (N) content of ryegrass in first cutting was highest (2.24%) as compared to 1.70 to 1.85% in ryegrass + oats and 1.77 to 1.98% in ryegrass + *sarson* mixture (Table 2). In the subsequent cuttings, the trend was reverse which might be due to less number of tillers than pure ryegrass resulting in higher uptake of N in mixture treatments. Whereas, the uptake of N by ryegrass + oats/*sarson* mixtures were higher than pure ryegrass in first and subsequent cuttings. In the first cutting, N uptake with ryegrass + 2.5 kg/ha *sarson* mixture was at par with ryegrass + 1.875 kg/ha *sarson* and ryegrass + 45 kg/ha oats mixtures but was significantly higher over rest of the treatments. Similar trend was observed in the subsequent cuttings. The total uptake was also highest with ryegrass + 2.5 kg/ha *sarson* mixture followed by ryegrass + 45 kg/ha oats and ryegrass + 1.875 kg/ha *sarson* (360.4 kg/ha) mixtures but the differences between different treatments were non-significant. This increase in N uptake was might be due to higher dry matter yield.

Fodder quality

Crude protein (CP) and *in vitro* dry matter digestibility (IVDMD) contents were higher in pure crop of ryegrass as compared to various mixtures of ryegrass + *sarson*/oats in first cutting (Table 3). Whereas, in the subsequent cuttings, CP and IVDMD contents of ryegrass increased in mixture plots. On the basis of four years average, pure ryegrass recorded 14.0% CP and 61.3% IVDMD when compared with 10.63 to 11.56% CP and 57.2 to 59.3% IVDMD in ryegrass + oats and; 11.06 to 12.38% CP and 58.0 to 58.7% IVDMD in ryegrass + *sarson* mixture. In the subsequent cuttings, CP and IVDMD values in ryegrass + oats were 14.31 to 14.69% and 61.2 to 61.7% and in ryegrass + *sarson* were 14.38 to 14.81% and 61.0 to 61.6%, respectively. In first cutting, higher CP and IVDMD contents in pure ryegrass might be due to higher nitrogen content in ryegrass as compared to oats and *sarson*, hence low CP and IVDMD contents in mixtures. In the subsequent cuttings, the plant population of ryegrass (Table 4) slightly decreased than pure ryegrass resulting in

Table 2. Effect of mixing different seed rates of oats and sarson with ryegrass on the economics, N content and N uptake of the fodder (Mean of 4 years)

Treatment	Net returns (Rs/ha)	Benefit : cost ratio	N content (%)		N uptake (kg/ha)		
			First cut	Subsequent cuts	First cut	Subsequent cuts	Total
Ryegrass (RG) pure	37,008	1.77	2.24	2.26	67.2	281.1	348.3
RG+oats 22.5 kg/ha	39,593	1.87	1.85	2.29	61.4	291.1	352.6
RG+oats 30.0 kg/ha	40,318	1.89	1.84	2.31	64.6	293.1	357.7
RG+oats 37.5 kg/ha	40,993	1.92	1.78	2.32	65.0	296.7	361.7
RG+oats 45.0 kg/ha	43,168	2.01	1.70	2.35	70.4	303.6	374.0
RG+sarson 0.625 kg/ha	38,693	1.85	1.98	2.30	62.4	285.2	347.6
RG+sarson 1.25 kg/ha	40,128	1.92	1.94	2.33	67.5	290.3	357.8
RG+sarson 1.875 kg/ha	42,363	2.02	1.91	2.35	73.5	286.9	360.4
RG+sarson 2.50 kg/ha	44,398	2.12	1.77	2.37	78.2	305.0	383.2
SEm±			0.02	0.03	2.5	11.9	13.5
CD (P=0.05)			0.07	0.09	7.2	NS	NS

Table 3. Effect of mixing different seed rates of oats and sarson on the crude protein and IVDMD of the fodder (Mean of 4 years)

Treatment	Crude protein content (%)		Crude protein production (t/ha)			IVDMD (%)		IVDMD production (t/ha)		
	First cut	Subsequent cuts	First cut	Subsequent cuts	Total	First cut	Subsequent cuts	First cut	Subsequent cuts	Total
Ryegrass (RG) pure	14.00	14.13	0.42	1.76	2.18	61.3	60.9	1.84	7.58	9.42
RG+oats 22.5 kg/ha	11.58	14.31	0.38	1.82	2.20	59.3	61.2	1.97	7.79	9.76
RG+oats 30.0 kg/ha	11.52	14.44	0.40	1.83	2.23	58.5	61.2	2.05	7.77	9.82
RG+oats 37.5 kg/ha	11.15	14.50	0.41	1.85	2.26	57.7	61.4	2.11	7.85	9.96
RG+oats 45.0 kg/ha	10.63	14.69	0.44	1.90	2.34	57.2	61.7	2.37	7.97	10.34
RG+sarson 0.625 kg/ha	12.39	14.38	0.39	1.78	2.17	60.2	61.0	1.90	7.56	9.46
RG+sarson 1.25 kg/ha	12.10	14.56	0.42	1.81	2.23	58.4	61.3	2.03	7.64	9.67
RG+sarson 1.875 kg/ha	11.95	14.69	0.46	1.79	2.25	58.1	61.4	2.24	7.50	9.74
RG+sarson 2.50 kg/ha	11.08	14.81	0.49	1.91	2.40	58.0	61.6	2.56	7.93	10.49
SEm±	0.19	0.25	0.01	0.07	0.08	0.7	0.7	0.07	0.29	0.34
CD (P=0.05)	0.55	NS	0.04	NS	0.24	2.0	NS	0.20	0.85	0.99

Table 4. Effect of mixing of different seed rates of oats and sarson with ryegrass on the characteristics of ryegrass, oats and sarson (Mean of four years)

Treatment	Plant height (cm)					Number of tillers (oats) or plants (sarson)/m²				
	Ryegrass		Oats		Sarson	Ryegrass		Oats		Sarson
	First cut	Subsequent cuts	First cut	Second cut	First cut	First cut	Subsequent cuts	First cut	Second cut	First cut
Ryegrass (RG) pure	66.6	55.7	0.71 (0.0)	0.71 (0.0)	0.71 (0.0)	2411	2061	0.71 (0.0)	0.71 (0.0)	0.71 (0.0)
RG+oats 22.5 kg/ha	65.6	56.1	9.35 (86.9)	7.44 (54.8)	0.71 (0.0)	2167	2037	13.96 (194.4)	4.14 (16.7)	0.71 (0.0)
RG+oats 30.0 kg/ha	64.1	55.6	9.51 (90.0)	7.66 (58.1)	0.71 (0.0)	2133	2011	15.11 (227.8)	5.10 (25.6)	0.71 (0.0)
RG+oats 37.5 kg/ha	68.6	55.4	9.47 (89.1)	7.61 (57.4)	0.71 (0.0)	1922	1964	17.11 (292.2)	5.52 (30.0)	0.71 (0.0)
RG+oats 45.0 kg/ha	66.5	55.5	9.42 (88.2)	7.60 (57.2)	0.71 (0.0)	1902	1944	17.30 (298.9)	5.72 (32.2)	0.71 (0.0)
RG+sarson 0.625 kg/ha	66.0	55.6	0.71 (0.0)	0.71 (0.0)	9.41 (88.0)	2122	1989	0.71 (0.0)	0.71 (0.0)	7.34 (53.3)
RG+sarson 1.25 kg/ha	66.2	55.3	0.71 (0.0)	0.71 (0.0)	9.59 (91.5)	2022	1964	0.71 (0.0)	0.71 (0.0)	8.72 (75.6)
RG+sarson 1.875 kg/ha	67.8	54.0	0.71 (0.0)	0.71 (0.0)	9.58 (91.2)	2089	2042	0.71 (0.0)	0.71 (0.0)	9.63 (92.2)
RG+sarson 2.50 kg/ha	65.5	53.0	0.71 (0.0)	0.71 (0.0)	9.72 (93.9)	2078	2026	0.71 (0.0)	0.71 (0.0)	11.47 (131.1)
SEm ±	2.2	1.7	0.16	0.14	0.17	71	76	0.27	0.11	0.18
CD (P=0.05)	NS	NS	0.48	0.41	0.49	208	NS	0.77	0.31	0.53

Oats and sarson data subjected to square root $\sqrt{x = 0.5}$ transformation and figures in parenthesis are original values

higher uptake of nitrogen. Among the mixtures, the higher CP content was observed with ryegrass + *sarson* than ryegrass + oat which indicates that ryegrass + *sarson* mixture is more nutritious than ryegrass + oat. The CP content of ryegrass + oat was lowest which was due to the contribution of oat fodder in the second cut whereas the proportion of *sarson* was negligible. CP and IVDMD production followed the trend of dry matter yield. Puri *et al.* (2005) also reported 20% crude protein content in pure shaftal as compared to 19% in shaftal + oats and 18.5% in shaftal + *sarson* mixtures.

Thus, it can be concluded that the addition of oats @ 37.5 kg/ha or *sarson* at the rate of 1.875 kg/ha with full seed rate of ryegrass (10 kg/ha) produced higher quantity of quality fodder.

REFERENCES

Chauhan, T.R. and Puri, K. P. 1989. Chemical composition, *in vitro* dry matter digestibility and nutrient production potential of lucerne when grown in mixture with ryegrass or oats. *Journal of Research, Punjab Agricultural University* **26**: 273–278.

Chauhan, T.R. and Puri, K.P. 1992. Quality and yield of shaftal (*Trifolium resupinatum* L.) when grown alone and as a mixture with ryegrass (*Lolium perenne* L.) or forage oats (*Avena sativa* L.). *Journal of Research, Punjab Agricultural University* **28**: 387–390.

Gill, G.S., Tiwana, M.S., Puri, K.P. and Thind, I.S. 1981. Performance of berseem and lucerne in monoculture and in association with rape and oats. In: *"Proceedings of National Symposium on Crop Management to meet the new challenge"* held at HAU, Hisar from March 14-15, 1981, pp. 84-91.

Puri, K.P., Tiwana, M.S. and Tiwana, U.S. 2001. Production potential of berseem (*Trifolium alexandrinum*) and ryegrass (*Lolium perenne)* mixtures. In: *"Proceedings of National Symposium on Resource Conservation and Agricultural Productivity"*. held at Punjab Agricultural University, Ludhiana from 22-25 November, 2004, pp. 481.

Puri, K.P., Tiwana, M.S., Tiwana, U.S. and Thind, I.S. 2005. Forage yield and quality performance of mixing ryegrass in shaftal+oats and shaftal+sarson mixtures. *Forage Research* **31**: 18–20.

Tilley, J.M.A. and Terry, R.A. 1963. A two stage technique for the *in vitro* digestion of forage crops. *British Journal of Grassland Society* **18**: 104–111.