

DO IRRIGATED COMPANION OAT CROPS REDUCE ALFALFA YIELD AND PROFITS?

Paul Jefferson and Bob Zentner,
Agriculture Canada Research Station,
Swift Current, SASK S9H 3X2

ABSTRACT

Establishment of 'Anchor' alfalfa with a companion oat crop was compared to direct-seeding the alfalfa on a sprinkler-irrigated site in 1982, 1983 and 1985. 'Beaver' alfalfa was added to the treatments in 1983 and 1985. An oat crop monoculture treatment was also included. Alfalfa-oat mixtures exhibited significant ($P < 0.05$) oat grain yield reductions of 9, 24 and 18% in the three seeding years, respectively. Oat forage yields tended to be reduced in oat-alfalfa mixtures by 3, 12 and 8%, respectively, but these reductions were not statistically significant ($P > 0.05$). The forage yields of direct-seeded alfalfa were 26, 20 and 20% higher (significant at $P < 0.05$) in the first production year (year following seeding) than oat-alfalfa mixture stands. In the second production year, yields were 22% higher ($P < 0.05$) only in the 1982 seeding. Establishment method effects on stand density were significant ($P < 0.05$) in the 1982 and 1983 seedings where the direct-seeded alfalfa had 50 and 25% higher plant densities, respectively. Economic analysis of net returns per hectare indicated that the establishment method with the best returns varied among the three seedings years.

INTRODUCTION

The use of companion crops for establishment of forage seedlings is not recommended under dryland conditions in the Brown soil zone because of competition for soil moisture. However, use of companion species continues to be practiced on irrigated areas because soil moisture is generally non-limiting. The value of a companion crop in this situation is twofold: i) weed control through greater plant competition, and ii) production of a usable yield in the year of forage establishment.

The forage yield of alfalfa, that was established with oat companion crops was reduced in the first production year compared to direct-seeded alfalfa (Nielsen et al. 1981). Oat grain yield may be reduced, increased, or unaffected by the alfalfa seedlings depending on the test environment (Nielsen et al. 1981). The objective of this study was to determine the magnitude of this yield reduction and the effect on economic returns for alfalfa when established with an oat companion crop under irrigation in SW Saskatchewan. The effect of the alfalfa seedlings on oat grain and forage yield was also determined.

MATERIALS AND METHODS

Oat cv 'Cascade' was seeded in monoculture, or with alfalfa cv 'Anchor' on June 10, 1982, May 26, 1983 and May 16, 1985. Alfalfa cv 'Beaver' was

added to the tests in the latter two years. The alfalfa cultivars were also seeded without a companion crop in each test. Each experiment was seeded in a randomized complete block design with 6 replicates. Plots were 1.8 m by 6.0 m and consisted of 12 rows spaced 15 cm apart. Seeding was done using a plot seeder at a depth of 2 to 3 cm. Recommended seeding rates of 8 and 30 kg/ha were used for the alfalfa and oats (as a companion crop) respectively. Fertilizer was applied at seeding at 25 kg/ha rate of 11-55-0 (NPK). Weeds were controlled as required using 2,4-DB applied at the recommended rate.

A sub-sample was cut from each mixture plot at approximately the soft-dough stage of the oat crop. This was separated into oat, alfalfa and weed components and the data compared for competition effects. The oat yield of the sub-sample was also used to calculate an oat dry matter forage yield similar to that obtained if the oat crop was used for hay rather than grain. Oat grain yields were harvested by direct combining at maturity. Direct-seeded alfalfa was harvested at 10% bloom stage. In the subsequent production years, the alfalfa stands were also harvested at 10% bloom. The data were analyzed by analysis of variance (SAS, 1985) and the treatment means separated by a LSD ($P < 0.05$).

Annual net returns for alfalfa grown alone or with an oat companion crop were calculated for each establishment test. Net return was defined as the income above the cost of seed (establishment year only) plus harvesting and transportation of the grain or forage (Table 1). Costs for fertilizer, seed-bed preparation, and herbicides were not included because they were common to all treatments.

Table 1. Summary of Economic Assumptions⁺

Item	Value	Units
<u>Products</u>		
Oat Grain	68	\$/t
Oat Hay	80	\$/t DM [†]
Alfalfa Hay	85	\$/t DM
<u>Inputs</u>		
Oat seed	0.14	\$/kg
Alfalfa seed - Anchor	3.30	\$/kg
- Beaver	3.85	\$/kg
Mower-conditioning	23.35	\$/ha
Baling	9.64	\$/t
Transport & stacking bales	8.80	\$/t
Combining Oats	11.62	\$/t
Transporting Oats	3.68	\$/t

⁺ Source: Saskatchewan Agriculture (1987).

[†] DM=dry matter.

RESULTS AND DISCUSSION

Grain and Forage Yields

Oat grain yielded 9, 24 and 18% less ($P < 0.05$) on the alfalfa-mixture treatments than the oat monoculture in the 1982, 1983 and 1985 establishment years, respectively (Table 2). Bird damage to the oat crop resulted in severe grain yield losses in 1985. There was no significant difference between the two alfalfa cultivars in the reduction in oat grain yield, nor on the test weight of the oat grain (data not shown). A similar trend was observed for the oat forage yield (Table 3). The alfalfa-mixture treatments tended to produce less forage than monoculture oats but the differences were not significant. The direct-seeded alfalfa yielded about 35% of the forage yield of the oat monoculture treatment in 1982 and 1985 and these yields are typical for irrigated alfalfa seedlings in SW Saskatchewan. In 1983, conditions were especially favorable for alfalfa growth with warm and moist July to August weather. The growing period precipitation and irrigation total was higher in 1983 (27 cm) than in 1982 (23) and 1985 (14 cm). Consequently, the direct-seeded alfalfa yielded 80% as much forage as the oat crop in 1983. The mixture components indicated no significant effect of alfalfa on the proportion of oat aboveground growth except in 1985. In that year, 3% of harvested material from the 'Beaver' mixture and 6% of that from the 'Anchor' mixture was alfalfa.

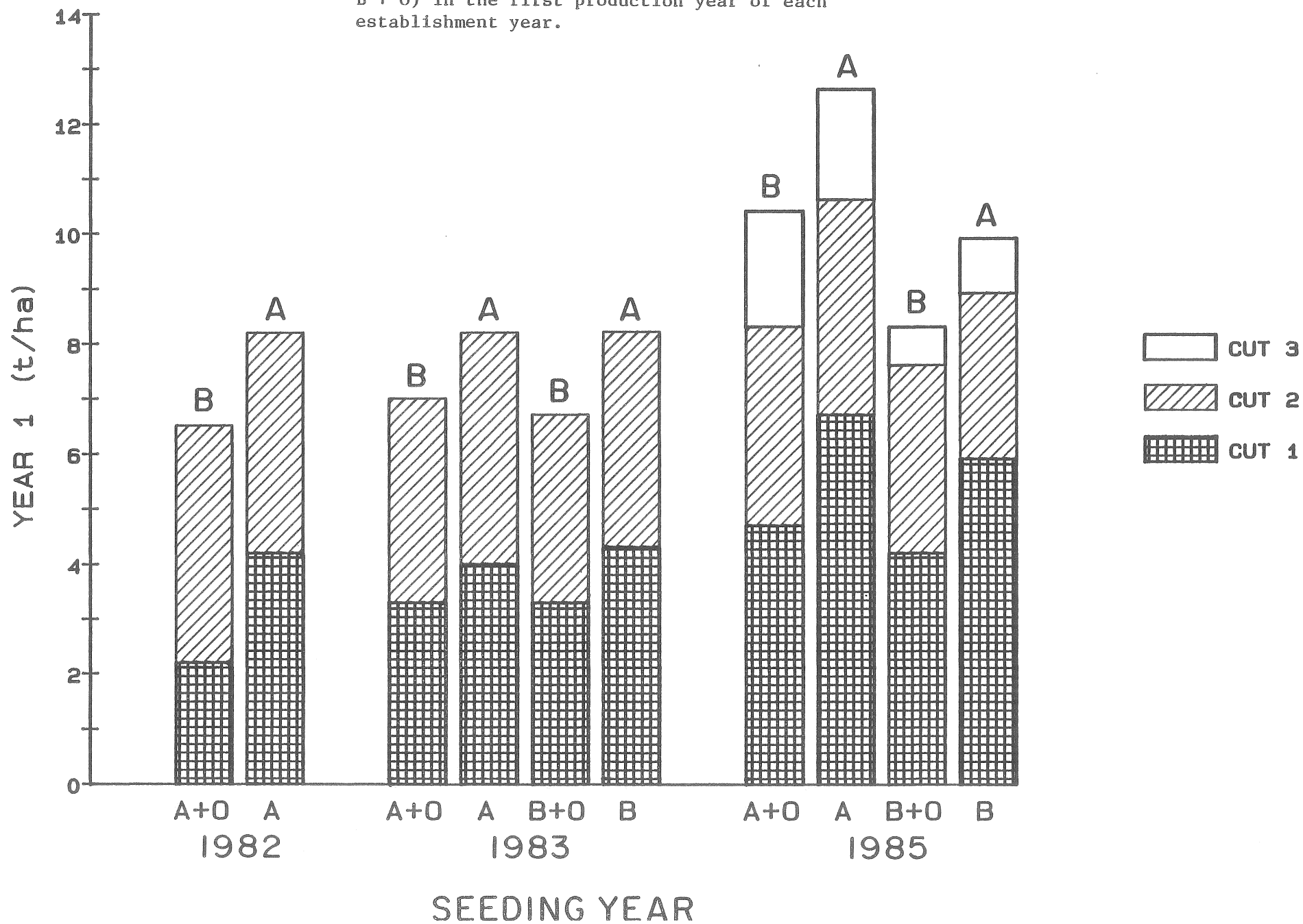
Table 2. Oat grain yield (kg/ha) of oats monoculture and oats-alfalfa mixtures for each seeding year.

	<u>1982</u>	<u>1983</u>	<u>1985</u>
monoculture	4581 a	4653 a	950 a
mixture-Anchor	4179 b	3606 b	780 b
mixture-Beaver	-----	3458 b	768 b

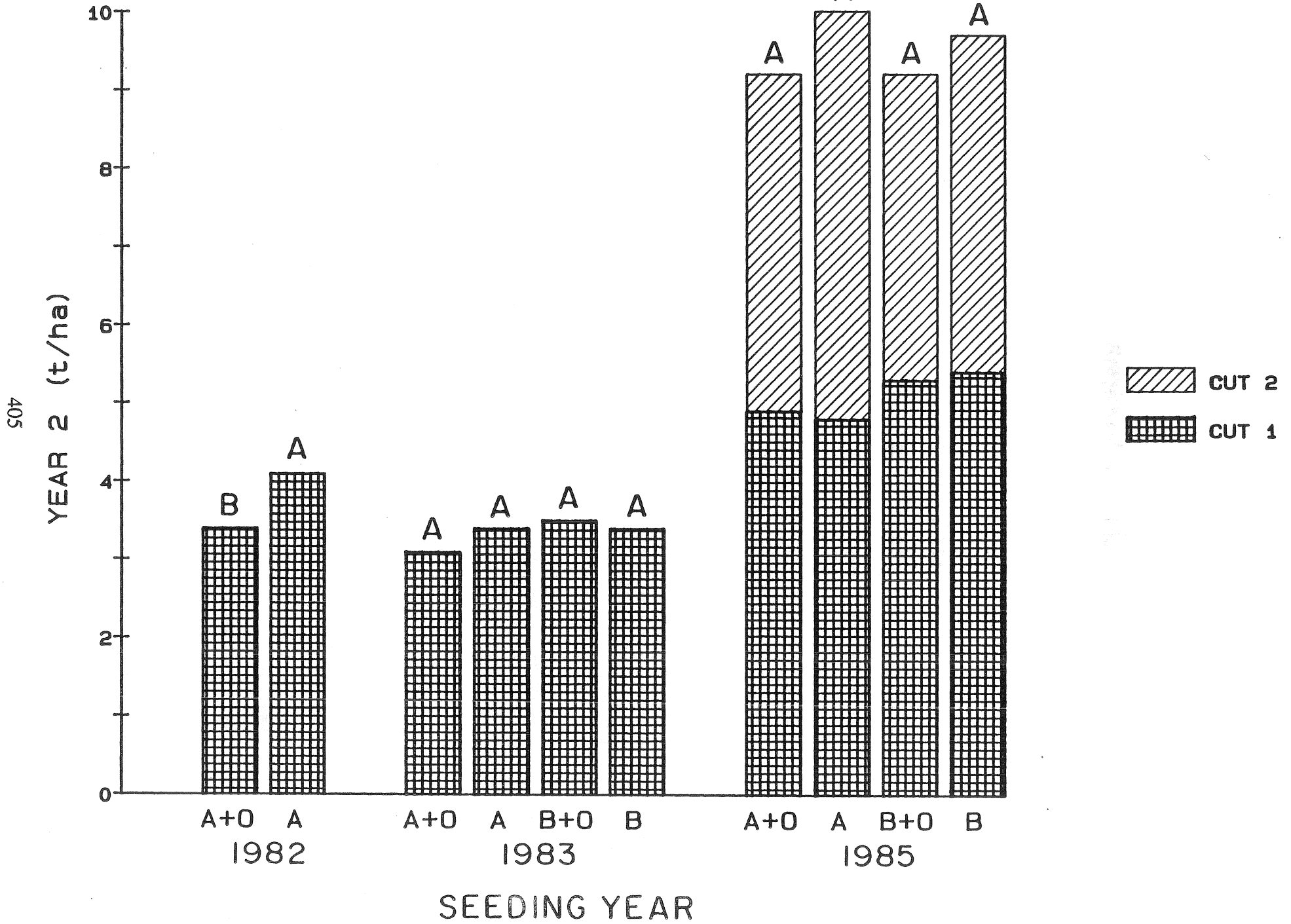
means followed by the same letter are not significantly different based on LSD ($P < 0.05$).

Direct-seeded alfalfa yielded 93, 25 and 42% more forage ($P < 0.05$) than the alfalfa-mixture in the first cut of the first production year in each seeding (Fig. 1). A similar yield advantage was observed for the second cut of the 1983 seeded stand. In the 1982 and 1985 seedings there were no differences in yield among the second and third harvests. Yield differences in the second production year of the three seedings were variable. Direct-seeded 'Anchor' alfalfa yielded more forage than the mixture-seeded treatment for first cut of the 1982 seeding and the second cut of the 1985 seeding (Fig. 2). Otherwise, the yield of the two establishment treatments were similar by the second production year. The direct-seeded alfalfa had more plants/m² than the mixture-seeded alfalfa for the 'Anchor' in 1982 and the 'Beaver' in 1983 (Table 4). By the second production year the plant

Figure 1. 'Anchor' and 'Beaver' forage yield (t/ha) for direct-seeded (A and B) and oat-alfalfa mixtures (A + O and B + O) in the first production year of each establishment year.



establishment year.



density was similar in most cases. These results suggest that the effect of the oat companion crop on the subsequent alfalfa productivity does not persist past the first production year.

Table 3. Oat and alfalfa forage yield (kg/ha) of oats monoculture and oats-alfalfa mixtures for each seeding year.

	<u>1982</u>	<u>1983</u>	<u>1985</u>
OATS			
monoculture	8627 a	8017 a	7050 a
mixture-Anchor	8358 a	6728 a	5856 a
mixture-Beaver	----	7400 a	7162 a
ALFALFA			
Anchor	2721	6057	2584
Beaver	----	6248	2672

means within columns followed by the same letter are not significantly different by LSD ($P < 0.05$).

Table 4. Plant density (crowns/m²) in second production year.

	<u>Seeding Year</u>		
	<u>1982</u>	<u>1983</u>	<u>1985</u>
Anchor	32 a	23 b	19 a
mixture-Anchor	22 b	23 b	18 a
Beaver	--	32 a	16 a
mixture-Beaver	--	22 b	16 a

means within columns followed by the same letter are not significantly different by LSD ($P < 0.05$).

Net Returns

Net returns were highest in all establishment years when the alfalfa was grown with an oat forage companion crop (Table 5). The direct-seeded alfalfa treatments produced the lowest net return in the 1982 and 1985 establishment years. Harvesting the oat crop for grain produced consistently lower net returns than harvesting it for forage under the assumed prices. The oat grain/oat forage price ratio would have to exceed 1.5 to 1.8 in order that oat grain be more profitable than oat forage. In contrast to the establishment year, net returns in the first and second production years were generally highest for the direct-seeded alfalfa treatments; although the differences in net return between direct-seeded and mixture-seeded treatments diminished in the second production year. Overall, the analysis suggests that there is little economic difference between direct-seeded alfalfa and using an oat companion crop when the oat crop can be harvested as forage in the establishment year.

Table 5. Comparison of net returns by establishment method

Establishment Year & Method	Net Return (\$/ha) [‡]					Present Value [¶]
	1982	1983	1984	Total		
<u>1982 Establishment Year</u>						
Anchor	131	550	276	957	781	
Anchor + Oats (Grain) ⁺	190	434	226	850	701	
Anchor + Oats (Forage) [‡]	461	434	226	1121	948	
<u>1983 Establishment Year</u>						
Anchor	353	548	225	1126	943	
Beaver	362	546	228	1136	952	
Anchor + Oats (Grain) ⁺	160	443	206	809	666	
Beaver + Oats (Grain)	147	448	232	827	678	
Anchor + Oats (Forage) [‡]	361	443	206	1010	849	
Beaver + Oats (Forage)	398	448	232	1078	906	
<u>1985 Establishment Year</u>						
Anchor	122	836	667	1625	1303	
Beaver	124	662	643	1429	1143	
Anchor + Oats (Grain) ⁺	141 [*]	690	610	1441	1157	
Beaver + Oats (Grain)	175 [*]	556	615	1346	1081	
Anchor + Oats (Forage) [‡]	308	690	610	1608	1309	
Beaver + Oats (Forage)	384	556	615	1555	1271	

- + Oats harvested for grain in establishment year.
⁺ Oats and alfalfa harvested as hay in establishment year.
[‡] Net return refer to the income above the cost of seed, harvesting and transportation.
^{*} Based on estimated oat grain yields of 3250 and 3975 kg/ha, respectively.
[¶] Based on a 10% discount rate

LITERATURE CITED

Nielsen, R.L., D.D. Stuthman and D.K. Barnes. 1981. Interference between oats and alfalfa in mixed seedings. Agron. J. 73:635-638.

SAS, 1985. SAS User's Guide: Statistics. SAS Institute Inc. Box 8000 Cary, NC 27511-8000.