INTERCROPPING BARLEY AND ANNUAL RYEGRASS FOR WINTER FORAGE

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ABSTRACT
Cost of winter feed for beef cattle (*Bos* sp.) must be reduced in the Intermountain West of the USA. This study evaluated the feasibility of a barley (*Hordeum vulgare* L.) and annual ryegrass (*Lolium multiflorum* Lam.) intercropping system. The experiment was conducted in 1992-93 and 1993-94 on a Timpanogas loam. Barley was sown at 84 and 112 kg/ha in both the fall and the spring. Fall-seeded barley was over seeded in the spring with 'Tetila' annual ryegrass (16 kg/ha). Annual ryegrass was sown with the spring-sown barley. Increased forage production from annual ryegrass was 45% in 1992-93 and 15% in 1993-94. From 0 to 3.8 Mg/ha, depending on conditions, of annual ryegrass was available for stockpiling for winter grazing. This could provide up to 11.3 AUM's/ha at $7.13/AUM. Management systems could be developed in which the small grain is ensiled, first growth of annual ryegrass is grazed, and the second growth is stockpiled and grazed during the winter.

KEYWORDS
Cattle, winter feed, stockpiled feed, annual ryegrass, barley

INTRODUCTION
Economic survival of ranchers in the Intermountain West dictates that winter feed be provided at lower cost. During the summer, many ranchers graze their cattle on mountain pasture, while feed through the winter months is provided from forage the rancher has either produced or purchased. Since grazing eliminates costs associated with machine-harvesting, it should lower over-wintering feed costs.

Studies on intercropping annual ryegrass with spring-planted barley in southern British Columbia concluded that barley and annual ryegrass cultivars may be successfully intercropped (Thompson et al., 1992b). It was also reported that intercropping annual ryegrass with spring-barley produced 19% more dry matter than a barley-barley cropping rotation (Thompson, Stout, and Moore, 1992a), and that the optimal planting rate for annual ryegrass and barley were15 kg/ha and 50 kg/ha, respectively (Thompson and Stout, 1992). Since conditions in intermountain valleys vary widely from those of British Columbia, it was not known if the conclusions from the British Columbia studies would hold for the Intermountain West. Thus, the objectives of this study were to evaluate the agronomic feasibility of forage production by intercropping fall-and spring-planted barley with spring-planted annual ryegrass.

METHODS
The experiment was conducted in 1992-93 and 1993-94 on a calcic argixeroll, fine-loamy, mixed mesic soil (Timpanogas loam). The location was the Brigham Young University Agriculture Station southeast of Spanish Fork, Utah (40º north latitude, 111º west longitude, elevation of 1387 m). The temperatures for the area tended to be a cooler than normal (-0.8ºC) during the 1993 growing season and above normal (0.5ºC) in 1994.

Barley cultivars were seeded in both the fall (15 Sept. 1992, 19 Sept. 1993) and the spring (16 Apr. 1993 and 17 Mar. 1994). Annual ryegrass was broadcast seeded the next spring (16 April and 17 March) over the fall-sown plots, and seeded at the same time as the spring-sown small grains. Four replicates in a randomized complete block design were used. The small grains were harvested at the soft dough stage of development, after which the annual ryegrass produced two subsequent crops. Yields are on a dry matter basis. Barley was sown at 84 and 112 kg/ha and annual ryegrass was seeded 16 kg/ha.

Nitrogen fertilization (NH_4NO_3) of the small grains consisted 78 kg N/ha, applied at time of planting for the 1992-93 season, and 56 kg N/ha applied at the time of planting for the 1993-94 growing season. During the 1992-93 growing season, 56 kg N/ha was applied at the 8-leaf stage of development. No additional N was applied to the barley in 1993-94. The annual ryegrass received an application during both growing seasons of 56 kg N/ha after removal of the small grain and after the first annual ryegrass harvest.

Relative feed value is a unitless number computed using DDM and DMI (Quade, 1990), as follows: RFV = (%DDM x % DMI)/1.29. It is used to compare the potential of forages for energy. As a standard, alfalfa harvested at the full-bloom stage has a RFV of 100. This is not high quality forage. Dairy producers look for feed with a RFV greater than 124. Beef cattle maintenance does not require feed with a RFV greater than 100.

Annual ryegrass samples were taken every seven to ten days after the second annual ryegrass harvest to determine the effect of fall and winter weather conditions on quality of stockpiled forage. Sampling ceased on 11 Dec. 1993 and 11 Nov. 1994. Heavy snowfall prohibited further sampling each year.

RESULTS AND DISCUSSION
There were no differences in forage yield between the 84- and 112-kg/ha (data not shown) planting rates, thus data were averaged. Forage yields from the fall barley exceeded that of spring barley by 19.5% in 1992-93, but in 1993-94 there was no difference (Table 1).

In 1992-93, only the first harvest of annual ryegrass in the spring-sown barley was less than the monocultured Tetila (Table 1). This was apparently a random response. In 1994, however, the Tetila monocropped yield was significantly higher than all but the spring-sown Steptoe in the second harvest. Barley provided too much competition and in the fall-planted plots what little annual ryegrass had been present during the second harvest was subsequently smothered by weeds.

Intercropping annual ryegrass with small grains increased the total forage yield and average of 45% in 1993 and 15% in 1994. The lower increase in 1994 was related to the warmer than normal spring weather, which caused vigorous barley growth, excessive competition for the annual ryegrass, and subsequent weakening or loss of annual ryegrass stands before the fall-planted barley was removed at the soft-dough stage.

Stockpiled annual ryegrass maintains good quality well into the late fall (Fig. 1). In fact, from early October until mid-November the RFV of the stockpiled material increased, presumably because of continued growth. Thereafter, the quality decreased, but even then the forage was still of sufficient quality to maintain beef cattle.

Two measures of the economic feasibility of a forage production system are the cost of producing enough forage to sustain a cow for one month, and the number of cattle which can be fed per hectare of

production. A reliable standard used to determine this is AUM (animal unit month). In 1992-93 annual ryegrass produced sufficient stockpiled forage in the second harvest to provide from 10.7 to 11.3 AUM's/ha. In 1993-94 the potential carrying capacity was much lower—6.1 AUM's. The variable costs for seeding, providing nitrogen fertilizer, and irrigation ranged from $5.48 to $5.19 in 1992-93 and was $9.62/AUM in 1993-94.

In summary: 1) When intercropping small grains with annual ryegrass for forage production, there is no difference in yield between seeding small grains at 84 or 112 kg/ha. 2) Optimum forage production may be with either fall- or spring-sown barley in an intercropping system with annual ryegrass. 3) The quality of the stockpiled annual ryegrass forage, with respect to protein concentration, is sufficient to meet the over-wintering nutritional requirements for cattle. 5) The stockpiled forage from such an intercropping system could sustain between 6 and 12 AUM's/ha at a variable cost from $5.19 to $9.62/AUM.

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Figure 1
Relative feed value (RFV) of annual ryegrass stockpiled (left standing in the field) for winter grazing

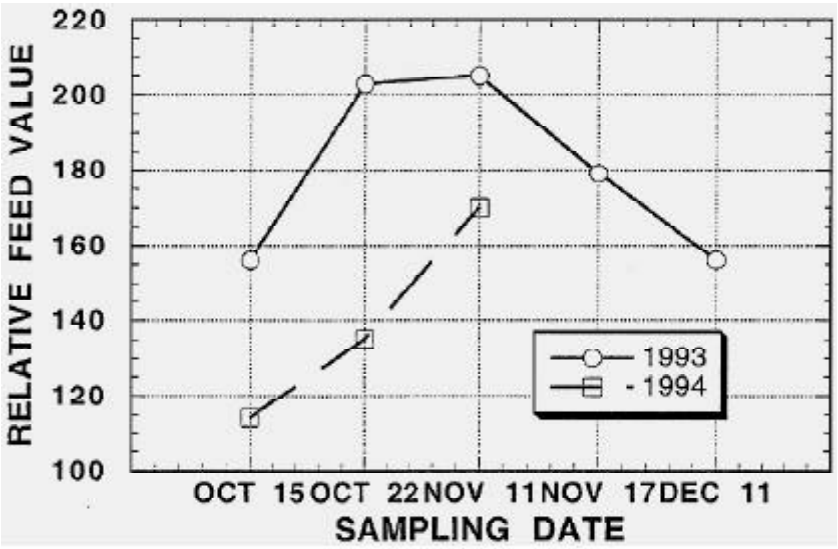

Table 1
Summary of barley and annual ryegrass yields and percentage of total forage produced by annual ryegrass during the 1992-93 and 1993-94 growing seasons.

	1992-93				1993-94			
		Annual Ryegrass		Annual		Annual Ryegrass		Annual
Treatment	Barley	Har. 1	Har. 2	Ryegrass	Barley	Har. 1	Har. 2	Ryegrass
	(.....Mg ha^{-1}.....)			%	(.....Mg ha^{-1}.....)			%
Monocropped								
Tetila	—	3.8a	3.7a	100.0	—	2.6a	2.6a	100.0
Barley								
Fall Barley	8.8a	3.6a	3.7a	45.0	11.2a	1.0b	0.0b	8.2
Spring Barley	7.4b	2.6b	3.8a	46.4	10.6a	1.2b	2.1a	23.7
Mean[1]	8.1	3.3	3.7	45.7	10.9	1.6	1.6	16.0

[1]Does not include monocropped annual ryegrass.
Means within a column followed by the same letter do not differ significantly, a=0.05