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# Tall Fescue Mixtures with Birdsfoot Trefoil or Alfalfa improve Forage Production, Beef Steer Gains, and Economic Returns

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## INTRODUCTION AND OBJECTIVE

- High fertilizer prices and environmental stewardship have increased interest in grass-legume mixed pastures.
- Grasses need nitrogen to produce sufficient forage—generally 112 to 168 kg/ha N per year in the western U.S.
- There has been a drastic increase in cost of N fertilizer.
- Low-levels of condensed tannins in birdsfoot trefoil are reported to increase ruminal nitrogen utilization and may improve livestock performance.
- Past grass-legume research was not indicative of the irrigated, rotationally stocked pastures common in the western U.S.
- Therefore the objectives of this experiment were:
  - Determine and compare relative livestock performance, economic return, and herbage mass and nutritive value of tall fescue with or without N-fertilizer to tall fescue binary mixtures with alfalfa or birdsfoot trefoil.

## MATERIALS AND METHODS

### Pastures and Plant Materials:

- Treatments: Tall fescue + N fertilizer (TF+N, 168 kg/ha), tall fescue unfertilized (TF-N), tall fescue + alfalfa (TF+ALF), and tall fescue + Birdsfoot trefoil (TF+BFT).



TF+BFT mixture

- Seeding rate: Monoculture, 18 kg ha<sup>-1</sup>; Binary mix, 11 kg ha<sup>-1</sup> TF and 7 kg ha<sup>-1</sup> legume (resulted in 30% legume in herbage mass).

- RCB design (3 reps) with 0.4 ha pastures divided into four 0.1 ha paddocks.

- Planted in Fall 2010. Mechanically harvested in 2011 to remove establishment year bias. Grazed in 2012 and 2013.

- Irrigated: 3.8 cm every 7 days during grazing season.

### Grazing and herbage Data:

- Grazed for 112 days (mid-May to Mid-September) in 2012 and 2013.

- Rotational Stocking: 7-day grazing period per paddock, 28-day rotation cycle (21 day rest period).

- Three Angus-cross steers per pasture — starting weight was 381 kg in 2012 and 304 kg in 2013.



TF+N grazing

- Put-and-take stocking: addition of mature cows in spring and removal of steers to overflow pasture in summer based upon available herbage.

- Steers weighed at end of every 28-day rotation cycle.

- Four 0.25-m<sup>2</sup> samples collected from paddocks just prior to grazing to determine stocking rate and herbage mass and nutritive value.

## RESULTS

Table 1. Livestock weight gain.

TRMT	Livestock weight (kg)		Cumulative average daily gain (ADG; kg)			
	Day 1 (begin)	Day 112 (end)	Day 1-28	Day 1-56	Day 1-84	Day 1-112
TF+BFT	344.2 A	425.7 A	1.30 A	0.84 A	0.82 A	0.73 A
TF+ALF	340.1 A	415.3 A	1.50 A	0.92 A	0.78 A	0.67 B
TF+N	346.2 A	414.7 A	1.17 AB	0.76 AB	0.65 B	0.61 C
TF-N	339.1 A	383.8 B	0.94 B	0.61 B	0.50 C	0.40 D
Mean S.E.	3.7	5.8	0.12	0.08	0.03	0.05
Trmt P-VALUE	0.3200	0.0001	0.0172	0.0039	0.0001	0.0001
YR P-VALUE	0.0001	0.0001	0.8364	0.6388	0.0619	0.3885
Trmt*YR P-VALUE	0.4342	0.1507	0.0607	0.1979	0.0498	0.4413

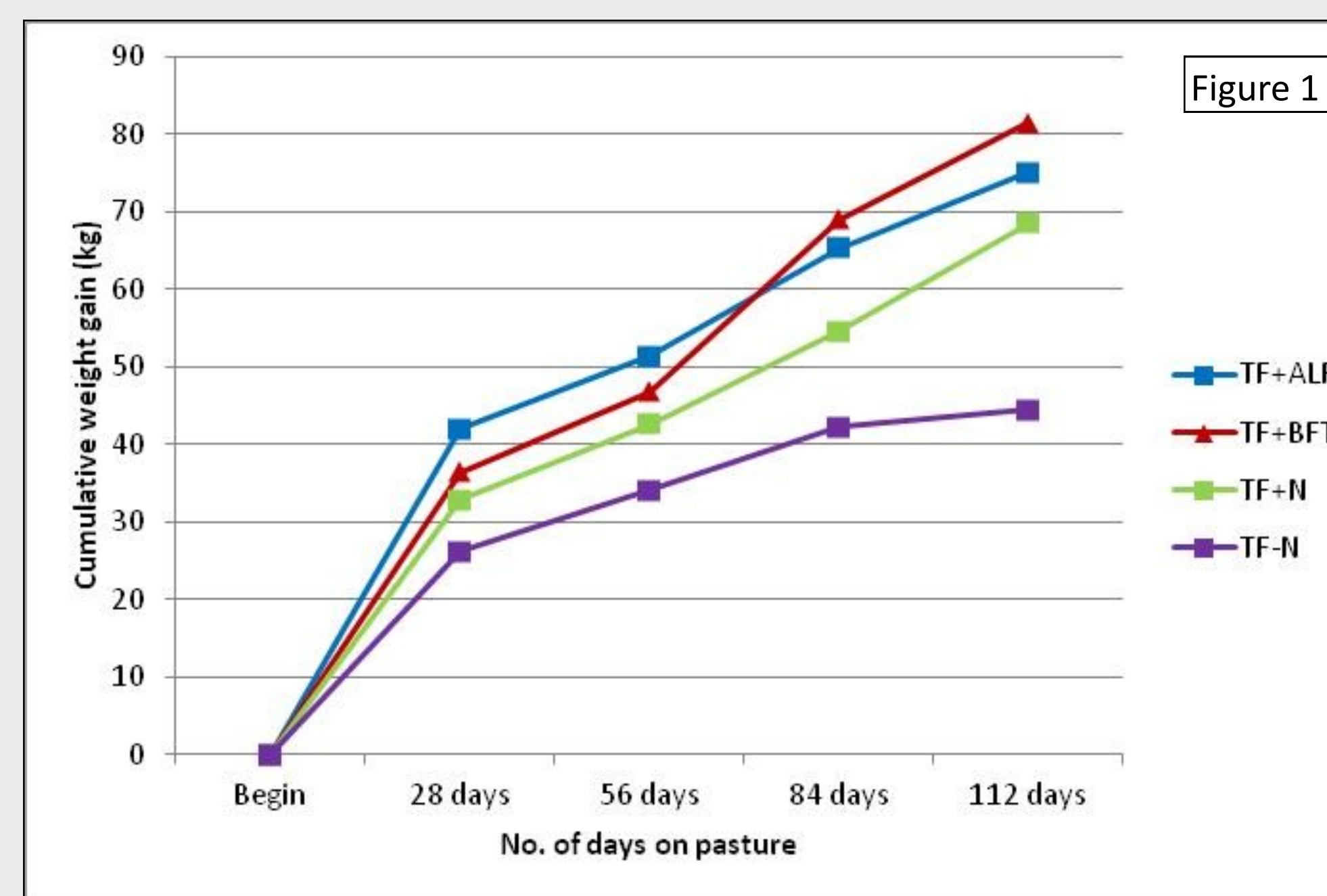


Table 2. Herbage mass and nutritive value.

TRMT	Herbage - kg ha <sup>-1</sup> -	CP	IVTD				NDF	NDFD	NFC	NEm	NEg
			- g kg <sup>-1</sup> -								
TF+BFT	10856 B	145.2 B	787.9 A	499.2 C	574.0 C	235.4 A	1.27 A	0.70 A			
TF+ALF	10386 B	159.4 A	788.6 A	491.8 C	564.6 C	229.6 A	1.25 A	0.68 A			
TF+N	11696 A	133.7 C	780.5 A	555.0 B	605.9 A	183.6 C	1.14 B	0.58 B			
TF-N	7285 C	105.1 D	768.5 B	569.7 A	591.4 B	193.9 B	1.10 C	0.54 C			
Mean S.E.	99	5.3	9.1	7.9	11.4	6.7	0.02	0.02			
Trmt (T) P-val.	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001			
YR (Y) P-val.	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001			
T*Y P-val.	0.0002	0.0159	0.0001	0.2348	0.0034	0.0001	0.0001	0.0001			
Rotat. P-val.	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001			
T*Rot. P-val.	0.0271	0.0938	0.3678	0.2348	0.0266	0.0176	0.5136	0.487			

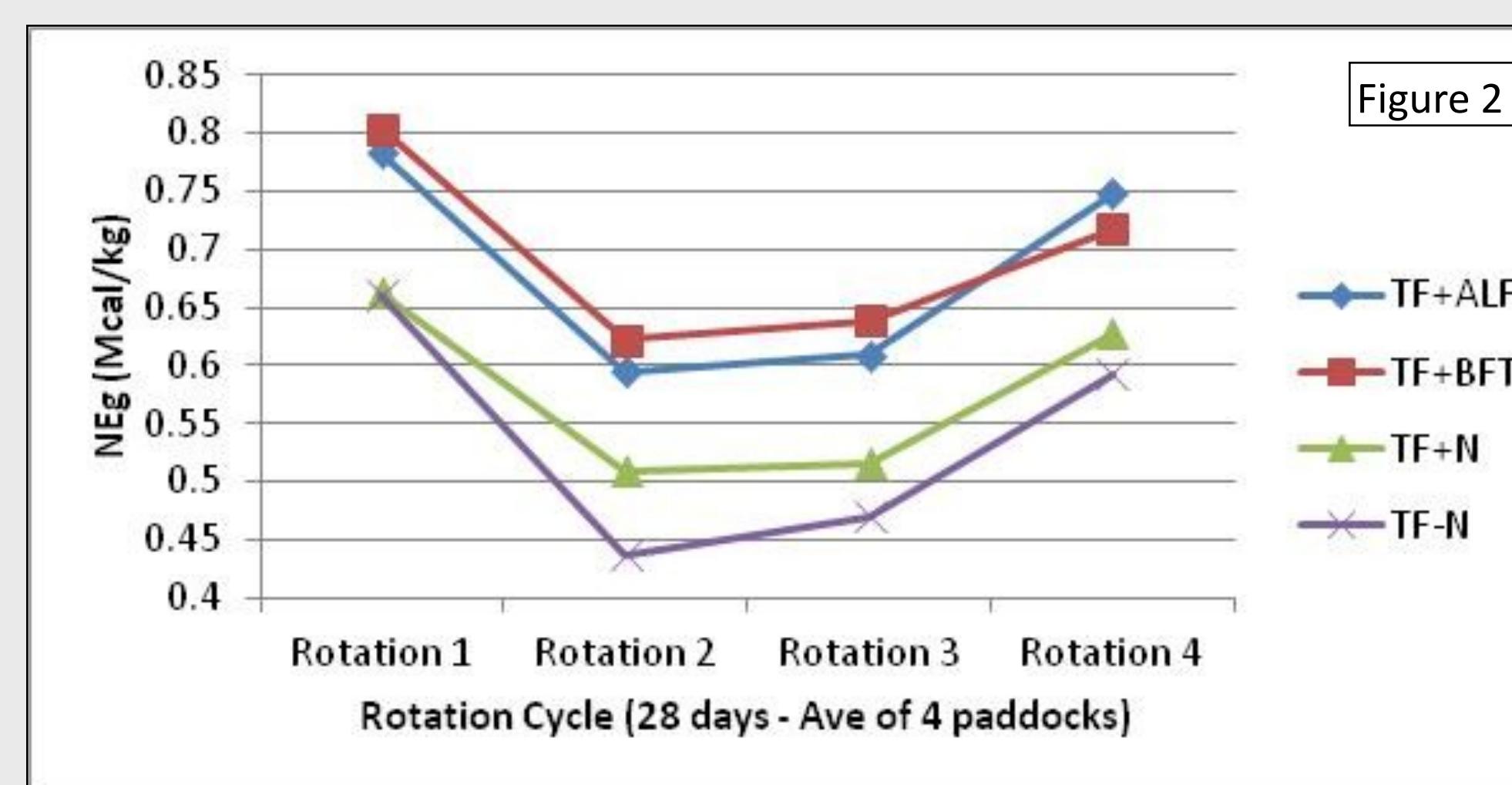


Table 3. Economic analysis.

TRMT	Initial value†	Final value	Added value (Steer)	Stocking rate‡	Added value (Land)§	Net Return#
	-\$ Steer <sup>-1</sup>	-\$ Steer <sup>-1</sup>	-\$ Steer <sup>-1</sup>	- AU ha <sup>-1</sup>	-\$ ha <sup>-1</sup>	-\$ ha <sup>-1</sup>
TF+BFT	957 A	1126 A	169 A	9.0 A	1528 A	1197 A
TF+ALF	961 A	1101 A	139 B	8.4 B	1174 B	846 B
TF+N	962 A	1105 A	143 AB	8.2 B	1175 B	494 C
TF-N	958 A	1042 B	84 C	5.0 C	446 C	96 D
Mean S.E.	10	14	10	0.3	85	85
Trmt P-value	0.9522	0.0001	0.0001	0.0001	0.0001	0.0001
YR P-value	0.0001	0.0001	0.0001	0.0004	0.0001	0.0001
Trmt*YR P-value	0.0472	0.1285	0.8116	0.0001	0.5206	0.5206

†Price based upon 5-year average for Utah/Idaho region.

‡Actual stocking rate used in study, was determined using green wt of herbage samples.

§Added value (land) = added value (steer) \* stocking rate.

#Net Return = added value (land) - amortized establishment and yearly management costs (\$ ha<sup>-1</sup>, TF+BFT=330, TF+ALF=328, TF+N=681, TF-N=349).

## CONCLUSIONS

- There were few significant Treatment by Year interactions for livestock performance; Treatment by Year interactions for herbage traits were mostly due to magnitude and not rank change.
- Overall, TF+BFT had the highest rate of steer weight gain (Table 1).
- Rate of weight gain was greatest for all treatments during the first 28 days of grazing (Fig 1).
- The decrease in rate of weight gain (from rotation-1 to rotation-2) corresponded with a decrease in NEg (Fig 2).
- TF+legume mixtures always had greater NEg than the TF monocultures (Table 2, Fig 2).
- Herbage mass was slightly less for TF-legume mixtures than the TF+N, but substantially greater than TF-N (Table 2).
- TF+BFT pastures had the highest economic net return, more than doubling the net return of TF+N (Table 3).
  - The net return of \$1197 ha<sup>-1</sup> for TF+BFT is comparable or better than common field crops in the region (\$464, \$780, and \$1608 for grain corn, wheat, and alfalfa, respectively).
- These results indicate that adding N via fertilizer or legume increases steer weight gains, herbage mass, nutritive value, and net return compared to no N fertilizer on tall fescue.
  - TF+legume mixtures result in greater steer weight gains and economic net return compared to TF+N or TF-N.
  - TF+legume mixtures can be substituted for TF+N to address environmental concerns (N-leaching, run-off) without reducing production.
  - TF+BFT results in the greatest ADG (Table 1) and Net Return (Table 3) without the risk of bloat.
  - Grass-legume mixtures with greater nutritive energy mid-grazing-season may further increase livestock gains and economic return.



TF+BFT grazing