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Comparing Risk for Default, Improved-Perennial and Annual Pastures in Beef Backgrounding Systems

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INTRODUCTION

Beef producers are reluctant to seed improved pasture species and utilize alternative grazing practices due to actual and perceived increases in cost of establishment, intensive management and changes in land use. The adoption of new technology is associated with risk of monetary loss if the technology fails when combined with the possibility of low and unpredictable rainfall. Default pasture species are those that remain years after planting, with abundance impacted by previous management and climate and are not chosen for enhanced performance under rotational grazing. They are considered less risky or lower cost than improved species bred for grazing. Examples of default species in the Canadian Parkland are smooth bromegrass, quackgrass and Kentucky bluegrass. Meadow bromegrass is an improved species, adapted to rotational grazing and to stockpiling and mixtures of spring-planted winter triticale and oats is an example of a novel annual pasture, which may act as a bridge between old and new pasture systems.

Stockpiling extends the number of pasture days from the summer growth period into the fall and may be used to add additional animal weight to backgrounding beef animals prior to a feedlot finishing period, albeit at a lower rate of gain than on a concentrate ration. However, the extra value in animal weight due to stockpiling must more than offset the costs of production on an additional land unit used for stockpiling.

The objective was to determine if pastures based on improved perennial and novel annual species mixtures could reduce economic risk of backgrounded beef production in summer and summer-stockpiled pasture systems.

MATERIALS AND METHODS

Detailed procedures, pasture production and production economics were reported previously (Baron et al., 2007, 2008). Briefly, pastures were replicated three times in a randomized complete block design on a silt loam Typic Haplustol soil, and stocked with beef heifers using the "Put and Take" method from 1999 to 2005. Data from 2002 and 2003 were removed because severe drought prevented completion of all treatments and systems. In each of Summer and Summer-stockpiled systems pastures consisted of Default (30 to 37-yr-old quackgrass, Kentucky bluegrass and smooth bromegrass) Improved (2 to 8-yr-old meadow bromegrass) and Annual (spring-planted winter triticale and oat mixtures) stands, Pastures were broadcast with 100, 13 and 25 kg ha^{-1} of N, P and K each spring. Each experimental unit consisted of a 1.3 ha paddock that was strip grazed rotationally. Summer and stockpiled components were randomized within replicates. Generally, the Summer systems were grazed from early to mid-June until September 15 (Area 1). The stockpiled component was managed as hay, cut in early July and as pasture from Sept. 15 until approximately October 25 (Area 2). Half of the "Tester" animals moved from the Summer to the stockpiled component in sequence, while the others were removed on Sept. 15. It was assumed that heifers were purchased and sold on the same day within years. If a treatment could not be initiated on the same day as others, daily maintenance was charged against that treatment at the average daily animal cost for the Default pasture within years.

A summary example for the basic calculation of gross margin is shown in Table 1. This entailed calculation of total revenue minus total cost per head, then mean seasonal stocking rates (sr^1 and sr^2) for specific rep, treatment and system combinations were used to convert animal (\$ hd^{-1}) to area (\$ ha^{-1}) variables (Table 1). Total cost of the stockpiled areas for each treatment (Area 2) had the revenue of hay subtracted. Animals moving from the Summer to Summer-stockpiled system carried costs from summer pastures into that system on an animal basis. The stocking rate of the stockpiled unit (sr^2) was used to determine costs and revenues of the stockpiled component and summer-stockpiled system on a land unit basis. The gross margin ha^{-1} for the Summer-stockpiled system was divided by 2.0, because it required twice the land units as the Summer system on a farm scale (Table 1).

Risk Analyses

Gross margin hd^{-1} and gross margin ha^{-1} for each pasture type within each system were compared for stochastic efficiency using the stochastic dominance method (Anderson et al. 1977). Continuous probability functions were fitted to observed data (n=15) using the normal distribution. The Monte Carlo procedure was used to smooth the distributions through random selection of the population over 10,000 iterations using the software @Risk (Anonymous 2002) with procedures described by Hardacker et al. (2004) and Anonymous (2002). Finally, the stochastic ordering among pastures was carried out according to the assumptions used for stochastic decision-making after Hardacker et al. (2004).

Table 1. Sample calculation of gross margin for Summer and Summer stockpiled systems using animal weight values for the Improved pasture treatment in 2001.

		Area 1 Summer	Area 1 and 2 Summer-Stockpile
		Cost	
Initial animal weight	kg hd^{-1}	323	323
Animal cost	\$ hd^{-1}	A = wt. x cost	C
Hay cost	\$ ha^{-1}	--	G = operating (hay)
Hay revenue	\$ ha^{-1}	--	H = yield x price
Net Hay Cost	\$ ha^{-1}	--	I = H - G
Pasture Cost	\$ ha^{-1}	B = operating + overhead	J = I + (additional operating after hay + overhead)
Total Animal Cost	\$ hd^{-1}	C = A + (B / s.r.^{1})*	L = C + (J / s.r.^{2})*
		Revenue	
Revenue hd^{-1}	\$ hd^{-1}	D = wt. x price	M = wt. x price
Final animal weight	kg hd^{-1}	436	476
Gross Margin hd^{-1}	\$ hd^{-1}	E = D - C	N = M - L
Gross Margin ha^{-1}	\$ ha^{-1}	F = E x s.r.^{1}	O = (N x s.r.^{2}) / 2

*s.r.^{1} and s.r.^{2} are mean seasonal stocking rates for summer and stockpiled components, respectively.

Statistical Analyses

Data for gross margin were subjected to analyses of variance within years and systems with the Proc Mixed procedure of SAS (Littell et al., 1996). Treatment effects were declared significant at $P \leq 0.05$.

RESULTS AND DISCUSSION

Gross Margin

The 5-yr average gross margin hd^{-1} for the summer system was \$16 hd^{-1}, \$14 hd^{-1} and -\$32 hd^{-1}, and for the summer-stockpiled system \$56 hd^{-1}, \$97 hd^{-1} and \$11 hd^{-1} respectively for Default, Improved and Annual pastures. Significant differences among treatments occurred for 2 of 5 yr. for the Summer and 4 of 5 yr. for the Summer-stockpiled systems (Table 2).

Table 2. Gross margin per animal for Default, Improved and Annual pastures in summer and summer-stockpiled pasture systems during five years at Lacombe, AB.

Year	Default*	Improved	Annual	LSD**
		\$ hd^{-1}		
		Summer pasture system		
1999	37	46	-77	56
2000	34	16	-15	ns
2001	52	37	4	29
2004	-42	-30	-46	ns
2005	1	1	-28	ns
		Summer – stockpiled pasture system		
1999	97	149	-42	23
2000	73	86	37	ns
2001	75	117	44	42
2004	-19	49	5	45
2005	56	84	10	34

*Default is 30 to 37 yr-old grass pastures; Improved is 2 to 8 yr-old meadow bromegrass pastures; Annual is spring planted winter triticale-oat pastures.
**LSD indicates differences between means within rows with a significant F test $P \leq 0.05$.

The 5-yr average gross margin ha^{-1} for the Summer system was \$78 ha^{-1}, \$81 ha^{-1} and -\$161 ha^{-1}, and for the summer-stockpiled system \$74 ha^{-1}, \$261 ha^{-1} and \$108 ha^{-1} respectively for Default, Improved and Annual pastures. Significant differences among treatments occurred in 3 of 5 yr. for the Summer and all years for the Summer-stockpiled systems (Table 3).

Table 3. Gross margin per ha. for Default*, Improved and Annual pastures in summer and summer-stockpiled pasture systems during five years at Lacombe, AB.

Year	Default*	Improved	Annual	LSD**
		\$ ha^{-1}		
		Summer pasture system		
1999	189	270	-412	213
2000	174	114	-76	ns
2001	203	171	14	122
2004	-185	-157	-231	ns
2005	7	6	-119	90
		Summer – Stockpiled Pasture System		
1999	138	423	-104	63
2000	113	261	108	112
2001	81	267	96	96
2004	-19	96	8	59
2005	56	177	15	52

*Default is 30 to 37 yr-old grass pastures; Improved is 2 to 8 yr-old meadow bromegrass pastures; Annual is spring planted winter triticale-oat pastures.
**LSD indicates differences between means within rows with a significant F test $P \leq 0.05$

In the summer pasture system the Annual pastures had significantly higher annual seeding costs and higher animal costs due to fewer pasture days (Baron et al., 2008). This resulted in a negative gross margin hd^{-1} and ha^{-1}. Fewer pasture days affected costs two-fold. First, since cattle were purchased on the same day additional maintenance costs above the normal pasture costs were incurred; second, carrying capacity was reduced resulting in the higher pasture costs being divided by a smaller number of animal units ha^{-1}. Improved pastures had a slightly higher stocking rate than Default pastures, but Default pastures had a lower operating cost than Improved pastures. Thus, only small differences exited for gross margin between Improved and Default pastures in the Summer system.

In the Summer-stockpiled system, which was the summer pasture in sequence with a hay-stockpiled pasture component, hay revenue reduced the pasture cost (Baron et al., 2008). Stocking rate for the Default pasture was reduced by 53% compared to the Summer pasture due to relatively poor regrowth yields, while that of the Improved pasture was reduced by only 9%. This resulted in high revenues from the Summer-stockpiled Improved pasture on a per animal and area basis. Carrying capacity on the Summer-stockpiled Annual pasture increased compared to the Summer component allowing revenue to overcome costs, but not to the gross margin level shown by Improved perennial pastures (Tables 2 and 3).

Risk

Risk associated with pasture treatments was assessed using the assumptions of stochastic decision making (Hardaker et al., 2004).

1. Graphically one treatment dominates another when its' distribution clearly lies below and to the right of the alternative.
2. When overlap occurs one treatment dominates the alternative when the cumulative area below and to the right is larger than the alternative.

For the Summer system the Default and Improved pastures overlap completely, therefore they are equally risky. Both dominate the Annual pasture on an animal (Fig 2a) and area (Fig. 2b) basis. The two perennial pastures have a lower probability of monetary loss than the Annual pasture.

For the Summer-stockpiled system the Improved pasture clearly dominates the Default and Annual pastures on an animal (Fig 2a) and area (Fig 2b) basis and is the least risky choice based on the first assumption.

The Default pasture dominates the Annual pasture for the first assumption on an animal basis (Fig 2a) and for the second assumption on an area basis (Fig. 2b). The Improved pasture has the lowest probability of a loss, followed by the Default and Annual pastures.

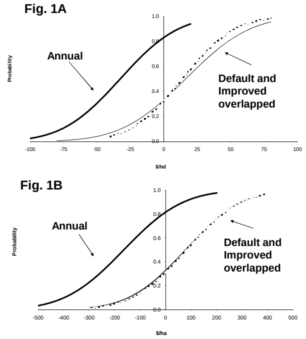

Figure 1. Cumulative probability functions of gross margin (A) hd^{-1} and (B) ha^{-1} for Default, Improved and Annual pastures in the Summer pasture system.

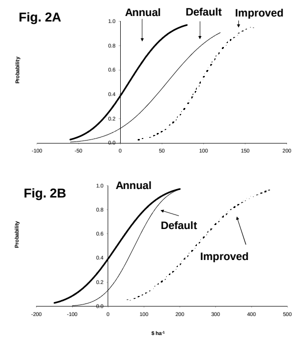

Figure 2. Cumulative probability functions of gross margin (A) hd^{-1} and (B) ha^{-1} for Default, Improved and Annual pastures in the Summer - stockpiled pasture system.

CONCLUSIONS

The research concludes that adoption of Improved perennial species is not more or less risky or more profitable than Default species when used for intensive pasture production during the traditional summer pasture period. However, when an Improved pasture species was combined with a stockpiled pasture component in sequence with a rotational summer pasture it dominated the other pasture treatments including Default and Annual species indicating less risk for pasture beef backgrounding, a lower probability for monetary loss and was more profitable.

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ACKNOWLEDGEMENTS

This research was funded by contributions from Agriculture and Agri-Food Canada Matching Industry Inititiative Fund, Sprucehaven Farms Ltd. Evansburg, AB and the Alberta Crop Industry Development Fund.

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