Technical Notes
Evaluation of dietary preference with a multiple latin square design

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Abstract

A sequential multiple latin square experimental design was evaluated as a tool for establishing dietary preference rankings. Dietary preference of 4 grasses was determined by a series of four 4 × 4 latin squares where rows were 4 days within a pen, columns were 4 locations of a grass within a pen, and treatments were 4 grasses. Each square (i.e., pen) utilized 1 lamb. Following the completion of trial 1, the most preferred grass was withdrawn and the 3 remaining grasses were further studied with a series of four 3 × 3 latin squares. This procedure was found to be a resource efficient and effective tool for preference ranking.

Key Words: intake, lamb, cool-season grasses, wheatgrass, foxtail, tall fescue

The primary value of a preference index is to rank various plants with regard to their palatability under a specified set of circumstances (Krueger 1972). Before seeding extensive areas to introduced grasses for complements to native range, it would be of value to determine preferences exhibited by livestock for the grasses under consideration. Preference may affect the extent to which the plants will be utilized (Truscott and Currie 1987). Preference evaluation of introduced grasses would be aided by a resource efficient ranking method. Latin squares have long been recognized as an effective, resource efficient experimental design and may provide a simple, economical preference evaluation procedure for use with complementary forages. Flexibility with the latin square can be increased by using multiple latin squares (Petersen 1985). We evaluated the efficiency of a sequential latin square design for ranking preferences of lambs for introduced grasses.

Methods

The study was conducted in an enclosed building at the Fort Keogh Livestock and Range Research Laboratory, Miles City, Montana. Four cool-season, perennial grasses were evaluated for preference by lambs to test the use of sequential multiple latin squares. Plots of mature, green 'Jose' and 'Orbit' tall wheatgrass (*Agropyron elongatum* (Host.) Beauv.), 'Garrison' creeping foxtail (*Alopecurus arundinaceus* Poir.), and 'Kenmont' tall fescue (*Festuca arundinacea* Schreb.) were mowed to a 5-cm stubble height and the material was chopped to a 5 cm length in August 1985. Four 4 × 4 latin squares were used initially to evaluate preference among the 4 species. In accordance with Cochran and Cox (1950) and Petersen (1985), the model for a combined analysis of variance of multiple squares is:

dependent variable = squares, rows in squares, columns in squares, treatments, error

For our study, we included the square * treatment interaction to obtain a better estimate of the error term in the event of a significant interaction. The following model resulted (Table 1):

Intake = pen, corner in pen, day in pen, grass species, pen * grass species, error.

The general linear model program (SAS 1985) was used for analyses. Each latin square consisted of 1 lamb in a pen, 4 corners of the pen, 4 days, and 4 grass species. Lamb weights averaged 24.5 kg at the beginning of trial 1. Each latin square was complete within a pen (2.1 × 2.4 m). Each grass was placed in a different predetermined corner of the pen such that each grass occupied a different corner each day to obviate potential position bias by the lambs. Water was maintained in a fixed location throughout each trial. Lambs were allowed free access to each grass species during a 7-day pretrial feeding period during which grasses were rotated through the 4 corners of each pen. Grass was provided and orts were collected morning and evening each day. Dry matter determinations (AOAC 1984) were made on grass and orts to obtain dry matter intake.

Following trial 1, the most preferred species was removed and a second trial conducted to evaluate the 3 remaining species. In trial 2, four 3 × 3 latin squares utilized the same model. Each latin square consisted of 1 lamb, 3 corners of the pen, 3 days, and 3 grass species.

Table 1. Analysis of variance tables.

	4 × 4 latin square		3 × 3 latin square	
Source of variation	d.f.	M.S.	d.f.	M.S.
Pen	3	3595.6	2	14190.6
Corner (pen)	12	3013.1	6	3250.7
Day (pen)	12	693.6	6	11269.2
Grass species	3	1083061.7	2	288061.7
Pen * grass species	9	6743.9	—[1]	————
Error	24	2544.5	10	24811.1

[1]Interaction nonsignificant (P = 0.31) in trial 2 and included in the error term.

Results and Discussion

In trial 1, corner (pen) and day (pen) were nonsignificant (P = 0.63 and 0.99, respectively). In trial 1, a significant pen * grass species interaction (P = 0.03) was the result of 1 lamb eating essentially 1 grass species only, 'Jose' tall wheatgrass, while the other 3 lambs indicated a strong preference for 'Jose' ($P<0.01$) but also ate significantly more 'Kenmont' tall fescue ($P<0.01$) than either 'Garrison' creeping foxtail or 'Orbit' tall wheatgrass (Table 2). In trial 2, the pen * grass species interaction was nonsignificant (P = 0.31) and was included in the error term. Pen, corner (pen), and day (pen) were nonsignificant (P = 0.58, 0.99, and 0.83, respectively). 'Kenmont' tall fescue was again highly preferred over 'Garrison' creeping foxtail and 'Orbit' tall wheatgrass in trial 2 (Table 3).

This procedure was an efficient tool for identifying a preference

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Table 2. Daily intake rates (g dm/day) with standard errors (SE) by pen and grass species, trial 1.

Grass	Pen 1	(SE)	Pen 2	(SE)	Pen 3	(SE)	Pen 4	(SE)
Jose	580	(31.0)	462	(67.0)	511	(3.9)	605	(25.0)
Kenmont	1	(1.0)	98	(43.7)	49	(20.5)	62	(10.9)
Garrison	0	(0.0)	11	(6.4)	3	(3.4)	23	(13.9)
Orbit	0	(0.0)	2	(1.3)	0	(0.0)	2	(2.2)
Total	581		573		563		692	

ranking of the grasses involved in this study. Time and resource requirements were minimal compared to previous preference evaluation studies conducted at Ft. Keogh. Currie et al. (1981) and Truscott and Currie (1987) had to establish single species, or variety, replicated plots of the grasses they evaluated. Multiple latin squares may be useful as well for evaluating preference on the basis of differences in leaf to stem ratio, leaf mass, protein levels, etc., within a given variety or species. The number of grass species or diets could easily be increased and still be effectively evaluated with this technique. Additional latin squares (i.e., lambs) could also be added. We concluded that sequential multiple latin squares was an economical, resource efficient and effective tool for studying diet preferences.

Table 3. Daily intake rates by grass species, trial 2.

Grass	g dm/day	(SE)
Kenmont	380	(38.4)
Garrison	147	(58.3)
Orbit	28	(13.1)
Total	555	

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