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Performance by Cattle and Sheep On Subclover-Grass Pastures

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THOMAS E. BEDELL

INTRODUCTION

Subterranean clover (*Trifolium subterraneum*) in combination with perennial ryegrass (*Lolium perenne*) or with Alta tall fescue (*Festuca arundinacea*) holds great promise for substantially increasing forage and animal production when properly managed (Figure 1). Under moderate to high phosphate levels and soil pH above 5.2 to 5.4, forage yields can consistently exceed three tons per acre. Because most of the land in the major areas of adaptation—western Oregon, western Washington, and north coastal California—are not suited to annual cultivation, appropriate types of grazing will constitute the greatest uses.

Research was designed to test various combinations of beef cattle and sheep use on subclover-perennial ryegrass and subclover-tall fescue mixtures in an effort to determine the degree of flexibility that a grazer might have in managing these kinds of forage mixtures. An earlier study indicated that cattle and sheep dietary preferences may differ when grazing these forage mixtures (Bedell, 1968). Cattle selected grass in preference to subclover with few exceptions. Sheep, on the other hand, preferred clover to tall fescue during the growing season but not during summer. On clover-ryegrass combinations, some grass was taken during the growing season but clover was preferred during the summer if it was available.

Dual or common-use grazing of these mixtures might offer more opportunity to efficiently harvest the forage than using a single kind of animal. Several studies indicate this possibility (Bond et al., 1968; Heinemann, 1969; Suckling, 1964, 1966; Van Keuren and Parker, 1967; Van Keuren et al., 1969). All of these studies revealed certain advantages to grazing both cattle and sheep over grazing either kind of stock alone.

During the spring and summer of 1967, 1968, and 1969 several combinations of dual use as well as single use were compared on the two forage mixtures at the Oregon Agricultural Experiment Station Adair Tract 12 miles north of Corvallis. A common stocking pressure was used. This bulletin reports animal performance from this experiment and presents recommendations for grazing these kinds of forage mixtures.



Figure 1. An improved subclover-perennial ryegrass dryland pasture grazed by steers and sheep together.

PROCEDURE

Six clover-ryegrass and six clover-tall fescue pastures, each $2\frac{1}{2}$ acres, were grazed with ewes and their twin lambs and yearling beef steers. Drinking water and trace-mineralized salt were continuously available.

Pastures were established in 1960 and 1961, and good stands of the seeded species resulted. Resident annual grasses, mainly ripgut brome (*Bromus rigidus*), soft chess (*Bromus racemosus*), and annual fescue (*Festuca myuros*), were intermixed throughout all pastures. Velvetgrass (*Holcus lanatus*) also was present but did not constitute an appreciable amount of forage.

Single superphosphate was applied at 250 pounds per acre (22 lbs. phosphorous, 30 lbs. sulfur) in the fall of 1966. Approximately 50 pounds phosphorus, 80 pounds potassium, and 18 pounds sulfur were applied per acre in the fall of 1967 in a mixture of single and treble superphosphate and muriate of potash. No fertilizer was applied in the fall of 1968, as the 1967 treatment was intended to last two growing seasons.

Sheep and cattle were combined on an animal unit equivalent basis. Animal unit (AU) conversion factors were: yearling steers = 0.7 AU, ewes = 0.2 AU, and lambs = 0.11 AU. Pastures were set-

stocked at an intensity designed to remove 80 to 90% of available forage by the termination of grazing in August. Clover-fescue produces about 15% more forage than clover-ryegrass, and the stocking pressure was set approximately 10% greater on clover-fescue.

The following grazing treatments were used:

Clover-fescue

- Cattle alone
- Cattle-sheep at 2:1
- Cattle-sheep at 1:1

Clover-ryegrass

- Sheep alone
- Cattle alone (not in 1967)
- Cattle-sheep at 1:2
- Cattle-sheep at 1:1
- Cattle-sheep at 2:1 (not in 1967)

Because lambs were weaned at varying times and the pasture size was fixed, the intended use ratios were only approximate.

Sheep from the OSU breeding flock were used all years, but cattle were purchased in March of each year. Ram lambs were not castrated; lambs averaged six weeks old at the beginning of the grazing period. All ewes were shorn prior to grazing. Sheep were treated for internal parasites at the beginning of the experiment in 1967 but not until mid-way into the season in 1968 and 1969.

Hereford steers were grazed in 1967 and 1968, but Hereford x Angus predominated in 1969. The steers were vaccinated for blackleg and treated for internal parasites at the beginning of the grazing period each year.

Animals were weighed individually in the morning. Weighing of lambs occurred at four-week intervals in the early season and at two-week intervals during the last few weeks prior to weaning. Cattle were weighed at the beginning and end of each season and at monthly intervals during each season. Animals could not be held off feed or water prior to weighing. When on dry forage, steers were pencil-shrunk 3% during the season and 2% at the termination of grazing. Lamb weights were not shrunk.

Species composition of the available forage was determined several times each session using the dry-weight rank method (Mannetje and Haydock, 1963). The amount of available forage was estimated by hand clipping. Forage samples were oven-dried and the amounts of forage available were expressed on a dry-weight basis.

Statistical analyses follow procedures outlined by Steel and Torrie (1960). In most instances, treatment effects were evaluated on a completely randomized basis.

RESULTS AND DISCUSSION

Forage Growth Pattern

Normally, sufficient rainfall occurs in September for tall fescue and perennial ryegrass to renew growth. Subclover and other annuals also germinate and become established at this time. With the cessation of moisture in late spring, the annuals (including subclover) die following seed-setting. Ryegrass becomes dormant due to moisture limitation and warm temperatures. Tall fescue is not summer dormant, although low soil moisture restricts its growth. The basal leaves usually remain green.

Forage growth conditions varied among the three years of the study. Sufficient fall moisture occurred for early renewal of perennial grass growth and establishment of annuals. Growth was exceptional during the fall of 1968 because an excessive rainfall in August (over 5 inches) was followed by warm temperature and continued moisture. The pastures were grazed each fall as part of normal and necessary management of these mixtures. Enough growth occurred in the fall of 1968 to sustain six ewes per acre safely from mid-September to mid-December.

Cool temperatures and saturated soils limit winter growth. Unusual snow and cold occurred in January and February of 1969. Onset of spring growth was later in 1969 than in 1967 and 1968. Late spring rain affects forage species composition differently, depending upon when the rain falls. Very little late spring rain occurred in 1967 and plant maturity followed a normal pattern. However, rain in late May and early June of 1968 stimulated a longer green forage period than usual, although it occurred somewhat too late to increase clover. In 1969 clover and ryegrass were nearly dry by mid-June when $2\frac{1}{2}$ inches of rain fell. The rain stimulated perennial grass regrowth, but it had a leaching effect on clover and other forage which was already dry, rendering it less desirable to grazing animals.

Animal Performance

Grazing cattle and sheep together at no time affected either kind of stock any differently than when they grazed separately. Steers and ewes would graze and spend idle time in close proximity.

1967. Ewes and twin lambs were put on pasture April 1. Lambs not previously reaching market weight and finish were weaned June 19. Steers commenced grazing April 11. Grazing of steers and ewes was terminated August 10.

The amount of actual use did not vary greatly among treatments (Table 1). Seasonal forage production varied, but by the season's end the differences were not large except for clover-fescue grazed by

Table 1. EFFECT OF GRAZING TREATMENT ON ANIMAL USE AND AMOUNT OF FORAGE REMAINING, 1967

Treatment	Cattle	Sheep	Total	Ratio (cattle: sheep)	Forage
<i>Clover-fescue</i>					
	<i>Animal unit days/A</i>				<i>lbs./A</i>
Cattle alone	219		219		2,110
Dual use					
2:1	156	85	241	1.84:1	960
1:1	109	109	218	1.0:1	930
Average			227		
<i>Clover-ryegrass</i>					
Sheep alone	16 ¹	180	196		760
Dual use					
1:1	108	108	216	1.0:1	675
1:2	62	145	207	.86:2	820
Average			209		

¹ One steer for three weeks in July.

cattle alone. Standards for use of these forage mixtures are not available, but repeated observations suggest about 700 pounds of dry forage per acre as a level below which animal performance may suffer. Using this criterion, only clover-fescue grazed by cattle alone could have sustained much additional use. With one animal unit day (AUD) at 25 pounds of forage, this treatment might have received 56 more AUD per acre. The other clover-fescue treatments could have received approximately 10 more AUD per acre.

In terms of grazing intensity relative to forage availability, some benefit resulted from grazing cattle alone but not sheep alone. On clover-ryegrass pastures more use was obtained by dual grazing than by sheep grazing alone, with little difference in the amount of forage remaining. Dual grazing clover-fescue at 2:1 was more beneficial than at 1:1.

Species composition was different as a result of different ratios of use. The higher the proportion of cattle, the more clover there was remaining, as cattle preferred grass to clover. Since clover has beneficial effects on grass growth and crude protein content through fixation of nitrogen as well as its own higher nutritive value, preferential removal by sheep can be considered detrimental.

Animal gain results in Table 2 show acceptable levels of performance regardless of treatment. Outstanding was clover-fescue grazed by cattle alone, likely due to availability of high quality forage. Although lambs gained well on all treatments, those from clover-fescue at 1:1 and clover-ryegrass with sheep alone gained less than those on

other treatments. Less preferred forage in these pastures during the latter part of the period before lambs were weaned may have affected lamb daily gain.

Gains per acre reflect daily performance and stocking intensity. Clover-fescue grazed by cattle alone clearly produced the greatest gain (Table 2). Poorest per acre performance occurred on the dual-grazed clover-ryegrass pastures. Although clover-fescue was stocked 10% heavier, gain per acre was 16% more than on clover-ryegrass. Gains under dual use were less than under single use.

Table 2. EFFECT OF GRAZING TREATMENT ON STEER AND LAMB GAINS, 1967

Treatment	Gains per day		Gains per acre		
	Cattle	Sheep	Cattle	Sheep	Total
<i>Clover-fescue</i>	<i>lbs.</i>	<i>lbs.</i>	<i>lbs.</i>	<i>lbs.</i>	<i>lbs.</i>
Cattle alone	2.45		715		715 ¹
Dual use					
2:1	1.91	.70	398	218	616
1:1	1.92	.64	281	314	595
Average	2.02	.67			628
<i>Clover-ryegrass</i>					
Sheep alone .....		.65		606	606
Dual use					
1:1	1.78	.76	233	260	493
1:2	2.00	.75	160	392	552
Average	1.89	.73			539

¹ Standard error, R/N = 22 pounds. Gain differences more than 45 pounds may be assumed to be significantly different ($P < .05$).

Although lambs were assigned to treatments at random, three of nine pastures had more lambs which were younger and lighter than the entire group. Since the criteria on lamb gain were based on weaning weights either when the lambs reached market weight or at a fixed date, the younger, lighter lambs were on pasture for a longer time period, resulting in more gain per lamb and per acre. The three pastures with younger and lighter lambs were replications of clover-ryegrass grazed by sheep alone and at 1:2 and of clover-fescue grazed at 2:1.

1968. Steers were put on pasture March 23 and 29; ewes and lambs went on pasture March 29. Lambs not reaching market weight were all weaned July 11. Ewes were removed July 21. Steers were removed from some pastures July 25, and the remainder were taken off August 9.

Approximately 12% more animal days of grazing were obtained from clover-fescue than from clover-ryegrass (Table 3). Some 25%

Table 3. EFFECT OF GRAZING TREATMENT ON ANIMAL USE AND AMOUNT OF FORAGE REMAINING, 1968

Treatment	Cattle	Sheep	Total	Ratio (cattle: sheep)	Forage
<i>Clover-fescue</i>					
	<i>Animal unit days/A</i>				<i>lbs./A</i>
Cattle alone	271	25 ¹	296		1,230
Dual use					
2:1	166	109	275	1.5:1	1,360
1:1	118	154	272	1.5:2	1,040
Average			285		
<i>Clover-ryegrass</i>					
Sheep alone		240	240		1,300
Cattle alone	234	60 ¹	294		900
Dual use					
1:2	66	166	232	1:2.5	1,600
1:1	116	151	267	.77:1	1,700
2:1	151	103	254	1.47:1	1,560
Average			254		

¹ Sheep moved from pastures with inadequate forage quality for gain.

more use was received on clover-fescue pastures in 1968 than in 1967; on clover-ryegrass the difference was 21%. 1968 was a heavy forage production season; as much as two tons of forage (dry-matter basis) per acre was available on some clover-fescue pastures in early June, even though they were fully stocked.

Lambs did not grow as rapidly in 1968 as in 1967, due possibly to incidence of internal parasites as well as preferential removal of clover in some pastures. Lamb gains were lower in clover-fescue pastures grazed at 1:1 and in clover-ryegrass grazed by sheep alone (Table 4). The clover component of the available forage was reduced to 5% by season's end in these pastures. Some 87% of the lambs grazing clover-fescue at 1:1 did not reach market weight by July 11. On the clover-ryegrass pastures grazed by sheep alone, 39% were feeder lambs (Table 4). Many lambs remained on pasture nearly three weeks longer in 1968 than in 1967 to increase the sheep component of the animal use data (Table 3). Lambs gained significantly more ($P < .01$) on dual-grazed clover-ryegrass and clover-fescue grazed at 2:1 than on clover-fescue at 1:1 and clover-ryegrass with sheep alone.

Steers gained nearly two pounds per day over the entire grazing period (Table 5). Data were analyzed to determine whether gains during summer (June 28-August 8) were different from gains during spring (March 23-June 28) as well as to determine whether gains differed among treatments within spring or summer periods.

Table 4. EFFECT OF GRAZING TREATMENT ON LAMB DAILY GAIN AND PERCENT OF LAMBS MARKETABLE, 1968

Treatment	Gain per day	Marketable by			
		May 31	June 10	June 21	July 11
<i>Clover-fescue</i>	<i>lbs.</i>	<i>%</i>	<i>%</i>	<i>%</i>	<i>%</i>
Dual use					
2:1 .....	.66	27	58	72	81
1:1 .....	.56	9	13	13	13
<i>Clover-ryegrass</i>					
Sheep alone .....	.54	18	30	52	61
Dual use					
1:2 .....	.68	36	63	67	76
1:1 .....	.62	27	47	80	87
2:1 .....	.62	17	42	59	84

Table 5. EFFECT OF GRAZING TREATMENT ON STEER GAINS, 1968

Treatment	Average daily gain		
	Spring	Summer	Overall
<i>Clover-fescue</i>	<i>lbs.</i>	<i>lbs.</i>	<i>lbs.</i>
Cattle alone	2.21	1.26 b ¹	1.94 ab ¹
Dual use			
2:1	2.00	2.56 a	2.12 a
1:1	1.68	2.62 a	1.96 ab
<i>Clover-ryegrass</i>			
Cattle alone	2.17	.22 c	1.59 b
Dual use			
1:2	2.36	2.06 b	2.29 a
1:1	2.11	.41 c	1.60 b
2:1	2.30	1.18 b	1.96 ab
Average	2.14	1.48	1.93

¹ Daily gains followed by different letters differ significantly, $P < .05$.

During spring no significant daily gain differences occurred, although a difference of .68 pound per day occurred between the slowest and fastest gaining groups (Table 5). The slowest gaining spring group was on clover-fescue grazed at 1:1. Sheep had seriously depleted the amount of available subclover, which may have affected steer performance either by the direct reduction in clover for dietary consumption or the indirect effect in reducing tall fescue growth and possible nutritive value through less fixation of nitrogen.

Normally steers would be taken off dryland pastures when inefficient gains occur. Steers were kept on pasture in 1968 beyond the

probable point of maximum daily performance in order to assess the extent of weight loss in relation to apparent forage quality. Stock were removed from some pastures when quantity of forage appeared to limit daily intake.

More steers lost more weight on clover-ryegrass pastures than on clover-fescue pastures in late July and early August. Gains were significantly different among treatments during the summer (Table 5). Steers on clover-fescue gained an average of 1.82 pounds per day compared to 0.76 pounds per day on clover-ryegrass ($P < .05$). Steers made acceptable summer gains on clover-ryegrass grazed at 1:2, but they were removed two weeks early (July 25). Also, steers on clover-fescue grazed at 2:1 were removed at this time, which may account for their higher gains (Table 5).

Spring gains were significantly greater ($P < .05$) than summer gains (2.14 as compared with 1.48 pounds per day). Over the entire grazing period, significant ($P < .05$) differences occurred among all treatments (Table 5). Steers gained 2.0 pounds per day on clover-fescue as compared to 1.8 on clover-ryegrass pastures ($P < .05$). Cattle under dual use made slightly more gain, 2.0 pounds per day, compared to single use, 1.85 pounds per day. Most of the gain difference was due to lowered summer performance on clover-ryegrass.

Gains per acre on clover-fescue were substantially greater (24%) than on clover-ryegrass (Table 6). Stocking rate on clover-fescue was only 12% greater. Clover-fescue grazed by cattle alone produced 767 pounds of gain per acre. Sheep alone on clover-ryegrass was the poorest treatment, 531 pounds per acre. Lambs were removed from clover-fescue 1:1 and clover-ryegrass sheep alone and 1:2 to the cattle alone treatments during late June and early July due to forage inadequate in quality to maintain gain. These lamb gains are added to those of cattle in the cattle alone treatments (Table 6).

1969. The grazing season was somewhat shorter than in 1967 and 1968. Lambs which had not reached market weight by June 20 were weaned at that time. Ewes were removed on June 27 in accordance with need for them in the breeding project. Steers were removed on July 20, as leaving them on pasture for a longer period would have resulted in weight losses.

Less grazing use was obtained than in previous years. Clover-fescue produced approximately 22% more grazing than clover-ryegrass (Table 7). Most pastures were grazed closely and, except for clover-ryegrass at 2:1, likely could not have sustained more use without detrimental effects on animal performance. On the basis of efficiency of the forage for gain, additional use on clover-ryegrass 2:1 would have had to be early in the season.

Table 6. EFFECT OF GRAZING TREATMENT ON STEER AND LAMB GAINS, 1968

Treatment	Gain per acre		
	Steer	Lamb	Total
<i>Clover-fescue</i>	<i>lbs.</i>	<i>lbs.</i>	<i>lbs.</i>
Cattle alone	739	28	767 a ¹
Dual use			
2:1	503	238	741 ab
1:1	325	348	673 c
Average			743
<i>Clover-ryegrass</i>			
Sheep alone		531	531 f
Cattle alone	526	87	613 de
Dual use			
1:2	216	441	657 cd
1:1	266	303	569 ef
2:1	434	256	690 bc
Average			598

¹ Gains per acre followed by different letters differ significantly, $P < .05$.

Table 7. EFFECT OF GRAZING TREATMENT ON ANIMAL USE AND AMOUNT OF FORAGE REMAINING, 1969

Treatment	Cattle	Sheep	Total	Ratio (cattle: sheep)	Forage
<i>Clover-fescue</i>	<i>Animal unit days/A</i>				<i>lbs./A</i>
Cattle alone	210		210		1,000
Dual use					
2:1	148	68	216	2.2:1	700
1:1	90	108	198	.83:1	730
Average			208		
<i>Clover-ryegrass</i>					
Sheep alone		162	162		960
Cattle alone	180		180		900
Dual use					
1:2	60	106	166	1.14:2	960
1:1	88	81	169	1.08:1	740
2:1	120	54	174	2.2:1	1,190
Average			170		

Lamb performance was affected significantly by grazing treatment (Table 8). Those treatments with the greatest sheep stocking pressures were the poorest producing. Subclover was generally not abundant and dried up rapidly. One clover-fescue pasture grazed for three years in sequence at 1:1 was so depleted of subclover by early June that the lambs were removed. Daily gains on this pasture for

Table 8. EFFECT OF GRAZING TREATMENT ON LAMB DAILY GAIN AND PERCENT OF LAMBS MARKETABLE, 1969

Treatment	Gain per day	Marketable by June 20
<i>Clover-fescue</i>	lbs.	%
Dual use		
2:1 .....	.63 a ¹	35
1:1 .....	.56 b	25
<i>Clover-ryegrass</i>		
Sheep alone .....	.40 c	0
Dual use		
1:2 .....	.44 c	0
1:1 .....	.52 b	9
2:1 .....	.63 a	38

¹Lamb gains per day followed by different letters differ significantly, $P < .05$.

April and May averaged only one-half pound. On clover-ryegrass pastures grazed by sheep alone and at 1:2, lamb gains averaged only .4 pound daily and these lambs also were removed in early June. Loss of clover (coupled with maturity of ryegrass) and tardy treatment for internal parasites appeared to be important factors contributing to this low gain. However, on treatments with all cattle or high cattle-low sheep, clover composition remained at a higher level and lambs did reasonably well. Those treatments with the highest daily gains also had a higher fat lamb percentage.

Steer gains during spring (March 28-June 27) were significantly different at the 10% level of probability, but the average daily gains on the two forage mixtures were not different (Table 9). Gains during summer (June 28-July 20) were quite variable; although gains were different in some treatments, none were statistically so. The level of steer gain did not seem to be associated with the amount of available forage.

Over the entire period (March 28-July 20), no differences occurred among treatments although gains differed by over one-half pound daily. Steers on clover-ryegrass maintained their gains during the summer in 1969 better than in 1968, perhaps due to the green-up of grass following late June rains. Some slight advantage in daily gain occurred with dual use as compared with single use, 1.69 to 1.61 pounds per day. But no overall gain difference occurred between forage mixtures.

Total production was less in 1969 than in 1967 and 1968 (Table 10). Animals grazing clover-fescue made about 35% more total gain than those on clover-ryegrass. Gain per acre varied significantly among

Table 9. EFFECT OF GRAZING TREATMENT ON STEER GAINS, 1969

Treatment	Average daily gain		
	Spring (3/28-6/27)	Summer (6/28-7/20)	Overall
<i>Clover-fescue</i>			
Cattle alone	1.75 ¹	1.08	1.66
Dual use			
2:1	1.79	0.79	1.65
1:1	1.69	1.01	1.60
Average	1.74	0.96	1.66
<i>Clover-ryegrass</i>			
Cattle alone	1.54	0.95	1.47
Dual use			
1:2	1.67	1.06	1.56
1:1	2.11	1.0	2.0
2:1	1.54	1.71	1.68
Average	1.72	1.18	1.64

¹ Spring gain LSD₁₀ = .35 pound per day.

Table 10. EFFECT OF GRAZING TREATMENT ON STEER AND LAMB GAINS, 1969

Treatment	Gain per acre		
	Steer	Lamb	Total
<i>Clover-fescue</i>			
Cattle alone	481		481 b ¹
Dual use			
2:1	333	196	529 a
1:1	200	284	484 b
Average			498
<i>Clover-ryegrass</i>			
Sheep alone		315	315 e
Cattle alone	363		363 d
Dual use			
1:2	133	223	356 d
1:1	238	198	436 c
2:1	272	158	430 c
Average			369

¹ Gains per acre followed by different letters differ significantly, $P < .05$.

treatments. All clover-fescue pastures promoted more gain than any clover-ryegrass treatment.

Greater differences in gain per acre occurred among clover-ryegrass than among clover-fescue treatments (Table 10). Some of the difference may be ascribed to stocking pressure, as some clover-ryegrass treatments could have received more grazing on the basis of

the amount of forage remaining (Table 7). Whether heavier stocking to achieve a greater degree of forage utilization would have resulted in greater gains is conjectural. The species composition of forage appears to be more important than the quantity available, especially for sheep.

Summary of Animal Performance

Stocking rates (animal use) over the three seasons are summarized in Table 11. The most grazing was obtained in 1968 and the least in 1969. Overall, clover-fescue pastures were stocked 12.4% heavier than clover-ryegrass; differences for 1967, 1968, and 1969 were 10, 9, and 22%, respectively. Although not a part of this study, both clover-fescue and clover-ryegrass forage mixtures supplied an additional 30 to 50 AUD of use per acre during the fall.

Table 11. EFFECT OF GRAZING TREATMENT ON ANIMAL USE, 1967-1969

Treatment	Animal unit days per acre				Ratio (cattle:sheep)		
	1967	1968	1969	Avg.	1967	1968	1969
<i>Clover-fescue</i>							
Cattle	219	296	210	242			
2:1	241	275	216	244	1.84:1	1.52:1	2.2:1
1:1	218	272	198	230	1:1	.77:1	.83:1
Average	226	281	208	238			
<i>Clover-ryegrass</i>							
Sheep	196	240	162	199			
Cattle		294	180	237			
1:2	207	232	166	202	.86:2	.8:2	1.14:2
1:1	216	267	169	217	1:1	.77:1	1.08:1
2:1		254	174	214		1.47:1	2.2:1
Average	206	257	170	212			

Gains varied among years more in some treatments than in others (Table 12). Steer gains on clover-fescue pastures varied little among treatments except for the higher gain in 1967 for the steer-only treatment. With clover-ryegrass forage, some advantage to steers was evident by combining sheep and cattle versus cattle alone. Steer gains on the 1:2 treatment were higher than on any other treatment for two of the three years. Little real difference occurred in steer daily gains among dual use treatments among years. Steer gains were higher on clover-fescue than on clover-ryegrass the first two years and the same in the third year. The difference was due to lowered summer gain on clover-ryegrass in 1967 and 1968. In 1969 steers gained slightly more on clover-ryegrass than on clover-fescue (Table 9), perhaps due to forage regrowth after late June rains.

Table 12. EFFECT OF GRAZING TREATMENT ON AVERAGE DAILY WEIGHT GAINS OF STEERS AND LAMBS, 1967-1969

Treatment	Steers				Lambs			
	1967	1968	1969	Avg.	1967	1968	1969	Avg.
<i>Clover-fescue</i>	<i>lbs./day</i>				<i>lbs./day</i>			
Cattle	2.45	1.94	1.66	2.02				
2:1	1.91	2.12	1.65	1.89	.70	.66	.63	.66
1:1	1.92	1.96	1.60	1.83	.64	.56	.56	.59
Average	2.02	2.00	1.64	1.91	.68	.61	.60	.63
<i>Clover-ryegrass</i>								
Sheep .....					.65	.53	.40	.53
Cattle		1.59	1.47	1.53				
1:2	2.00	2.29	1.56	1.95	.75	.68	.44	.62
1:1	1.78	1.60	2.00	1.79	.76	.62	.52	.63
2:1		1.96	1.68	1.82		.62	.63	.62
Average	1.89	1.86	1.68	1.79	.73	.61	.50	.60

Table 13. EFFECT OF GRAZING TREATMENT ON STEER AND LAMB GAINS, 1967-1969

Treatment	1967	1968	1969	Average
<i>Clover-fescue</i>	<i>pounds per acre</i>			
Cattle	715	767	481	654
2:1	615	741	529	628
1:1	595	673	484	584
Average	628	727	498	615 ¹
<i>Clover-ryegrass</i>				
Sheep	606	531	315	484
Cattle		613	363	488
1:2	552	657	356	522
1:1	493	569	436	499
2:1		690	430	560
Average	539	612	369	506

¹ P < .05, clover-fescue vs. clover-ryegrass.

With lambs, gain differences due to treatment were more clear-cut. Performance on clover-fescue was better at 2:1 than at 1:1 all of the years. On clover-ryegrass, performance was poorest when sheep grazed by themselves, approximately .10 pound per day less than under dual grazing. Only in the high cattle-low sheep treatments were lamb gains maintained over the three-year period. The light sheep stocking pressure in relation to cattle appeared to have more beneficial results for lambs than for cattle, although steers gained at respectable levels.

The greatest production per acre clearly occurred in 1968 and the poorest in 1969; significant ($P < .05$) variation occurred among the three years (Table 13). Over 21% more gain was obtained on clover-fescue as compared to clover-ryegrass, a significant increase ($P < .05$). This varied from 16% in 1967 to 35% in 1969. Because stocking intensity was also purposefully less on clover-ryegrass and as lamb gains and steer gains contributed differentially to the total gain figures, the yearly comparisons are more meaningful on a comparable treatment basis.

Averaged over the three years on both pasture mixtures, no difference occurred between gains under dual use versus single use, 559 and 542 pounds per acre, respectively. However, on clover-ryegrass some advantage occurred with dual use as compared with single use by either sheep or cattle (not in 1967). On clover-fescue the reverse tended to occur (not in 1969).

CONCLUSIONS AND RECOMMENDATIONS

Cattle and sheep grazing together can increase total weight gains consistently on clover-ryegrass but not on clover-fescue. The magnitude of weight increase per acre from 315 to 767 pounds indicates the high productiveness of subclover-grass mixtures. Flexibility in management provided by grazing both kinds of livestock not only may return more gain but also may achieve a more stable species composition from year to year. Hence, grazing animals can be used beneficially to manipulate species composition as well as to make productive use of the forage.

The amount of subclover in the available forage during April, May, and June largely determines lamb performance. Thus, grazing programs which promote or retain the greatest percentage of subclover in the forage crop will also be those from which sheep will exhibit highest production. High cattle performance appeared also to be associated with subclover in the forage, but this may be more through the effect of abundant clover on soil nitrogen status rather than as a direct contribution to the diet.

If tall fescue and perennial ryegrass are equally adaptable on a site, clover-fescue will produce from 10 to 15% more forage during the spring-summer period. In these experiments, 238 AUD or approximately 8 animal unit months (AUM) of grazing per acre were obtained on clover-fescue pastures, 12% more than the 212 AUD or 7 AUM per acre on clover-ryegrass. An average of 21% more weight gain was achieved on clover-fescue than on clover-ryegrass (615 as compared to 506 pounds per acre).

The kind of grazing treatment is important. To achieve and maintain adequate gains on clover-fescue and at the same time not seriously

deplete the clover population, either cattle-only or a high cattle-low sheep ratio seems best. On the basis of these experiments, clover-fescue grazed at 1:1 produced adequate lamb and steer gains in its first year, but the total performance may suffer when this treatment is continued for more than one season. Sheep appear to have inadequate amounts of preferred forage in late spring to maintain satisfactory levels of gain. Adequate gains along with a greater degree of forage stability occurred when sheep numbers were either low or absent.

More management flexibility appears feasible with clover-ryegrass than with clover-fescue forage mixtures. Some cattle use on clover-ryegrass in addition to sheep use is desirable but not mandatory in order to harvest the forage crops. In terms of animal production, dual use was superior except for one year, and the differences than were slight.

Sheep, as a single kind of stock, are commonly grazed on clover-ryegrass in western Oregon. Sheep will preferentially reduce the clover component as spring advances. Clover may be reduced so low that lambs will not achieve market weight or finish. In these experiments, this occurred on the sheep-only and 1:2 treatments. On the remaining dual use treatments (1:1, 2:1), lambs gained relatively well and fewer lambs failed to achieve market finish.

Cattle gains through late June are comparable on the two forage mixtures. However, under the normal dry summer conditions, gains will decline more on clover-ryegrass than on clover-fescue. It is doubtful whether livestock producers could afford the low gains on clover-ryegrass; consequently, cattle should not be expected to make good gains on clover-ryegrass during the summer.

Should a livestock operator possess both cattle and sheep and both forage mixtures, the following grazing plan may be workable as synthesized from the results of these experiments: Clover-ryegrass pastures could be alternately grazed between years at cattle:sheep animal unit ratios of 1:2 and 2:1; clover-fescue pastures could be stocked at 2:1.

Approximately mid-June, all cattle could be placed on clover-fescue and all sheep on clover-ryegrass. This procedure should allow cattle to continue to gain on clover-fescue. After lambs are weaned, there should be enough ewes on pasture to adequately remove the dry clover-ryegrass herbage, insuring a desirable environment for sub-clover germination and establishment in the fall.

The clover-ryegrass forage mixture establishes sooner and more easily than clover-fescue on many of the steep slopes in western Oregon. Also, sheep graze the slopes more uniformly than cattle. Hence, results with clover-ryegrass may be more applicable and dual use more beneficial than single use. Should a livestock operator prefer not

to run cattle and sheep together, clover-ryegrass pastures grazed by sheep or by cattle could be alternated among years.

The nature of the forage growth pattern, with approximately one-half of the growth occurring in May, makes uniform harvesting by grazing quite difficult unless grazing is concentrated. A common practice is to concentrate grazing use during May and June and to harvest a hay or silage crop on areas not grazed. This has resulted in relatively high subclover populations.

Until further research and demonstration indicate optimum stocking levels, managers should graze livestock in a way as to promote the highest possible subclover composition. In these experiments, continued grazing of clover-fescue at 1:1 and clover-ryegrass by sheep only or 1:2 were the grazing procedures least likely to achieve desirable results.

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ABSTRACT

Subclover-perennial ryegrass and subclover-tall fescue forage mixtures are both capable of high forage production, but the kind of grazing each receives strongly determines the level of animal production. When yearling steers and lambs were grazed from late March to early August, weight gains approximated 100 more pounds per acre from clover-fescue than clover-ryegrass each year over a three-year period.

Several grazing treatments were tested. These included cattle and sheep alone and cattle:sheep animal unit ratios of 1:2, 1:1, and 2:1 on clover-ryegrass, and cattle alone and at 2:1 and 1:1 on clover-fescue. Stocking rates were approximately 10% higher on clover-fescue than on clover-ryegrass because the fescue mixture normally produces about 15% more forage. Yearling steers and ewes with twin lambs grazed continuously at levels designed to remove most of the available forage.

Total per acre weight gains varied from 315 pounds with lambs alone on clover-ryegrass in 1969 to 767 pounds with steers alone on clover-fescue in 1968. Daily gains of steers averaged slightly more on clover-fescue (1.91 pounds) than on clover-ryegrass (1.79 pounds) but varied among grazing treatments and among years. Lamb daily gains also varied among years but were consistently lower on clover-fescue grazed at 1:1 and on clover-ryegrass grazed at 1:2 and by sheep alone.

Weight gains per acre on clover-fescue were greater with cattle alone (654 pounds) and dual use at 2:1 (628 pounds) than with dual use at 1:1 (584 pounds) because sheep prefer clover to tall fescue, and clover was more rapidly depleted both within and among seasons on the 1:1 treatment. On clover-ryegrass lower per acre gains occurred by grazing either sheep or cattle alone (486 pounds) as compared to the dual use treatments (527 pounds).

When production was averaged over three years on both pasture mixtures, there was no advantage to dual use over single use. But, for clover-ryegrass some advantage accrued to using cattle and sheep over either kind of stock alone. Clover in the forage mixture declined among years when grazed by sheep alone or on the high sheep-low cattle treatments. This lowered lamb gains. With one exception (1969) on clover-fescue, per acre gains were always highest when grazed by cattle alone as compared to sheep and cattle together.

Key words: Grazing, performance, sheep, cattle, pasture, subclover, ryegrass, fescue.