

The Effect of Cutting Frequency on the Persistence and Dry Matter Yield of Some Grasses and Legumes Seeded Alone or in a Complex Pasture Mixture

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INTRODUCTION

The seedling vigor of each forage species in the mixture has an important influence on its actual stand, its botanical composition as well as the relative percentage of productive species and weeds. The undesirable but aggressive species may compete with desirable ones and reduce their stand. They may, themselves go out of stand, leaving the voids susceptible to weed invasion. The aggressiveness of the species may be due to their size, number and longevity, rate of germination, rate of growth and tolerance to unfavourable environments (9). The simple and complex mixtures were found to be infested with weeds six years after establishment (3). Perennial ryegrass seemed to take over all voids left by orchardgrass and timothy (2).

Dry matter yields in pure stands were highest for orchardgrass followed by tall fescue, bromegrass and perennial ryegrass. Also timothy yields were highest followed by redbud, bromegrass or orchardgrass (4,5,7).

Cutting frequency has a pronounced effect on the yield of grasses. Orchardgrass was higher-yielding than timothy and bromegrass under three and five cuttings (8). Perennial ryegrass yielded twice as much under long intervals of 30 days than under short intervals of 10 days (1).

MATERIALS AND METHODS

Two experiments, one in April 1959 and the other in April 1960 were planted at Ohio State University Agronomy farm at Columbus, Ohio, U.S.A. The treatments were a complex mixture and its components (Table 1). There were 12 forage crops harvested three or four times during the growing season. Cutting frequency was used in the main plots and forage crops in the sub-plots of the split plot experiment with four replications.

The Legumes were band seeded, placing 280 kg/ha of 0-20-20 fertilizer. The grasses were broadcast seeded and fertilized with 144 kg/ha of ammonium sulphate and 280 kg/ha of 0-20-20, ploughed down before seeding. Sub-plots were 2.14 × 7.34 m in 1959 and

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Table 1 Seeding rates of the complex pasture mixture and its components with their percentages by weight in seed of complex mixture.

Species	Seed Rate	Percent Seed in Mixture
1. Complex pasture mixture	13.64	100
2. Tall fescue (<i>Festuca arundinacea</i>)	3.64	24
3. Perennial ryegrass (<i>Lolium Perenne</i>)	4.55	20
4. 'Lincoln' smooth brome grass (<i>Bromus inermis</i>)	3.46	18
5. Orchardgrass (<i>Dactylis glomerata</i>)	2.73	14
6. Timothy (<i>Phleum pratense</i>)	1.37	9
7. Kentucky bluegrass (<i>Poa pratensis</i>)	2.27	1
8. Redtop (<i>Agrostis alba</i>)	0.91	1
9. Rough bluegrass (<i>Poa trivialis</i>)	2.27	1
10. 'Ladino' white clover (<i>Trifolium repens</i>)	0.91	4
11. White Dutch clover (<i>Trifolium repens</i>)	0.91	3
12. 'Kent' white clover (<i>Trifolium repens</i>)	0.91	1
13. 'Empire' birdsfoot trefoil (<i>Lotus corniculatus</i>)	2.73	—
14. 'Viking' birdsfoot trefoil (<i>Lotus corniculatus</i>)	2.73	—

1.83 × 7.34 m in 1960. No harvest was taken in the seeding year. The harvest treatments were four times (June 1, July 1, August 1, and September 1) and three times (June 10, July 23 and September 10) during the growing season.

The botanical composition of each plot was determined at each harvest date by visually estimating the legume and grass components in the complex mixture. A strip was harvested by a National 3ft sickle bar mower from the center of each plot and the green weight was recorded. Moisture samples were taken, weighed and dried by forced air at 60°C and dry matter was calculated. These data were analyzed by procedures given by Steel and Torrie (6).

Table 2 Stand percentage recorded in May, 1960, of complex pasture mixture and individual components of mixture, seeded in April, 1959.

Species	Percentage of Stand
1. Complex pasture mixture	80
2. Tall fescue	70
3. Perennial ryegrass	100
4. Smooth brome grass	100
5. Orchardgrass	100
6. Timothy	40
7. 'Kentucky' bluegrass	30
8. Redtop	0
9. Rough bluegrass	0
10. 'Ladino' white clover	100
11. White Dutch clover	80
12. 'Kent' white clover	50
13. 'Empire' birdsfoot trefoil	90
14. 'Viking' birdsfoot trefoil	100

RESULTS AND DISCUSSION

The stands established from the 1959 planting were poor for some species because of low rainfall. Establishment of redtop, *Poa trivialis*, and Kent white clover was definitely inferior. The stands established from the 1960 planting were excellent (data not presented).

Botanical Composition

At the time of the first harvest in 1960, from stands established in 1959, perennial ryegrass was the most predominant species of the sward. The contribution of this grass was, however, reduced with each subsequent harvest from a high of 50% down to 20% in the mixture. The percentage of Orchardgrass increased as the season advanced under both harvest systems. The percentage of tall fescue remained nearly constant in the four-harvest system but increased much in the three-harvest system. The percentage of smooth brome grass remained nearly constant under both harvest systems. The legume content was negligible to zero under both harvest systems (Table 3).

In 1961, perennial ryegrass was the most predominant species before the first harvest but was completely eliminated afterwards. This trend was also noticeable in 1960. Orchardgrass percentage was highest in the second harvest and decreased later in the season under both harvest systems. Tall fescue percentage increased with the season but formed a major part of the stand in three harvests only (Table 4).

DRY MATTER YIELDS

In 1960, the average dry matter yield (combining both harvest systems) of single species was found to vary from 3.40 tons per hectare for Kentucky bluegrass to 12.10 tons per hectare for Empire birdsfoot trefoil. In comparison, the dry matter yield of complex Mixture was 8.33 tons per hectare.

The species ranged from 3.33 tons per hectare to 12.35 tons per hectare under the three-harvest system; as compared to 7.80 tons per hectare for Complex Pasture Mixture (Table 4).

Table 3 Botanical composition of complex pasture mixture recorded prior to each harvest date under two systems of harvest.

Harvest Species	1960 <i>Four Harvests</i>				1961 <i>Three Harvests</i>		
	1	2	3	4	1	2	3
Perennial ryegrass	50	40	30	20	50	30	20
Orchardgrass	15	25	30	35	15	30	30
Tall fescue	15	10	15	20	15	20	30
Smooth brome grass	15	15	20	20	15	15	20
Legume	5	5	5	5	5	5	0
Perennial ryegrass	30	0	0	0	40	0	0
Orchardgrass	18	77	60	60	30	60	43
Tall fescue	18	55	26	19	20	28	46
Smooth brome grass	10	9	8	8	5	3	0
Legume	4	9	6	11	0	5	6

Table 4 The yield of dry matter of complex pasture mixture and its individual components under two systems of harvest (tons/ha).

Harvests Species	1960			1961		
	Four	Three	Average	Four	Three	Average
Complex pasture mixture	7.80	8.85	8.33	9.55	12.68	11.13
Tall fescue	7.33	9.15	8.25	11.68	10.80	11.25
Perennial ryegrass	5.20	6.00	5.60	8.60	6.70	7.65
Smooth brome grass	12.48	9.28	10.88	11.30	9.93	10.63
Orchardgrass	9.30	8.10	8.70	9.48	10.95	10.23
Timothy	4.90	5.75	5.33	9.50	9.38	9.43
Kentucky bluegrass	3.33	3.58	3.40	7.68	9.48	8.58
Ladino white clover	9.48	8.58	9.03	9.53	10.45	9.98
White Dutch clover	8.58	5.60	7.10	10.00	11.38	10.53
Kent white clover	7.05	6.08	6.58	—	—	—
Red top	—	—	—	8.28	8.63	8.45
Poa trivialis	—	—	—	6.63	7.73	7.18
Empire birdsfoot trefoil	12.35	11.83	12.10	—	—	—
Viking birdsfoot trefoil	11.70	11.40	11.55	—	—	—
Harvest average	8.08	6.73	7.95	9.28	9.83	9.55

— = not included or did not establish (see text), the number followed by the same letter are not significantly different ($P = .01$).

The average dry matter yield of all crops under four-harvest was 8.08 tons per hectare and under three-harvests was 6.73 tons per hectare. The average dry matter yield of legume taken as whole was 9.25 tons per hectare as compared to 6.88 tons per hectare for grasses. Complex Pasture Mixture yielded 8.33 tons per hectare dry matter as compared to 7.93 tons per hectare for the single species (Table 5).

There was no significant difference due to harvest treatment in 1960 but the species and the species $\times$ harvests was highly significant. Pure stands of brome grass 'Empire' birdsfoot trefoil, 'Viking' birdsfoot trefoil, 'Ladino' white clover, white dutch clover and orchardgrass were significantly better than the complex mixture under the four-harvest system. Under the three harvest system, only the trefoils were better than the complex pasture mixture and tall fescue, brome grass, orchardgrass and Ladino clover were similar to it in yield of dry matter (Table 4).

In 1961 the dry matter yield varied from 6.63 tons per hectare for *Poa trivialis* to 11.68 tons per hectare for tall fescue under four harvests, and from 6.70 tons per hectare for

Table 5 Dry matter yield of complex pasture mixture and pure species under two systems of harvest (tons/ha).

Species	1960			1961		
	4	3	Average	4	3	Average
Complex pasture mixture	7.80	8.85	8.33	9.55	12.68	11.13
Pure species	8.10	7.70	7.93	9.25	9.50	9.40
Grasses	6.68	6.98	6.83	9.15	9.20	9.18
Legumes	9.83	8.70	9.25	9.75	10.90	10.33
Average	8.08	6.73	7.95	9.28	9.83	9.55

perennial ryegrass to 12.68 tons per hectare for complex pasture mixture for three harvests (Table 4).

The dry matter yield of grasses was 9.18 tons per hectare and that of legume was 10.33 tons per hectare. The combination of all pure species yielded 9.40 tons per hectare, as compared to 11.13 tons per hectare for the complex pasture mixture. Dry matter yield of pure species for four harvests averaged 9.28 tons per hectare as compared to 9.83 tons per hectare for three harvests (Table 5).

The difference between Complex Pasture Mixture and the pure species was highly significant. While harvest systems and harvest $\times$ species were not significant ($p = .01$), complex pasture mixture was superior to the average yield of all grasses and legumes.

The Complex Pasture Mixture was not significantly different ($P = .01$) from tall fescue, smooth brome grass, white Dutch clover, orchardgrass, Ladino clover, or timothy. Perennial ryegrass, *Poa trivialis*, Kentucky bluegrass and redtop were inferior to complex pasture mixture, as well as to tall fescue, smooth brome grass and white Dutch clover in dry matter production.

Perennial ryegrass which formed about half of the sward under both harvest systems in both years was reduced in subsequent harvests gradually in 1960 but abruptly in 1961. In 1960, it was reduced due to the competition from other equally aggressive grass species better adapted to a high temperature. One of these grasses is Orchardgrass which contributed more as the season advanced under both harvest systems. This grass was equal in aggressiveness to tall fescue under three harvests but more aggressive under four harvests again perhaps due to its heat tolerance. It was also more aggressive than brome grass and legumes under both harvests and in both years — as determined by its percentage in stand.

Among the grasses perennial ryegrass and Kentucky bluegrass were the poorest in dry matter production in both years. This was probably due to high temperatures during the summer. A large percentage of the seed of complex pasture mixture was perennial ryegrass (20%) an aggressive grass that yields poorly at high temperatures. This did much to counterbalance the higher yielding grasses such as orchardgrass, smooth brome grass and tall fescue. Inferior yielding grasses like *Poa trivialis* redtop, Kentucky bluegrass and Timothy were the least contributors to the complex pasture mixture. This would indicate that a few well chosen species will definitely produce higher yields than a mixture of many species.

SUMMARY

1. There was no observable advantage of the complex pasture mixture over the high yielding pure species for dry matter production.

2. Out of the 11 species included in the complex pasture mixture, only perennial ryegrass, tall fescue, orchardgrass and a small percentage of smooth brome grass and legumes were established. Following the first harvest, ryegrass which comprised 50% of the original stand was largely replaced by other grasses.

3. Orchard grass, perennial ryegrass and tall fescue were more aggressive than smooth brome grass in the complex mixture but were not high yielders in pure stands.

4. Kentucky bluegrass, redtop, *Poa trivialis* and perennial ryegrass were lower yielding in pure stands.

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