COMPARISON OF OATS AND ANNUAL RYEGRASS AS WINTER FORAGE CROPS

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ABSTRACT

Forage crops of Wimmera annual ryegrass (Lolium rigidum), *Saia oats* (Avena strigosa) *and Algerian oats* (Avena sativa) *were compared for production during winter in four field experiments on the mid north coast of N.S.W. Each species was studied at four nitrogen rates;* 0, 34, 67 *and* 100 *kg* ha^{-1}*N applied at sowing and after each harvest. Ryegrass was sown at three different rates.*

The main difference between species was the greater early growth rates of oats and this was responsible for a greater total yield from oats than ryegrass. Saia oats produced higher yields than Algerian. Ryegrass took two to four weeks longer than oats to the first grazing after sowing, but from then on growth rates were similar for each species. Yields of ryegrass were not increased by sowing rates greater than 28 *kg* ha^{-1}*. The results indicate that the optimum level of nitrogen was a rate of* 67 *kg* ha^{-1}*N per harvest. This was required on soils with a high nitrogen content to ensure high forage yields and on soils with a low nitrogen level to ensure an adequate protein content as well as maximising yields.*

It was concluded that annual ryegrass is a lower cost alternative winter forage crop to oats except in the case where forage is required as soon as possible after sowing. Saia oats is then the preferred species.

INTRODUCTION

The provision of adequate quantities of quality feed for cattle during winter is a major problem confronting farmers and graziers along the subtropical east coast of Australia. Pastures in this area are dominated by tropical grasses such as carpet grass, paspalum and kikuyu, species that produce very little forage in winter. Attempts to fill in the winter feed gap by sowing pastures of perennial temperate grasses have invariably failed, unless irrigation is available, due to an unfavourable environment for such species (Gartner 1965; Humphreys 1969; Jones and Rees 1972).

The most successful approach to this problem has been to annually sow forage crops of temperate species such as oats (Crofts 1959; Gartner 1965; Colman 1966; Macadam 1968; Humphreys 1969).

In the Manning district of N.S.W. (lat. 32°S) at the southern end of the subtropics, ryegrass cultivars have on occasions been used as winter forage crops and have gained favour as alternatives to oats, as they are easier to manage, especially in wet situations, and the seed cost is less.

However, Crowder, Sell and Parker (1955) and Burton and Prine (1958) in the southern U.S.A., and Crofts (1965, 1966) at Camden N.S.W. have shown that ryegrass is inferior to oats for winter herbage production. These comparisons have only involved perennial ryegrasses. Annual ryegrasses appear to be a more logical choice than perennial ryegrass for winter forage crops as Davidson (1964) found that annual ryegrasses were superior to perennial ryegrasses in herbage production during their first year of growth in the Riverina of N.S.W.

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This paper reports a series of experiments designed to evaluate the herbage production and response to nitrogen of oats and annual ryegrass over the period from June to September, the main period of low forage availability.

EXPERIMENTAL

Sites

Field experiments were sown in the Manning district of the mid-north coast of N.S.W., two in 1968 and two in 1969. In each year, one experiment was sown on a soil of high fertility and one on a soil of low fertility. Details of the experimental sites are shown in Table 1.

TABLE 1

Details of experiment sites

Experiment	Sowing date	Location‡	Soil	p.H (1:2)	P Bray No. 1 ppm	Total N %	Exchangeable K $\mu e\%$
1*	23.iv.68	Coralville	Deep, well structured loam	5.3	43	0.36	0.45
2	26.iv.68	Cundletown	Shallow, poor structured clay	5.3	14	0.10	0.45
3*	21.iv.69	Coralville	Deep, well structured loam	5.3	34	0.30	0.16
4	30.iv.69	Killawarra	Shallow, gravelly clay	5.6	8	0.17	0.20

*Experiments 1 and 3 were 50 m apart.
‡Coralville, Cundletown and Killawarra are respectively 30 km north, 3 km north and 18 km west of Taree.

Climate

Temperature and rainfall at Taree for 1968 and 1969 are shown in Figure 1. In general, temperature and rainfall in 1968 were below average, while 1969 was characterised by above average temperatures and good rainfall. The sites at Coralville received 10 to 20% more rain than the other sites.

Design

Each experiment consisted of two replications of a factorial involving 5 species —sowing rate combinations × 4 nitrogen rates as listed below:

(i) Species/sowing rate:
Saia oats (*Avena strigosa*) @ 135 kg ha^{-1}
Algerian oats (*A. sativa*) @ 180 kg ha^{-1}
Ryegrass (*Lolium rigidium* cv Wimmera) @ 28, 56 and 84 kg ha^{-1}.

Saia and Algerian oats were sown at rates recommended for the Manning district. There was no information on appropriate sowing rates for Wimmera ryegrass and hence several rates were used, based on farmer experience.

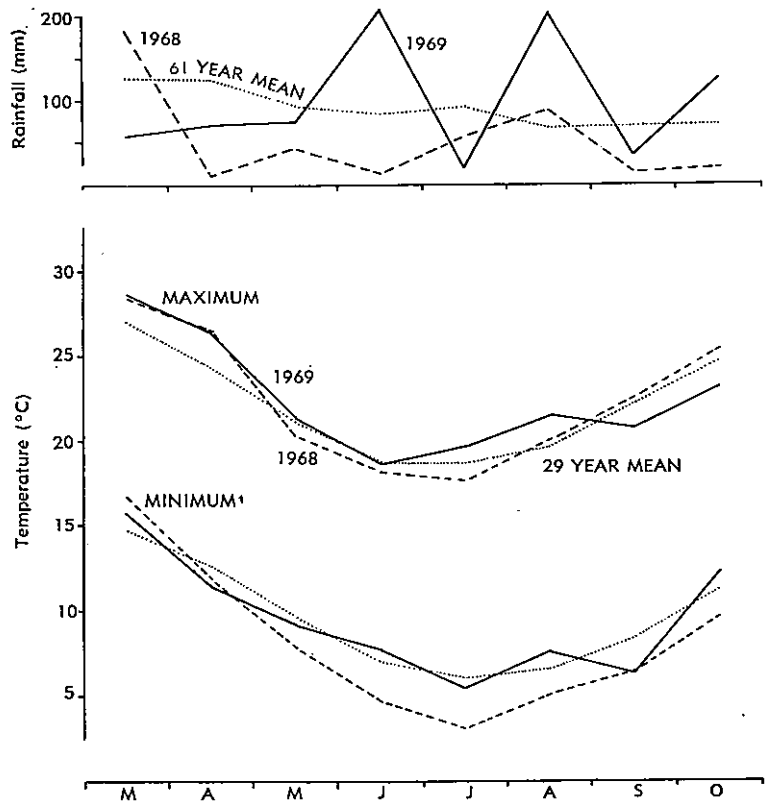

FIGURE 1
Rainfall and temperatures at Taree in 1968 and 1969.

(ii) Nitrogen:
0, 34, 67 and 100 kg ha^{-1}N (N_0, N_{34}, N_{67}, N_{100}) as ammonium nitrate applied at sowing and after each harvest.

Individual plots were 1.8 m × 6.25 m and the experiments were laid out as randomised blocks.

Procedures

The experiments were sown during April each year onto a prepared seed bed, by broadcasting the seed followed by raking then rolling. The sowing dates are shown in Table 1. At sowing all plots received a basal fertilizer dressing of 448 kg ha^{-1} molybdenum superphosphate and 112 kg ha^{-1} potassium chloride plus the appropriate nitrogen treatments.

All plots in each experiment were sampled whenever the faster growing plots reached the stage where they would normally be grazed. This was 30 to 35 cm for oats and 20 to 25 cm for ryegrass. A sample strip 0.91 m × 4.45 m was cut with an autoscythe to a height of 7 cm from the centre of each plot, weighed green and a 0.45 kg subsample taken for dry matter and nitrogen analysis. Sub-samples were dried in an oven at 80°C for 20 hours. Replicates were bulked for each treatment for nitrogen analysis at each harvest. After sampling the whole plot was mown to 7 cm, the surplus material removed, and the appropriate amounts of nitrogen applied.

RESULTS

Species dry matter yields

The total dry matter yields of each species at each sowing rate are shown in Table 2.

TABLE 2

Dry matter yield and nitrogen content of oats and ryegrass (mean of four nitrogen rates) —% nitrogen in brackets

Species	Sowing rate kg ha^{-1}	Experiment* 1. Coralville, 1968	2. Cundletown, 1968	3. Coralville, 1969	4. Killawarra, 1969
		kg DM ha^{-1}			
Saia Oats	135	4355(3.8)	2035(2.2)	3670(2.7)	5070(2.7)
Algerian Oats	180	3585(3.7)	1390(2.5)‡	2900(2.7)	3680(2.8)
Ryegrass	28	2870(3.8)	1490(2.8)‡	2600(2.8)	3860(2.6)
Ryegrass	56	3050(3.7)	1340(2.8)‡	2950(2.8)	3770(2.4)
Ryegrass	84	2550(3.7)	1610(2.7)‡	2780(2.6)	3990(2.6)
SE		350	230	260	400
LSD (P = 0.05)		730	480	550	840

*Total yield of 3 harvests in experiments 1, 2 and 3, and four harvests in experiment 4.
‡No nil nitrogen samples analysed.

Saia oats produced significantly ($P < 0.05$) more forage in each experiment than the other species while differences between Algerian oats and ryegrass were largely non-significant.

There was no increase in dry matter yields from sowing rates of Wimmera ryegrass in excess of 28 kg ha^{-} , hence the results for that sowing rate have been used in presenting further results.

Response to nitrogen

The total dry matter yields of each species, in each experiment, in response to nitrogen are shown in Figure 2.

The pattern of response to nitrogen was in general similar for each species in any one experiment but varied between experiments depending largely on site and year. In the dry year 1968. there was a smaller response to nitrogen than in the

TABLE 3

Mean per cent nitrogen in forage samples for each experiment at each nitrogen rate —mean of oats and ryegrass

Experiment	Nitrogen Rate N_0	N_{34}	N_{67}	N_{100}
	N%			
1. Coralville '68	3.1	3.4	3.9	4.1
2. Cundletown '68	1.7*	2.1	2.6	3.1
3. Coralville '69	2.5	2.4	2.8	3.1
4. Killawarra '69	2.2	2.3	2.9	3.4

*Saia oats only.

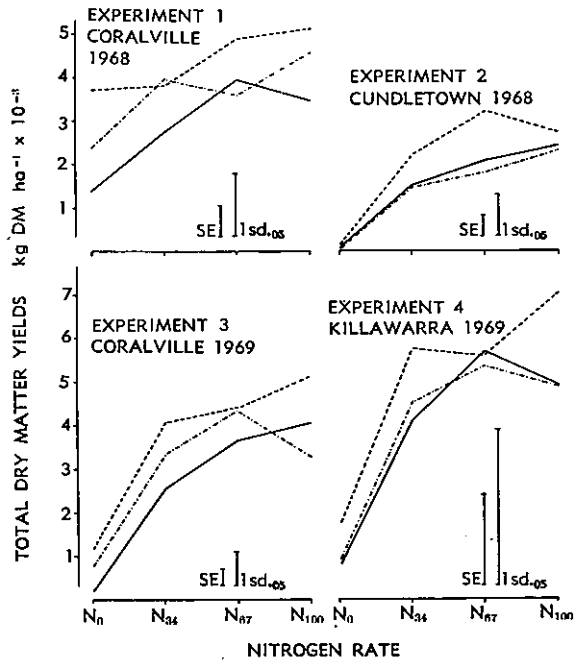

FIGURE 2
Response to nitrogen by oats and ryegrass in each experiment; --- Saia oats, —·— Algerian oats, ——— ryegrass.

wet year 1969. Forage yields in 1968 were greater on the more fertile site but this was not so in 1969. In no experiment were dry matter yields significantly increased by applications of nitrogen in excess of the N_{67} rate.

Nitrogen content and apparent recovery

The mean nitrogen content of each species in each experiment is shown in Table 2. Differences between species were few and inconsistent. The major factors influencing nitrogen content were nitrogen rate and site and this is shown in Table 3.

The nitrogen content of the herbage increased with nitrogen rate. Higher nitrogen contents were recorded in experiments 1 and 3 in response to the higher soil nitrogen levels.

Seasonal growth

The seasonal growth of each species from sowing for each experiment is shown in Figure 3. The mean growth rate for each species over each harvest period is plotted at the mid point of each harvest interval.

In the first growth period from sowing, the oats, particularly Saia oats, grew faster than ryegrass in each experiment. During the second and later harvest periods the growth rate of ryegrass was not significantly different to that of Algerian or Saia oats in each experiment except for the final harvest in experiment 4. Yields from Saia oats were higher at that time due to plants coming into head.

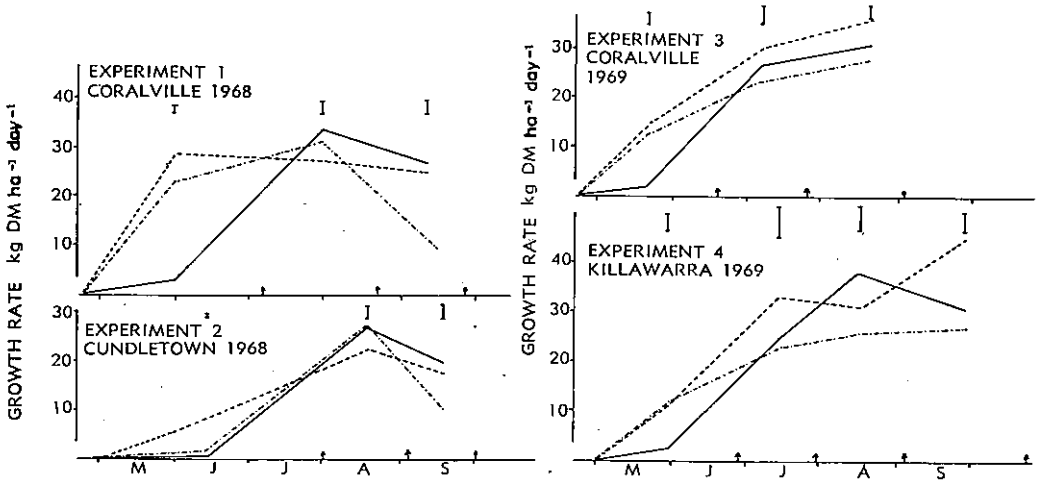

FIGURE 3
Seasonal growth of oats and ryegrass in each experiment—Mean of four nitrogen rates; --- Saia oats, —·—Algerian oats, ——— ryegrass; I = S.E., ↑ = harvest date.

DISCUSSION

The results presented show that Wimmera ryegrass was capable of high forage yields when treated as a forage crop. Wimmera ryegrass also responded to nitrogen in a similar manner to oats and had a similar nitrogen content.

The major difference between oats and ryegrass was that oats had a greater initial growth rate and hence provided forage for grazing in a shorter period from sowing than did Wimmera ryegrass. Oats was ready to graze two to four weeks earlier than ryegrass. This difference between species was especially noticeable with Saia oats where the greater total yields (Table 2) can be largely attributed to the greater initial growth rates (Figure 3).

Crofts (1966) defined the period of greatest feed shortage for the Sydney region as a 100-day period commencing in June. Much the same situation exists on the mid north coast of N.S.W. The experiments reported here were all sown in late April and while oats were often ready for grazing during June, Wimmera ryegrass was not. This suggests that to utilize Wimmera ryegrass as a forage crop, it should be sown early in autumn. Further research on times of sowing for ryegrass would obviously be worthwhile.

The response to nitrogen was similar for oats and ryegrass and appeared to depend more on site and prevailing climate than species. The results can be used to estimate the appropriate nitrogen rates to use on oats or ryegrass forage crops. The results of experiments 1 and 3, on soils with a high nitrogen content, suggest that at least the N_{34} rate would be required for improving forage yields in dry years (experiment 1) while in years of good rainfall the N_{67} rate is more appropriate (experiment 3). In practice it would be wise to apply the N_{67} rate on such soils as rainfall was below average in 1968 (experiment 1). On the soils with a low nitrogen content, there was no response in forage yields to more than the N_{34} rate in either year (experiments 2 and 4).

Forage crops of oats and ryegrass are frequently used for dairy cows and it is therefore necessary to consider forage quality as much as quantity. It is generally considered that a crude protein content of 15% (2.4%N) is required by dairy cows. This level was equalled or exceeded at all nitrogen rates in experiments 1 and 3

but in experiments 2 and 4 (Table 3) 2.4% N was only exceeded at the N_{67} and N_{100} rates. Thus on poor soils, it would be advisable to apply the N_{67} rate to ensure an adequate crude protein content.

These results suggest that the N_{67} rate is appropriate for oats and ryegrass forage crops on both good and poor soils, on good soils for quantity of forage and on poor soils for quality as well as quantity of forage. These experiments have also demonstrated that the yields of well fertilized oats and ryegrass on low fertility soils can equal the yields obtained on soils high in fertility provided rainfall is adequate.

No response was noted in these experiments to sowing rates for Wimmera ryegrass in excess of 28 kg ha^{-1}. This sowing rate probably represents the upper limit for Wimmera ryegrass when sown as a forage crop. The minimum sowing rates that will allow maximum sward growth rates will need to be determined in further experiments.

The cost of seed will be an important factor in the choice of which species to use as a forage crop. In 1973 the price per kg of seed at Taree was 24.8 cents for Saia oats, 12.4 cents for Algerian oats and 26.4 cents for Wimmera ryegrass. The seed cost when sowing forage crops is thus \$33.48 ha^{-1} for Saia oats; \$22.32 for Algerian oats and \$7.39 for Wimmera ryegrass (28 kg). Although yields from Wimmera ryegrass were less than from oats, the cost of forage would be considerably less. The greater yields from Saia oats would not be sufficient to compensate for the greater seed cost. The same cultural operations are required to sow both oats and ryegrass.

The use of Wimmera ryegrass as an alternative winter forage crop to oats appears to be justified from the results of the experiments reported here. The one exception is where forage is required as soon as possible after sowing and then oats, especially Saia oats, is the preferred species.

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