PASTURE ESTABLISHMENT STUDIES AT INVERMAY RESEARCH STATION

N. A. CULLEN, Invermay Research Station, Mosgiel

This paper examines some of the factors which go to make good pastures, in particular those concerned with the critical establishment stage.

Some of these factors, for example, weather, disease, and pests, are partly or largely beyond control, but others, such as seed-bed preparation, time and method of sowing, amount of seed sown, inclusion of cover crop, fertiliser application, and subsequent management are chiefly dependent on the farmer.

It is largely with one of these-the amount of seed sown-that this paper is primarily concerned. Trials into this aspect of pasture establishment were first begun at this, Station three years ago when various seed mixtures were included in a series of rape and grass trials:

In the following year investigations were commenced into the effect of various rates of ryegrass on pasture establishment and production.

This series, which included trials on both the fertile plains soil and the less fertile hill soils, was repeated with some minor changes in the 1957-58 season.

Results to date have generally indicated that the amount of ryegrass normally sown is unnecessarily high and that sowing lighter rates of ryegrass has several advantages, one of which, cost, is immediately apparent.

These trials have further shown that the inclusion of ryegrass, even at comparatively light rates, is likely to result in considerable suppression of the slower establishing grasses and clovers, particularly under high fertility conditions.

Details of Trials

1. Treatment and Experimental Procedure 1956-57 Series

These trials consisted of six mixtures comprising a basal mixture of cocksfoot, timothy, and clovers, with various rates of perennial and short-rotation ryegrass.

Each plot was sown, in duplicate, on both soil types, the flat land trial being sown in October 1956 and the hill trial two months later.

Mixture	Per. Ryegrass lb/ac	Short. Rot. Ryegrass lb/ac	Cocksfoot lb/ac	Timothy lb/ac	White Clover lb/ac	Mont. Red Clover lb/ac
1	0	0	5		3	3
2	10	0	5	3	3	3
3	10	5	5	3	3	3
4	10	10	5	3	3	3
5	10	15	5	3	3	3
6	20	5	5	3	3	3

Subsequent management consisted of periodic grazing and spelling, the 'grass being kept at a relatively short "sheep pasture height".

Production cuts were taken at times representative of seasonal growth, strips being cut before grazing.

1957-58 Series

Treatments in this series followed the pattern, of the previous year, but with some changes in, the rates of ryegrass sown. Actual treatments were:

Mixture	Per. Rye- grass lb/ac	Short; Rot. Ryegras lb/ac	Cocksfoot lb/ac	Timothy lb/ac	White Clover lb/ac	Mont. Red Clover lb/ac
1	0	0	5	3	3	
2	5	0	5	3	3	3 3
3	0	5	5	3	3	3
4	5	5	5	3	3	3
5	15	0	5	3	3	3
6	0	15	5	3	3	3
7	15	5	5	3	3	3
8	15	15	5	3	3	3

Three replicas of each treatment were sown in December 1957, again on both hill and flat land.

(2) Results High Fertility Flat Land Soil

(A) **1956-57 Trial**

Establishment was good in all treatments, although weeds, especially fathen and spurrey, were initially thick in some plots, These were largely controlled at the first grazing and were not serious after the first few weeks.

Despite weed competition, plant counts taken six weeks after sowing indicated that grass and clover germination and establishment were satisfactory. Perennial ryegrass. averaged about. 30 plants per sq ft with a 10 lb seeding rate, cocksfoot (5 lb/acre) 5 plants, timothy and white clover (3 lb/acre) approximately 20 plants per sq ft, and red clover (3 lb) about 10 plants. per sq ft.

During the establishment stage no production measurements were taken, but from observations it was apparent' that production

was highest in the heavier rates. However, six months after sowing the lighter rates of ryegrass did not appear greatly inferior in production, while general appearance, thrift, and composition were superior.

At this time production from the "no ryegrass" treatment was much less than the treatments including ryegrass, but the percentage of timothy, cocksfoot, and clovers was much higher.

This can be seen from the table of point analysis results below:

Table L-Details of Point Analysis Measurements taken 18.6.57. (Hits per 100 points.)

Treatments	Ryegrass	Cocksfoot	Timothy	Clover White	Clove Red	Other*
1. No Rye	—	40	44	42	21	20
2. 10 lb Per.	82	12	30	16	20	4
3. 10 Per. + 5 S.R.R.	124	4	18	13	10	7
4. 10 Per. + 10 S.R.R.	118	3	6	8	10	1.5
5.. 10 Per. + 15 S.R.R.	131	—	10	8	6	4
6. 20 Per. + 5 S.R.R.	111	9	9	5	12	4

* Other includes *Poa annua*, weeds, dry matter, and bare ground.

The suppression effects are shown clearly in graphical form.

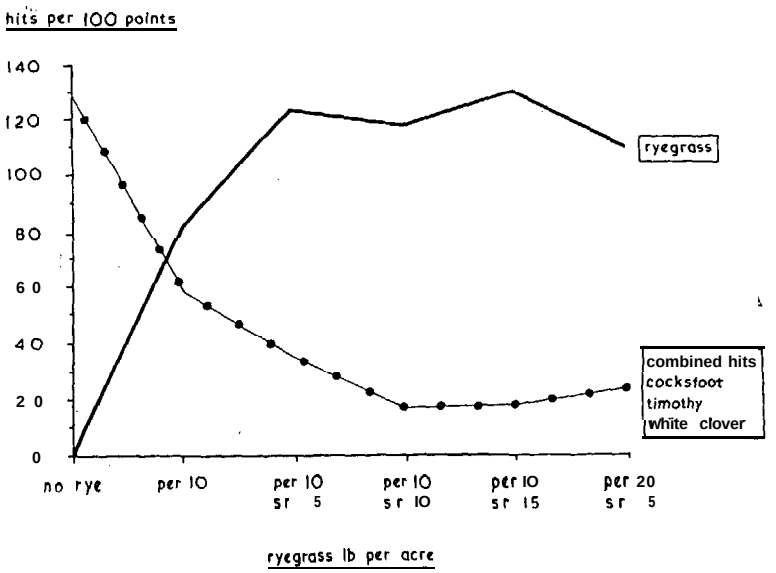

Fig. 1 .-Hits on Cocksfoot, Timothy, and White Clover with Various Rates of Ryegrass: Flat Land Series 1956-57.

Noteworthy Features:

1. Only a small difference is present in the number of ryegrass hits between the 10 lb and 25 lb seeding rates.

2. Total hits show only a small variation and are actually highest in the lightest rate of ryegrass (10 lb of perennial ryegrass).
3. A marked reduction in hits on cocksfoot, timothy, and white clover occurs in the presence of ryegrass and particularly where the heavier rates were sown. This illustrates clearly the severity of the suppression effects of ryegrass on high fertility soils.
4. Red clover is not affected to the same extent as white clover.

Production Data

In the season after sowing three cuts were taken at times representative of the seasonal growth. These were:

1. Early spring: approximately 10 months after sowing.
2. Late spring: approximately 13 months after sowing.
3. Summer: approximately 15 months after sowing.

Details of the production are shown in Table 2.

Table 2.-Production lb/ac Dry Matter Part Season 1957-58.

Treatments	27.8.57	13.11.57	15.1.58	Total
1. No Rye	390	1,490	3,100	4,980
2. 10 lb Per. Rye	670	2,170	2,680	5,520
3. 10 Per. + 5 S.R.R.	820	1,580	2,570	4,910
4. 10 Per. + 10 S.R.R.	900	1,620	2,600	5,120
5. 10 Per. + 15 S.R.R.	900	1,220	3,020	5,140
6. 20 Per. + 5 S.R.R.	860	2,380	2,520	5,760

In the early spring production was highest from the treatments which included short-rotation ryegrass, but the contribution of other species in these treatments was low.

In the late spring the "no ryegrass" treatment was comparable with those containing the higher rates of short-rotation ryegrass, but inferior to those in which perennial ryegrass was dominant. The short-rotation ryegrass treatments at this time were somewhat unthrifty in appearance and appeared to be suffering from nitrogen deficiency.

At the summer, cut taken in January the "no ryegrass" treatment proved superior to the others in production, vigour, and general appearance.

The production figures indicate that despite the much higher production from the short-rotation ryegrass dominant treatments in the early spring, total production from these treatments was inferior to those in which perennial ryegrass dominated and only comparable to the "no ryegrass" treatment.

(B) **1957-58 Series**

Establishment was good in all treatments as a result of abnormally wet conditions. Growth was extremely rapid, especially in the

high rates, and at the first cut some six weeks: after sowing these treatments yielded about double the "no ryegrass" treatment and significantly more than the light rates. This trend persisted throughout the establishment period, although at each cut the margin in favour of the high rates was less, until by May, six months after sowing, no significant difference was present. between the 5 lb and 30 lb rates of ryegrass. Production from the "no ryegrass" treatment, however, was still significantly less at this time.

Table 3.-Yield in lb/ac Dry Matter for period 4.2.58-1.5.58.

Treatments	4.2.58	13.3.58	1.5.58	Total 3 Cuts
1. No ryegrass	800	1,090	640	2,530
2. Per. Rye. 5 lb	1,010	1,510	1,190	3,710
3. **S.R.** Rye. 5 lb	**1,070**	**1,330**	**1,070**	**3,470**
4. Per. Rye. 5 lb, S.R. Rye 5 lb	1,180	1,510	**1,210**	**3,900**
5. Per. Rye. 15 lb	**1,280**	1,690	**1,260**	**4,230**
6. S.R. Rye. 15 lb	1,650	1,660	**1,200**	**4,510**
7. Per. Rye. 15 lb, S.R. Rye. 5 lb	1,400	**1,660**	**1,210**	**4,270**
8. Per. Rye. 15 lb, S.R. Rye. 15 lb	1,750	1,680	1,210	**4,640**

All treatments include cocksfoot 5 lb; timothy 3 lb; red clover 3 lb; white clover 3 lb.

Results in this trial generally followed a similar pattern to those of the previous year with severe suppression occurring in the presence of the high rates of rye&ass. This was clearly shown by point analysis measurements taken in May and confirmed by tiller counts taken during September.

Table +-Point Analysis: Measurements Taken. Six Months After Sowing. (Hits per 100 points.)

Treatments	Rye-grass	Cocks-foot	Tim-othy	White Clover	Red Clover	Annual Poa	'Other
1. No Rycgrass	—	12	34	27	6	39	19
2.' Per. Rye. 5 lb	49	7	23	14	7	18	19
3. S.R. Rye. 5 lb	59	5	18	11	2	18	17
4. Per. Rye. 5 lb + S.R. Rye. 5 lb	74	4	10	5	3	11	21
5. Per. Rye. 15 lb	63	2	7	7	3	**1 2**	**23**
6. S.R. Rye. 15 lb	70'	1	4	5	1	4	23.
7. Per. Rye. 15 lb + S.R. Rye 5 lb	75	1	4	6	4	8	23
8. Per. Rye. 15 + S.R. Rye. 15 lb	**83**	Tr	3	4	2	6	24

* Other includes weeds, dry matter, and bare ground.

It can be seen from the above table that hits on timothy, cocksfoot, and white clover again drop sharply with the increase in ryegrass seeding rates.

Tiller counts taken during September 1958. followed a similar pattern, as shown in Table 5.

Table 5.—Number of Tillers per Square Foot Nine Months after Sowing.

Treatments	Rye-grass	Cocks-foot	Tim-othy	White Clover	Red Clover	Annual Poa	Total
1. No ryegrass	147	429	260	41	698	1,575
2. Per. Rye. 5 lb	673	22	248	127	22	345	1,437
3. S.R. Rye. 5 lb	496	28	131	85	10	265	1,015
4. Per. Rye. 5 lb + S.R. Rye 5 lb	741	19	141	50	13	222	1,186
5. Per. Rye. 15 lb	871	26	127	65	18	348	1,455
6. S.R. Rye 15 lb	724	11	42	33	14	88	912
7. Per. Rye. 15 lb + S.R. Rye. 5 lb	962.	12	61	42	23	187	1,287
8. Per. Rye. 15 lb + S.R. Rye 15 lb	913	3	40	18	10	89	1,073

From these counts it can also be seen that for equivalent seeding rates short-rotation ryegrass is more severe than perennial ryegrass in its suppression effects.

During the present 1958 spring two cuts have been taken. These follow closely the previous year's results; in the early spring (August) the short-rotation ryegrass treatments were the highest yielding, while in the mid-spring period perennial ryegrass was the most prominent. Again at both cuts yield differences were small between the 5 lb and 30 lb seeding rates.

Table B.-Point Analysis: Hits per 100 Points taken Seven Months after Sowing: Hill Series.

Treatments	Ryegrass	Cocksfoot	Timothy	Clove White	Clover Red	Other*
1. No ryegrass		29	39	34	19	33'
2. Per. Rye. 5 lb	45	8	22	17	12	35
3. S.R. Rye. 5 lb	60	6	12	14	11	25
4. Per. 5 lb + S.R.R. 5 lb	68	3	15	14	12	31
5. Per. Rye. 15 lb	58	5	8	12	7	39
6. S.R. Rye. 15 lb	76	2	10	10	13	25
7. Per. 15 lb + S.R.R. 5 lb	72	4	9	6	11	35
8. Per. 15 lb. + S.R.R. 15 lb	86	2	4	7	8	33

* Includes other grasses, weeds, dry matter, and bare ground.

Hill Series 195647 and 1957-58

During both seasons results from the trials conducted on the less fertile hill soils closely parallelled those obtained on the highly fertile plains soil. Production differences were less than in the more fertile plains series, but similar trends were present, the higher rates giving greater productioninitially but the lighter rates being comparable after the establishment phase. In regard to general appearance and composition, the lighter seed rates appeared as good as, or better than; the heavier rates.

In comparison with the plains soil, suppression effects were less, particularly with the clover species. However, suppression was still considerable, -as can be seen from a comparison of point analysis and tiller count measurements taken on both series.

In this trial the hits on timothy, cocksfoot, and white clover again fall sharply with increase in ryegrass seeding rate. Clover suppression, however, is less, especially red clover. Tiller counts again show a similar trend to the flat land series, but total tillers are fewer.

As in the flat land series fewer ryegrass tillers are present in the two short-rotation ryegrass only treatments.

Table 7 .-Tiller Counts Hill Series 1957-58.

Treatments	Ryegrass	Cocksfoot	Timothy	Clover White	Clover Red	Total
1. No Rye.		157	199	232	71	659
2. Per. Rye. 5 lb	341	73	109	144	9x	765
3. S.R.R. 5 lb.	275	45	101	121	50	592
4. Per 5 lb + S.R.R. 5 lb	458	33	57	134	89	771
5. Per. Rye. 15 lb	530	34	57	87	49	757
6. S.R.R. 15 lb	478	14	55	105	70	722
7. Per. Rye. 15 lb + S.R.R. 5 lb	546	16	74	98	38	772
8. Per. Rye. 15 lb + S.R.R. 15 lb	593	**15**	52	107	42	809

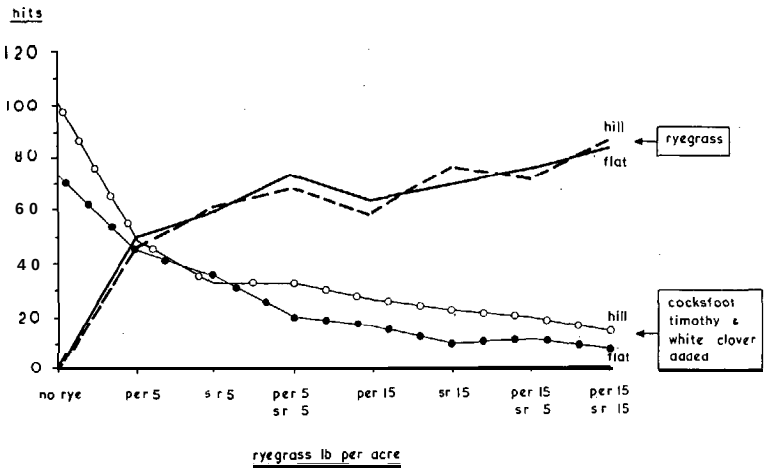

Fig. 2.—Comparison Point Analysis Hits: Hill and Flat Land Series 1957-58.

The number of combined cocksfoot, timothy, and white clover tillers declines from 578 in the "no ryegrass" treatment to 174 in

the 30 lb ryegrass treatment. This compares with a range of 836 to 61 in the flat land series, again an indication of the reduced suppression in the hill series. Point analysis data and tiller counts for the two series are shown in Figs. 2 and 3.

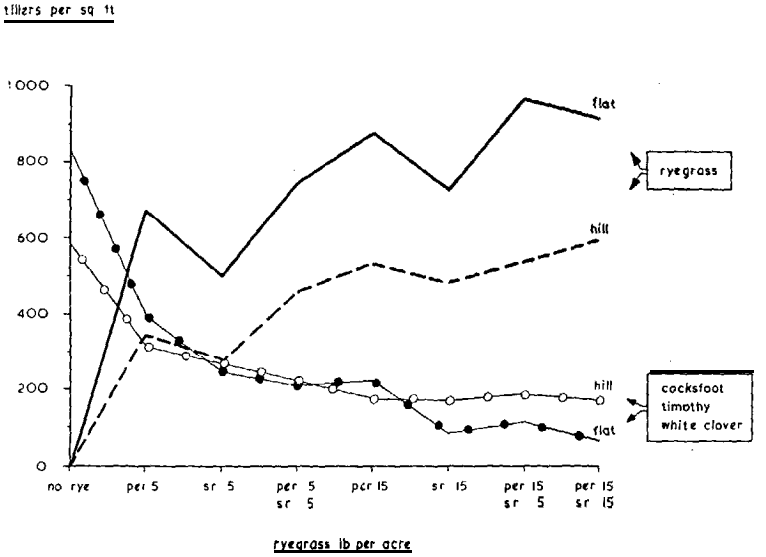

Fig. 3-Comparison Tiller Counts: Hill and Flat Land Series 1957-58.

The range between the no ryegrass and the highest rate (30 lb) is shown in Table 8 for the 1957-58 series.

Table 8.—Comparison between No Ryegrass and 30 lb on Hill and Flat Land.

		Tillers/Sq. ft.		Hits per 100 Points	
Species		Nil	30 lb	Nil	30 lb
Cocksfoot	Flat	147	3	1 3	Tr.
5 lb/ac	Hill	157	15	38	2
Timothy	Flat	429	40	47	3
3 lb/ac	Hill	199	52	51	5
White Clover	Flat	260	18	34	4
3 lb/ac	Hill	230	87	40	7
Red Clover	Flat	41	10	7	2
3 lb/ac	Hill	71	38	21	10

From this table it can be seen that clover suppression is less in the hill series than on the flat, timothy is slightly less, and cocksfoot is much the same. The very marked drop in the number of cocksfoot tillers in the presence of ryegrass is indicative of the extreme sensitivity of this species to ryegrass competition.

In the trial on the high fertility flat land,. inclusion of only 5 lb of perennial ryegrass resulted in a reduction from 147 cocksfoot

tillers to only 22. With timothy the reduction was relatively less, being from 429 to 248.

Discussion and Conclusion

From the above results it is obvious that the use of high seeding rates of ryegrass can result in severe suppression of slower establishing species, particularly cocksfoot, timothy, and white clover. Red clover is less sensitive to competition and is not affected to the same degree. With lighter ryegrass rates this competition is less intense and as a result sward composition is likely to be superior, while production: except for the initial phase, is comparable.

Use of high seeding rates has two main advantages.

1. Weed suppression. .
2. Quick initial ground coverage and consequent higher production at this time.

Where these factors are of considerable importance, for example on weedy soils and in marginal land development, heavier seed mixtures should be sown.

Under most conditions pastures in Otago and Southland are sown in the spring and early summer. At this time there is usually adequate feed available for grazing and hence the profuse growth resulting from a high seed sowing can be an embarrassment and be inadequately controlled as a result. For this reason lighter seed rates are little disadvantage at this time. By the spring after sowing, when maximum "produciidn is desirable, the initial advantage from the high rates will have been largely lost and the lighter mixtures are likely to be comparable in yield and superior in composition.,

In the long term, light seed rates have many advantages, particularly in regard to composition.. The violent change from complete ryegrass dominance to complete clover dominance is largely avoided and seasonal growth is more even. Summer growth in particular is usually higher, and this may be of advantage; where lamb fattening is important.

These trials were sown without a cover crop. Where rape is included, effects and results are likely to be different, as the lighter seed rates mixture can suffer severely from the rape competition.

, Mixtures including short-rotation ryegrass have the important advantage of' relatively high- production' in. the winter and early spring and for this reason short-rotation ryegrass is , worthy of inclusion. However, it is apparent from I the results presented above that the amount ,of short-rotation should, be kept to a minimum so that the, suppression; effects are comparatively, small.

In the above trials **the** amount of cocksfoot, timothy, and clovers sown was constant. Other work indicates that increasing the rate of seed of these species will not compensate for the suppression effects of the high ryegrass seed rates.

Conclusion

In this paper I have endeavoured to describe the suppression effects **of** ryegrass with different levels of fertility. From these results it is hoped that a better appreciation will have been gained of the importance of ryegrass seeding **rate** on pasture composition and through use of this knowledge better pastures may be grown.

DISCUSSION

Q. (A. C. Hurst): I consider farmers are sowing too high a seeding rate, particularly of ryegrass.

A. Agreed 'that under ideal conditions we can get down to much lower rates e.g. 1 lb timothy, 2-3 lb cocksfoot and total up to 9 lb.

Under lower fertility conditions slightly higher seed rates are required, e.g., including up to 10 lb perennial, and this. applies particularly to land development areas.

Q. (A Stuart): Consolidation must be good for success with low rates. May be preferable to sow rye/white alone and sow other species in special purpose pastures.

Q. (Dr P. D. Sears): In the North Island we have been using lighter rates of seeding and to overcome the low production in the first six months we include barley or some erect growing grcenfeed. I consider Mr Cullen's lowering of clover percentage is more due to competition for light rather than nitrogen deficiency, due to the long periods between grazing (1 month). If frequency of grazing was increased different results might be obtained.

A. In the first year of each trial the areas were close stocked and grazed at less than monthly intervals and therefore results are not entirely due to competition for light but largely to lack of nitrogen.

L. Blackmore: I would support Mr Stuart on high rates. Farmer should not reduce rates until he has experimented in portion of paddock. Failure may follow poor cultivation, lack of consolidation or unsuitable sowing technique for conditions. I would be wary about recommending low seeding rates for general farm practice.

Q. (H. R. Scott): Has Mr Cullen done any work with the hay and grazing strains of meadow fescue and with what effects on the cocksfoot, timothy and clovers?

A. We find these strains have a much less severe suppression effect, but not so great on cocksfoot, etc. On hill soils it does not compete with weeds or weed grasses. It also has low summer production so I am not enthusiastic about this grass. In England it is grown as a comparison with lucerne but in N.Z. its low winter and dry weather production makes me wonder what place it has in our farming.

Q. (Mr Reid): Production figures have been given for various seeding rates in the establishing stage. What is the relative production now?

A. Early spring cuts showed continued advantage in high rates. Throughout spring low rates made relatively more production and at the November cut the no-ryegrass treatment yielded 60 per cent more than the highest rate of ryegrass.