OF WHAT SIGNIFICANCE IS THE PRESENCE OF *POA TRIVIALIS* IN RYEGRASS PASTURES?

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THE productivity of New Zealand grassland has been increased markedly by the identification, selection and improvement of ryegrass varieties through plant breeding programmes, and by the clear insight provided by pasture ecologists, into the major factors governing the productivity of ryegrass-clover associations. If the proposition is accepted that sown ryegrass-clover associations, with appropriate management, are the basis for maximum herbage productivity, then some consideration must be given to the role of any unsown species which may replace the sown species in the sward.

The presence of these is an indication of either the lack of knowledge to prevent their ingress or to effect their removal, or of their acceptance as a valuable component of the sward.

The necessity for further information seems obvious. Either these species augment or limit herbage production on an annual or seasonal basis, or alternatively result in a change in botanical composition with no marked effect on herbage productivity. The latter factor could well be the more important. The recent demonstration of the differences in animal production from ryegrass varieties (Rae, *et al.*, 1963) indicates the need for an assessment of the value of all the sward components, for animal as well as for herbage productivity.

Poa trivialis is of particular interest because this species is a common unsown component of perennial ryegrass pastures, thriving on land which is wet throughout the whole year or during winter.

This species was introduced to New Zealand (Allan, 1940). Thomson (1922) notes that *Poa trivialis* was first recorded in New Zealand in Hooker's list of 1864, and in the Manual published in 1906, as not uncommon in fields and waste places throughout both islands.

Its inclusion in early pasture mixtures was probably general, but few reports have been noted. For example, Cockayne (1914) advocated the inclusion of *Poa trivialis* in

bush burn seeds mixtures for wetter areas; Foy (1922) reported the results of the germination tests of several lines of seed; and Hamblyn (1951) stated that this species was included in the primary seeds mixtures sown in Taranaki. Saxby (1956) noted that *Poa trivialis* was already present in most of the country to which it was suited and was therefore rarely, if ever, sown.

Experiments carried out at the Welsh Plant Breeding Station by Stapledon and Davies (1922-8) showed that although *Poa trivialis* did not yield heavily in pasture mixtures, this species was persistent and its inclusion provided a dense "bottom" in the sward and reduced the amount of weeds present. Bearing in mind the general lack of persistency in the ryegrasses available at that time, their assessment of the value of *Poa trivialis* is readily appreciated. Recent research, in which the herbage productivity from commercial and Aberystwyth ryegrass varieties has been compared, likewise indicates the association of marked amounts of *Poa trivialis* with lack of ryegrass persistency (Hughes, 1956 ; Green, 1960, 1961). *Poa trivialis* was recently referred to by Cooper (1962), as an invariable invader of sown grassland under high fertility conditions in Great Britain.

Only one comparison of the relative herbage production from swards sown with ryegrass varieties and with *Poa trivialis* has been sighted in overseas literature. In the West of Scotland, the production for a three-year period from *Poa trivialis-white* clover swards under cutting management was 14,560 lb dry matter (D.M.)/acre compared with 18,590 lb D.M. from ryegrass varieties [range 14,910–20,330 lb D.M.] (Hunt, 1956).

Likewise, there are few published records of the growth of *Poa trivialis* in New Zealand. Saxby (1956) stated that "trials with this grass on this type of country [rolling clay country] have shown that its inclusion in a general mixture has been responsible for a reduction in the yield from the pasture over a period of several years". Levy (1936) sowed 4 lb of *Poa trivialis* in a seeds mixture containing 30 lb perennial ryegrass, 10 lb cocksfoot and 3 lb white clover per acre and the inclusion of this species reduced the total dry matter yield from 33,100 lb D.M./acre to 31,800 lb D.M. over a three-year period. This is the only published work sighted in which a direct comparison was made of the herbage production from ryegrass swards sown with and without *Poa trivialis*. Suckling (1960) measured the production from *Poa trivialis* and from perennial ryegrass swards,

under a monthly cutting system, on the Grasslands Division hill country station at Te Awa. The *Poa trivialis* swards produced 1,790 lb D.M./acre compared with 11,890 lb D.M. from perennial ryegrass, but as noted by Suckling, this comparison was probably not a fair one, because the swards were located on a sunny northern aspect.

On several occasions, the late Dr P. D. Sears suggested that the presence of *Poa trivialis* could be a factor limiting the attainment of maximum herbage productivity from ryegrass-white clover associations, e.g., Sears (1960). His views were based largely on observations from several of his experiments with perennial ryegrass-clover swards under grazing management at Palmerston North. In one of these, *Poa trivialis* comprised 80% of the botanical composition of the sward in the spring. The presence of *Poa trivialis* in large amounts was considered by Sears to result in the suppression of white clover, with a consequent effect on the productivity of the association.

A programme of research was carried out at Grasslands Division, Palmerston North, during the period from 1961-5 to study in detail the ecology of *Poa trivialis* growing in association with perennial ryegrass and white clover, so as to determine what effect the presence of this species had on pasture productivity.

In this paper, the results from two of the experiments are discussed. The first compared the annual and seasonal herbage production from Poa *trivialis*-white clover, perennial ryegrass-white clover and *Poa* trivialis-perennial ryegrass-white clover (hereafter referred to as mixed) swards, under frequent intensive (hard) and infrequent less intensive (lax) cutting systems. Part of the results are presented here and further details will be published elsewhere. The second experiment compared the annual and seasonal herbage production from perennial ryegrass-white clover and from mixed swards under hard grazing management.

Both experiments were sown in March at seeding rates of 4 lb *Poa trivialis*, 15 lb perennial ryegrass and 2 lb white clover per acre, and the treatments were commenced in the following March. In the first experiment, nitrogen was applied after each cut in an amount equivalent to that removed in the cut herbage.

In Table 1, annual herbage yields from the cutting experiment are shown for the periods from March to February, 1962-3 and 1963-4.

The total herbage yield from both cutting treatments in 1962-3 was higher from the ryegrass than from the mixed

swards, but the difference was only of the order of 10%. Total grass and clover yields from the mixed swards were lower than from the ryegrass swards, the percentage reduction in clover yield being more marked than the reduction in grass yield, but on a species basis the most marked reduction was in ryegrass yield.

The *Pou trivialis* swards produced lower grass and higher clover yields than those obtained from the other swards, the combined effect being lower total herbagc yields. The difference in total herbage yield from the *Poa triviulis* and ryegrass swards was reduced under hard cutting, because of the high clover yield from the former sward.

A notable feature of the comparison was the marked similarity in the pattern of results obtained under both cutting treatments.

Results were not obtained from the *Poa trivialis* swards for the entire period of the third year from sowing, because of the increasing difficulty in maintaining these swards free from other grasses such as sweet vernal and Yorkshire fog. These could not be dressed out of the seed sample that was sown.

In 1963-4, total herbage yields were of the order of 1.5 times higher than in 1962-3. Clover yields were particularly low. Continued wet weather in late spring-early summer favoured grass growth.

Significant differences between the swards in total herbage, total grass and clover yields were not shown in 1963-4, but the ryegrass yield from the mixed sward was lower than that from the ryegrass sward.

Poa trivialis did not comprise as high a percentage of the grass yield from the mixed sward as in the previous year (45% compared with 60%). This difference could be associated with seasonal weather conditions. The summer period of 1962-3 was exceptionally dry and although the yields from both ryegrass and *Poa trivialis* were similarly reduced on a percentage basis, the subsequent recovery of Poa *trivialis* in the autumn was substantially less than ryegrass. Thus, while the mixed swards were *Poa trivialis* dominant in the late autumn, winter and early spring periods of *1962-3, Poa trivialis* was not dominant at any stage in 1963-4. Marked annual **changes** in the percentage of *Poa trivialis* in ryegrass swards have been a feature of unpublished data to which the writer has had access.

The particularly *low* yield of *Poa trivialis* in the lax treatments **may have** been the result of marked "burning" of this grass following nitrogen application after a cut in

TABLE 1: CUTTING EXPERIMENT

Annual Herbage Yields (lb D.M./acre)

	Cutting Treatment	Sward Type	Total Herbage	Total Gruss	Species Yields Poa trivialis	Species Yields Ryegrass	Species Yields White Clover
Year 1962-3 (1/3/62-28/2/63)	Hard	*Poa trivialis*	9,520±220	4,640±240	4,640		4,880±260
		Ryegrass	10,200	6,630		6,630±170	3,570
		Mixed	9,320	6,050	2,960	3,090	3,270
	Lax	*Poa trivialis*	8,950±190	4,960±220	4,960		3,990±200
		Ryegrass	10,650	7,030		7,030±120	3,620
		Mixed	10,530	6,540	2,990	3,550	2,980
Year 1963-4 (1/3/63-29/2/64)	Hard	Ryegrass	16,860±270	13,960±300		13,960±430	2,900±170
		Mixed	16,540	13,900	3,290	10,610	2,640
	Lax	Ryegrass	16,460±220	14,230±400		14,230±250	2,230±330
		Mixed	15,790	13,020	1,430	11,590	2,770

TABLE 2: GRAZING EXPERIMENT

Annual and Seasonal Herbage Yields (lb D.M./acre)

	Sward Type	*Total Herbage*	*All Grass*	*Species Yields* Poa trivialis	*Ryegrass*	*White Clover*
Year (1/3/64-28/2/65)	Ryegrass	8,980 ± 80 8,900	6,060 ± 320 6,980	1,950	5,410 ± 280 3,930	2,920 ± 260 1,920
Autumn	Ryegrass		950 ± 25		940 ± 10	270 ± 50
	Mixed	1,220 ± 30 1,210	1,020	110	810	190
Winter	Ryegrass	1,350 ± 15				230 ± 30
	Mixed	1,590	1,420 ± 40	490	1,080 ± 20	160
Spring	Ryegrass	3,500 ± 60	2,650 ± 50		2,320 ± 10	850 ± 30
	Mixed	3,490	3,000	1,010	1,630	490
Summer	Ryegrass	2,910 ± 40	1,340 ± 280		1,150 ± 160	1,570 ± 250
	Mixed	2,610	1,530	340	660	1,080

the late autumn and of subsequent shading from the ryegrass component.

Dealing specifically with seasonal production, in 4962-3 the total herbage yield from the mixed and *Pou trivialis* swards in winter, was slightly higher than that from the ryegrass swards. The most marked effect of the inclusion of *Poa trivialis* was shown in the spring when the difference in the total herbage yields from the ryegrass and mixed swards was of the order of 400 to 800 lb D.M./acre. Total herbage yields obtained from the *Poa trivialis* swards in the summer were comparable with those from the ryegrass swards, the marked reduction in *Poa trivialis* yield being offset by the increased clover yield. The percentage difference in the ryegrass yields from the ryegrass and the mixed swards increased from 20 to 30% in the 'autumn to maximum values of 60 to 70% in the summer.

In 1963-4, the total herbage yield from the mixed sward in the winter was higher than that from the ryegrass sward, only under hard cutting management. The percentage reductions in the ryegrass yield from the mixed swards were less marked than in the previous year, and, in the summer, amounted to only 15% and 5% under hard and lax cutting respectively.

The main effect of the inclusion of *Poa trivialis* was a modification in the pattern of ryegrass growth in the winter and early spring. Changes in the percentage of *Poa trivialis* were opposite to the changes in the percentage of white clover and thus these species showed a complementary growth pattern, although, as indicated, competition from *Poa triviulis* reduced clover growth. The full effect of this reduction in clover growth on the total herbage yield from the mixed sward was probably not shown, because nitrogen was applied after each cut to allow for the amount of this nutrient removed in the cut herbage.

In Table 2, annual and seasonal yields from a comparison of ryegrass and mixed swards under hard grazing management are shown. The pattern of results differed in some respects from those for the cutting experiment, but, in common, demonstrate the reduction in ryegrass and clover yields from the mixed sward and the seasonal pattern of *Poa trivialis* growth with a marked reduction in the yield from this species in the summer. The maximum percentage of *Poa trivialis* in the mixed swards was 35% and no marked differences in total herbage yields were shown.

The general pattern of the results from these two experiments showed that in effect the inclusion of *Poa trivialis*

resulted in marked changes in the botanical composition of mixed swards, without any apparent marked effect on the annual total herbage production. Consideration should be given to the reductions in clover and ryegrass yields.

Because nitrogen was applied in the first experiment and because the second experiment was of limited duration, the full effects of the reduction in clover yield were probably not obtained. A reduction in the nitrogen status of the association, through decreased clover yield, should in the long term result in lowered grass yields. In other experiments carried out at Grasslands Division, the pattern of the response of *Poa trivialis* and perennial ryegrass to various levels of fertility, in terms of applied nitrogen and phosphate, was similar, indicating that a reduction in the nitrogen status would not favour the growth of *Poa trivialis* relative to that of ryegrass. As mentioned previously, the seasonal growth patterns of *Poa trivialis* and clover are opposite, so that the extent to which *Poa trivialis* reduces clover growth, particularly in the winter, should be the main factor governing total herbage production, but there may not be any significant reduction in this until clover growth has been markedly reduced. Further, a reduction in the growth of *Poa trivialis* in dry summer conditions may or may not be offset by increased clover growth, according to the management applied.

Due weight must also be given to the reduction in ryegrass yield at all seasons, but particularly in the spring. In terms of animal productivity, this reduction could be of importance, and yet, although large amounts of *Poa trivialis* are present in ryegrass pastures, very little is known about the quality of this species.

Provided sufficient ryegrass is present in the sward, competition from this species should be sufficient to limit the ingress of *Poa trivialis* and, if present in small amount, to keep its growth in check even in wet spring and summer conditions. The obvious difficulty is to first obtain and then to maintain an appropriate balance between grass and clover, so that the ryegrass is not checked. This would be a likely point for the ingress of *Poa trivialis.*

Some measure of the difficulty in preventing the ingress of *Poa trivialis* is suggested from the results of an experiment carried out at Palmerston North in which a known number of *Poa trivialis* seeds were sown outdoors, at monthly intervals from March. The final germination of seed from a July sowing was 33%, six weeks after sowing.

The germinatidn from earlier sowings was higher. Thus, it would appear to be a difficult proposition to prevent the establishment of *Poa trivialis,* particularly where treading damage had occurred in the winter.

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DISCUSSION

Suggestions have been made that Poa trivialis *may be eradicated by appropriate* pasture management. *The ingress* of *this species has apparently been aided by spelling pastures. Would you comment on the suggested practice of heavy winter stocking as a means of eradicating this species?*

The implication is that the ingress and subsequent growth of *Poa trivialis* is favoured by shading and the absence of treading. I have found no evidence that *Poa trivialis* is any more shade tolerant than perennial ryegrass. While heavy treading does damage *Poa trivialis,* this practice may also "open up" the pasture at a period when the germination of the buried seed of this species is possible. The maintenance of a densely tillered ryegrass pasture appears to be the answer to preventing the ingress of *Poa trivialis.* If present in small amounts, then some degree of shading may reduce its growth. Where large amounts are present, I doubt whether pasture management alone can eradicate this species.

How did you *keep* Poa trivialis *out of the ryegrass plots in your experiments?*

The application of nitrogenous fertilizer after each cut maintained the density of ryegrass tillers in these.

For how long does the buried seed of Poa trivialis *remain viable in the soil?*

The ingress of *Poa trivialis* into pastures does'not occur until some two to four years from sowing. Thus, it appears that the buried seed is viable for at least three to five years.

Is Poa trivialis *a perennial species?*

Yes. This species was maintained in plots under hard cutting treatment over a period of three years. No seeding or seedling ingress of this species was observed.

Would the speaker comment on the level of fertility in relation to the ingress of Poa trivialis?

Ingress of *Poa trivialis* occurs in high fertility conditions. If this species reduces the clover content, then its growth in turn must eventually be affected and it is probable that at that stage the further ingress of lower fertility status species occurs.