TIMOTHY AND COCKSFOOT STRAIN SELECTION

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Timothy *(Phleum pratense)* as a pasture species is well known as a late-maturing grass which thrives in damp situations but also grows quite well in a variety of soils. It is a highly palatable grass requiring a relatively fertile soil and apart from growing well in temperate climates shows to advantage also in the colder temperate zones. Timothy has been most extensively used in the United States of America, and is regarded as an important species in Canada and in northern Europe. In Sweden it is considered to be the most important of the hay grasses. In each of these countries it has been grown either alone, or with red clover, to provide hay crops, but in recent years the increasing interest in grazing pastures has suggested the necessity to locate and develop varieties or strains of timothy specially adapted for use in pasture mixtures.

Cocksfoot *(Dactylis glomerata)* is a valuable perennial grass which will grow and produce feed on all but the wettest and the driest medium to low fertility country. Its best use is on country that is too dry for permanent swards of perennial ryegrass and white clover.

Both timothy and cocksfoot are species of particular interest to Southland farmers, and it is important that those who use these species are aware of the strain differences in either of these grasses.

TIMOTHY

Strain selection work with timothy dates back practically sixty years in America and 46 years in Sweden when early, medium, and late-flowering varities were selected out and used to extend the range of latitudes in which timothy could be grown. More recently, attention has been given to the selection of leafy and rust-resisting types. Because this species

was being grown mainly as a crop to be harvested for hay or for seed, selection was mainly for quick growth and early maturity. It was not until the Welsh Plant Breeding Station at Aberystwyth commenced its breeding programmes, from 1919 onward, that attention was directed to the selection of "pasture" types of timothy.

It has been estimated that the quantity of timothy seed required annually for pasture sowings within New Zealand amounts to 125 tons, and in fact between the years 1927 and 1945 that was the average tonnage which was imported. Ninety-seven per cent. of this amount, at that time, came from the United States of America.

Our first investigations in 1939 indicated that the plants from much of the seed being imported were not the most suitable for use in grazing pastures and were generally of a non-persistent type. For further trials seed samples were collected from as many different sources as possible. Eventually the following material was available.

TABLE 1.

Samples for Trial

Origin of Samples	No. of Samples
Commercial (actual origin unknown)	57
United States of America	23
Great Britain	22
Sweden	7
Canada	3
New Zealand grown	47
Total	159

The tests have consisted of single plant observations, row trials, and measurement trials.

Single Plant Trials.

Within three months after planting out in the field differences in plant type were apparent and became even more distinct in subsequent months. On the basis of relative growth at different seasons of the year, leafiness or stemminess of individual plants, stages of maturity, and susceptibility to winter burning, there were three distinct types of plants as follows :-

1. "Hay" type, characterised by stemmy, coarse-leaved, tall-growing, early flowering plants.

2. "Pasture-hay" type. Plants more leafy, multi-tillered, later maturing, and not so tall growing as the "hay" type.

3. "Pasture" type. Leafy, medium early flowering plants, extremely prostrate growth habit.

Row Trials.

Seedling rows of timothy often establish very slowly and may have to be grown on for six months before differences in type become pronounced. The greatest differences develop at or near flowering time. The "hag" type is the first to send up flowering shoots, whereas the "pasture-hay" type shows no emergence of flowering shoots for a further period of 21 to 30 days. The pasture type is relatively early flowering, but its growth remains fine leaved, dense, and close to the ground. It sends up comparatively few flowering shoots.

In terms of total leaf production the extreme "pasture" type is far below that of the other types and its dry matter production when cut as hay has been found to be little more than half of that of the "hay" or "pasture-hay" types. Both the "pasture" type and the "pasture-hay" type make a leafy hay as against the stemmy product from the "hay" type.

TABLE 2

ROW TRIALS-HAY WEIGHTS

Group	No. of Samples	Average yield in lb dry matter per Row	Dry matter yield in tons per Acre	Ratio Leaf to Stem
"Hay"	7	2.76	4.1	1 : 5.11
"Pasture-hay"	9	2.75	4.1	1 : 2.23
"Pasture"	1	1.98	2.9	1 : 3.24
N.Z. Grown	5	2.71	4.0	1 : 3.62

Type in Relation to Origin

Included in the 23 samples known to be of American origin there were 4 selected lines, and the remainder were commercial samples. The samples from Great Britain contained 6 commercial lots and 16 samples of the Welsh Plant Breeding Station's

selections. The Swedish and Canadian samples were all bred selections. There were 30 New Zealand harvested samples of natural origin and 17 of pedigree origin or grown on from the Welsh Plant Breeding Station's 5.48 strain.

A type of classification of the total 159 lines is shown in Table 3.

TABLE 3. TYPE IN RELATION TO ORIGIN

Origin	Group Classification. "Hay"	"Pasture-hay"	"Pasture"
Commercial (origin unknown)	57	—	—
American	23	—	—
Canadian	3	—	—
Swedish	7	—	—
Scotch and English	6	—	—
New Zealand	28	2	—
New Zealand Grown S.48	—	8	—
New Zealand Pedigree Selections	—	9	—
Welsh P.B.S.	—	13	3
TOTAL (159 samples)	124	32	3

Seventy-eight per cent. of all lines tested were of the "hay" type, 20 per cent. were of the "pasture-hay" type, and 2 per cent. were the "pasture" type. All the Canadian and American samples, whether commercial or selected, belonged to the "hay" group. Some of their selections were more leafy than the normal "hay" types, and were also a few days later in commencing flowering.

Winter-hardiness is of prime importance in the Scandinavian countries, and with their long and severe winters and a relatively short growing season, quick-maturing types are required. Nevertheless in our trials the Swedish selections exhibited no particular superiority in yields or winter-hardiness, but on the contrary were relatively low yielding and most susceptible to frost injury and winter burning.

Most commercial samples lack uniformity in plant type and consist of a range of types varying in growth form from prostrate to semi-prostrate and from semi-erect to erect. This is true of all imported lines, such as the English and Scotch, as well as the New Zealand harvestings of uncertified origin. All the

New Zealand grown lines. which could be traced back were found to have been grown in the districts of Lime hills, Boggy Burn, Winton, and Otapiri, thus grouping into a comparatively small geographical location. It was further interesting to find that these lines differed somewhat from all other types. They were most like the "hay" types, but were not as tall growing, were more leafy, less winter dormant, better growing in the second year, and generally 7 to 10 days later flowering than imported plants of the "hay" type.

The Welsh Plant Breeding Station selections S.48 "pasture-hay," S.51 "hay," and S.50 "pasture" type have been of special interest. These were built up from plants collected as wild plants in English old pastures and were selected as being plants which could be grazed as well as hayed.

The "pasture" type (S.50) forms a dense; close-growing, grassy cushion, but its total production is too low to warrant inclusion in our pasture mixtures. Plants of the "pasture-hay" type (S.48) are leafy, multi-tillered, medium tall in height, relatively late flowering, highly resistant to rust, and good winter growers. The "hay" type (S.51) is not greatly different in performance from the "pasture-hay" type, but the plants themselves are characteristically light green in colour and have long leaves. The leafage comes high up the stems and so produces a leafy crop when cut for hay. Both the "hay" and the "pasture-hay" types recover well from cutting or grazing. Leafy plants of these have not been severely damaged by frost.

TIMOTHY IN SOUTHLAND

Timothy is a grass which appears to have particular application in Southland. If the fertility is high, strong stands of timothy and white clover can be maintained over a long period of years and-frequent seed crops, with a good average yield per acre, can be obtained. One paddock has been quoted as yielding 27 consecutive harvests with an average yield of 240lb of seed per acre. Generally in Southland 500lb of machine-dressed seed per acre is considered a good yield. Successful stands for seed production have been obtained by drilling in November at the rate of 3lb per acre with 1½lb per acre of rape as a cover crop.

Before the inclusion of timothy in the certifica-

tion scheme, 90 per cent. of the New Zealand grown timothy grass was harvested in Southland and 50 tons or more were. harvested annually. Certification using seed grown from imported seed of the S.48 strain was introduced in 1945, and since that time a pedigree strain, bred and selected for New Zealand eonditions, has become available also. However, from figures supplied by the Department of Agriculture most of the Certified seed is being grown in Canterbury (see Table 4). .

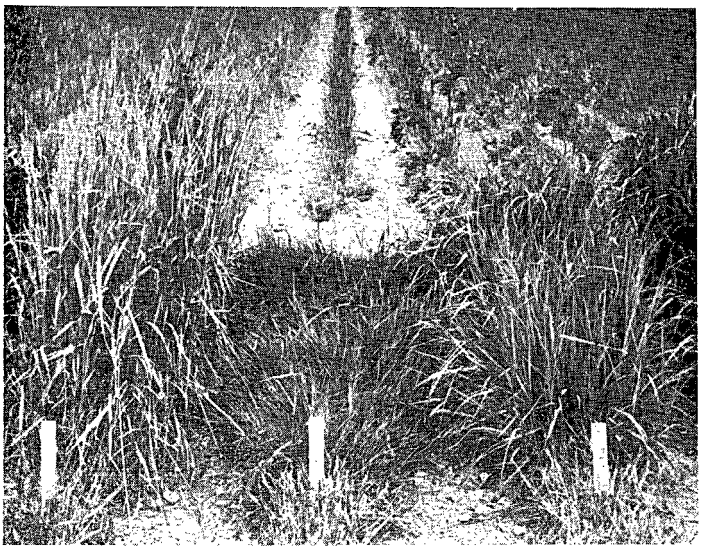

Fig. I.-Timothy strain types. Left, tall growing, early flowering "hay" type. Centre, fine leaved, prostrate growing, extreme "pasture" type. Right, leafy, medium tall, later flowering "pasture-hay" type.

TABLE 4.

Quantities of Timothy Seed Certified.

District	1944-45 lb.	1945-46 lb.	1946-47 lb.	1947-48 lb.	1948-49 lb.
Christchurch	86	2147	3957	1206	131
Mid-Canterbury	—	22675	35617	13133	17057
Otago	—	—	—	596	
Eastern Southland	—	311	245	1411	1642
Totals	86	25133	39819	16346	18830

The total amount of Certified seed harvested over the past five years seems quite inadequate to meet a requirement estimated to be in excess of 100 tons per annum ; and I have no doubt that if only the users of

timothy seed realised the superiority of the Certified types over the previously imported and locally grown uncertified types they would demand **Certified** seed only. The potentialities of the Certified and selected types are shown by the following yield figures from a replicated trial at the Gore Experimental Area.

TABLE 5

Yields of Strains of Timothy over a Period of 18 Months in lb. of Dry Matter per Acre.

	Timothy	Red Clover	White Clover	Other Species	Total
Imported	5530	643	2673	1273	10119
Certified	8011	854	1737	599	11201
Southland	5100	938	2505	1250	9793
Fedigree	8725	809	1513	685	11732

The pedigree and Certified are both significantly superior to the imported or Southland grown uncertified seed.

Brief reference has already been made to cocksfoot as a species. It is interesting to note that in some trials at Gore the total dry matter production from a grass plus clover mixture has been little different when the grass has been the best available strain of ryegrass, 'or cocksfoot, or timothy.

Actually the trials from which comparative figures are given below were sown on the same day, and each grass was sown with the same red clover and white clover, with the same rates of clover in each mixture..

TABLE 6

Yields of Grass plus Clover Mixtures at Gore *over* a Period of 18 Months in lb. of Dry Matter per Acre

	Grass	Red Clover	White Clover	Other Species	Total
Perennial Ryegrass (Pedigree)	8821	327	820	264	10232
Timothy (Pedigree)	8725	908	1513	685	11732
Cocksfoot (Welsh Selection)	5208	1095	2111	1724	10138

The total of dry matter yields from each mixture do not vary greatly, but with cocksfoot the lower yield of grass is compensated by a greater yield of both red and white clover,

COCKSFOOT

Ever since the ekrtification in the 1931-32 season of seed from areas on Banks Peninsula and from Plains grown seed of the same type, followed in 193'7 by the recognition of the Canterbury Agricultural College C.23 as a pedigree strain, New Zealand farmers have been provided with a reliable strain of cocksfoot. But since that time further bred strains have been pro-

Fig. II.-Cocksfoot strains. Left, Welsh S.143 "pasture" type. Centre, nucleus selection. Right, New Zealand Certified.

duced by plant breeding stations overseas, and it has been stated also that Danish seed growers have adopted the New Zealand Certified type in place of the original Danish type. It is therefore important to know the capabilities of any of these new strains of cocksfoot.

Included in our trials have been the Canadian selection "Hercules," the Welsh Plant. Breeding Station's "hay" type S.37, "pasture-hay" S.26 and "pasture" type S.143, and the Swedish selections "Brage" and late hay strain S.V. 01008. The Welsh S.37 and S.26 have been outstandingly good leafy and productive types. The pasture type S.143 is finer 'leaved and not such a vigorous grower. The Canadian and Swedish types are more leafy than earlier commercial samples, but they are severely affected by frost damage causing leaf burn and winter dormancy.

There is no doubt that some of the best plant material from overseas can be combined with our New Zealand types to produce a cocksfoot superior to the best we have at present. The possibilities are shown in the following figures from a strains measurement trial at Gore.

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Yields of Cocksfoot Strains at Gore over a Period of 18 Months in lb. of Dry Matter per Acre

	Grass	Red Clover	White Clover	Other Species	Total
Welsh "hay" Selection	5208	1095	2111	1724	10138
New Zealand Pedigree (C.23)	4216	769	2272	2208	9465
New Zealand Certified	4974	766	1715	1739	9194

SEED PRODUCTION

There have been several remarkable changes in the geographical location of the principal cocksfoot seed producing areas in New Zealand. From **1852** until **1900** cocksfoot seed harvesting on Banks Peninsula grew from small beginnings to the harvesting of seed from approximately 20,000 acres. From **1900** there has been a steady decline until the areas harvested on the peninsula now barely reach 2000 acres.

As the acreage on the peninsula declined the acreage of cocksfoot seed in the Ashburton County steadily increased to a figure of 5000 acres in 1931. Since 1931 Ashburton County has continued to harvest 3000 to 4000 acres yearly.

The third district to be associated with cocksfoot seed production on an extensive scale is the Southland County. Here the industry is of comparatively recent origin, but the expansion in acreage has been much more rapid than in the Ashburton County. In 1935-36 the area harvested for cocksfoot seed was 311 acres; 7 years later it had increased to 2173 acres, and in the 1945-46 season Southland County was the largest producer of cocksfoot seed in New Zealand, with approximately 4500 acres harvested. Perhaps of equal importance is the fact that most of the seed harvested is of a Certified type. In the sowing down of new areas for seed production seed of the highest grade of Certified seed obtainable should be sown.