

STRAIN IN SUBTERRANEAN CLOVER.

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SUBTERRANEAN *clover* (*Trifolium subterraneum*) is an annual which perpetuates itself by copious reseeding. In grassland, economy the annual is important, and more particularly so under soil and climatic types that impose on the vegetation periodic and seasonal stresses unfavourable to sustained growth. Low soil-fertility that permits of vacant spaces in the sward, or drought that causes growth to cease and swards to open, are the two major contributing factors to the income and persistence of the annual. The common annual clovers in New Zealand grasslands may be arranged in an ecological order ranging from the hardest and poorest of habitats up to habitats where the perennial species are able to dominate. Haresfoot trefoil, striated clover, clustered clover, suckling clover, hop-trefoil, reversed clover, subterranean clover, spotted burr-clover, and toothed burr-clover represents a fairly accurate placing in ascending order according to habitat, the haresfoot trefoil occupying the poorest and hardest habitat, and the burr-clover the more fertile. The habitat a stage better than the burr-clover habitat may be occupied by perennial species, and the chief of these is white clover. White clover, however, also perpetuates itself on fairly hard habitats by reseeding; and in this regard it is of great ecological interest that the poorer, short-lived, almost annual strains of white clover dominate on the more arable and harder habitats in New Zealand, the more perennial strains occupying the really high-fertility habitats, that seldom are subject to hard seasonal conditions. Of the perennial strains of white clover, Kentish wild white appears to offer the best form for perennial low-fertility habitats, the New Zealand type 2 the more suitable for the next grade of soil, and the New Zealand type 1 for the most fertile, soils or those that can be rendered so by top-dressing, &c.

This classification of clover types enables one to visualize readily the place subterranean clover may take in grassland ecology. The burr-clovers may be ruled out as being unsuitable for pasture work on account of their low palatability and burr-like seed-pods that are a menace to the wool crop. Thus subterranean clover occupies a place in grassland ecology intermediate between suckling clover and perennial strains of white clover, merging well with the suckling clover habitats and covering as well the habitat range of the annual and short-lived strain of white clover. A plant in such a position is of great value in any programme of pasture improvement, where the initial soil conditions are such that good strains of white clover may not be readily established. Subterranean clover, then, is a pioneer acting in the capacity of a stepping stone between the less valuable annual clovers and white clover. The above arrangement of clovers is a reliable index of the available soil, fertility, particularly in regard to available supplies of phosphate, potash, and lime; and just as each

represents a fertility standard so each represents a fertility demand. Thus subterranean clover has; a soil-fertility demand between suckling and white clover.

The rise of a species to dominance in grassland is, a reflex of its ability to produce under the conditions offering. Thus, in a rising scale of fertility upbuilding, subterranean clover replaces suckling clover and white clover replaces subterranean clover, provided always in the latter case that droughts do not hinder and retard the development of the perennial white clover.

The ability of subterranean clover to produce more fodder than suckling clover is the keynote to the successful use of phosphatic top-dressing on country that prior to the introduction of subterranean clover, scarcely returns sufficient growth to warrant the expense of top-dressing. Haresfoot trefoil, striated clover, clustered clover, and suckling clover all respond to phosphatic top-dressing, but the results from top-dressing these plants have not encouraged the widespread use of phosphate on them. The introduction of subterranean clover on to country carrying swards where the lesser annual clover dominated previously has meant an extended range of country that can be profitably top-dressed, and this fact has led to an enormous increase in the amount of subterranean-clover seed sown during the last two or three years. It must be realized that the value of subterranean clover is largely wrapped up in the knowledge that the country pays to top-dress when subterranean clover is present, and does not pay to top-dress when subterranean clover is absent.

This point alone is of great significance, because the moment phosphate may be economically applied, any grassland farmer has the, making of his country in his own hands. Phosphate is the driving force to grassland progress, and the more efficiently this force can be applied the greater the progress. Subterranean clover is a more efficient and larger-capacity machine for the exploitation of phosphate than are the lesser annual clovers, and on this fact lies its intrinsic potential value on all, those soil types which in their initial unimproved conditions do not, or cannot be economically made to, support white clover.

The writers in subsequent pages have dealt with the question of strain in subterranean clover, and it will be clear that there are possibilities in regard to the use of various strains. Subterranean clover in itself reflects extremely well the selective propensities of a species to variously conditioned habitats. Thus we have the extremely early, stemmy, free-seeding, short-lived strains that are suitable for the extremely dry habitats where only short periods for growth intervene between periods of drought. The mid-season strains can be regarded as suitable for less droughty conditions, and the late strains suitable for areas where moist conditions prevail well into the season. Ecologically there is no call in New Zealand for the specially early-flowering group, but there is definitely a place for the mid-season- and late-flowering groups. Both these latter groups are desirable-the mid-season to give the autumn, winter, and early spring growth, and the late to continue the spring growth further into the summer. Thus the use of the two

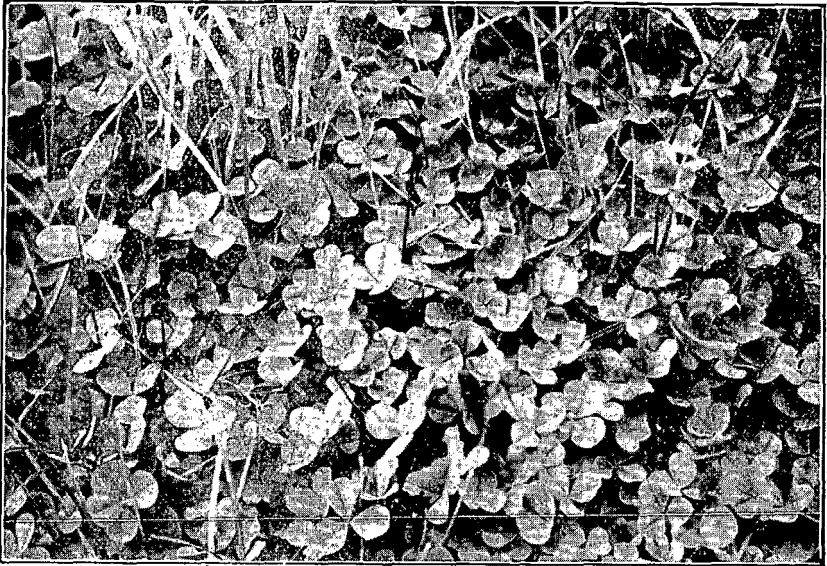


FIG. 1. PERENNIAL RYE-GRASS, SUBTERRANEAN CLOVER, WHITE CLOVER IN ASSOCIATION ON RIVER-ACCRETION COUNTRY, - GIVING A GOOD SWARD WITH THE SUBTERRANEAN CLOVER DOMINATING THE WHITE CLOVER.

Such a sward can be profitably top-dressed.

[Photo by E. Bruce Levy.]



FIG. 2. PERENNIAL RYE-GRASS, WHITE CLOVER, SUBTERRANEAN CLOVER IN ASSOCIATION ON RIVER-ACCRETION COUNTRY.

White clover is dominating the subterranean clover wherever the soil fertility is sufficiently high for good white-clover growth or is being maintained at a high level by the use of superphosphate.

[Photo by E. Bruce Levy.]

strains, either blended together in the one mixture or sown as separate paddocks, tends to extend the seasonal range of production of subterranean clover on the farm.

Subterranean clover generally should not be sown pure but for preference should be combined with a good perennial strain of white clover and perennial rye-grass.

The reason for this is obvious, viewing the possibilities for improvement and development that are created by phbsphating and by increasing the stock carried per acre as a result of the increased feed produced. The subterranean clover initiates the

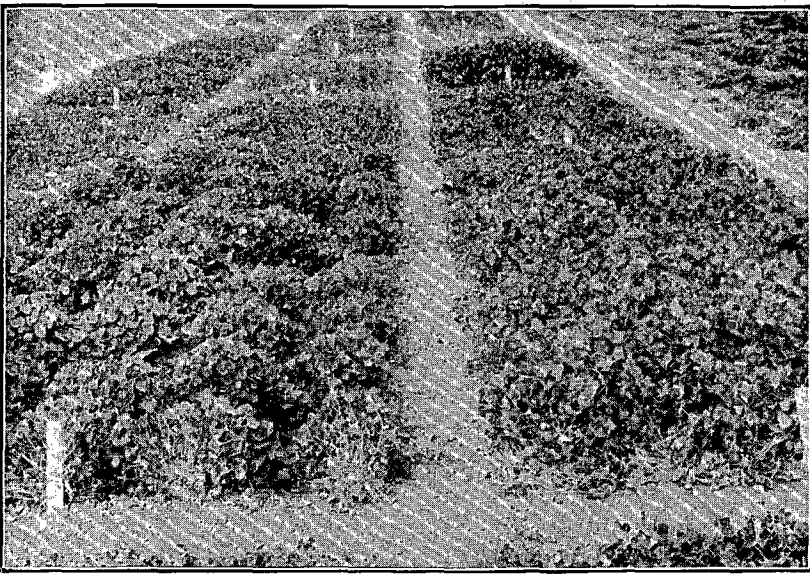


FIG. 3. SUBTERRANEAN CLOVER STRAIN TRIALS SHOWING SPRING GROWTH, AND PARTICULARLY THE GOOD EARLY SPRING GROWTH OF THE BUMERANG AND NANGEELA STRAINS.

Photograph taken 16th October, 1935.

Foreground (left to right) : (a) Bumerang. (b) Nangeela.

Second row : (a) Mount Barker. (b) Mount Barker. (c) Tallarook.

Third row : (a) Myall. (b) Daliak. (c) Wenigup.

Fourth row : (a) Mount Barker. (b) Tallarook. (c) Dwalganup.

[Photo by L. W. Gorman.]

improvement, and the stock carried, in addition to the phosphate applied, carries this improvement forward to a point where the conditions are made suitable for the growth of good strains of white clover and rye-grass, and the moment this eventuates, provided the white clover and the rye-grass are included, the development is carried a stage further, to the point, that there develops a rye-grass white-clover sward with the subterranean clover occupying a smaller and smaller position in the grassland; it going the way of all annuals once the soil conditions are brought to a stage where the high-producing perennial species are adequately provided for.

In the case of developing very low-fertility soils which have to undergo marked change, before the rye-grass-white-clover sward is possible, then, pure sowings, of subterranean clover may be fully justified, but where the soil and climatic conditions are not far removed from the possible rye-grass-white-clover sward, then the three species should be combined.

STRAIN TRIALS.

Altogether fifty-seven different samples of this seed have been grown at this station. Nine were from commercial sources and forty-eight were obtained from Australian research stations. After making general



FIG. 4. SUBTERRANEAN CLOVER TRIALS SHOWING THE TOTAL AMOUNT OF GROWTH UP TILL THE END OF SPRING.

Photograph taken 28th November, 1935.

Foreground (left to right): (a) Myall. (b) Daliak. (c) Wenigup.

Second row: (a) Mount Barker. (b) Tallarook. (c) Dwalganup.

Third row: (a) Dwalganup. (b) Hill's Small-seeded. (c) Wangaratta.

[Photo by L. W. Gorman.]

observations for a period of three years, a more intensive study was commenced. This has been in progress for the last two years. Seed of each sample was sown in boxes of sterilized soil on 11th February, 1935. The resulting seedlings were planted out in May as spaced plants 1/2 ft. apart in plots 10 ft. long by 5 ft. wide, and then allowed to grow and join up to form the equivalent of a broadcast plot. Completed records on these plots over a period of one year, were kept, and the following matters were recorded: Nature of growth (leafy or stemmy); time of commencing growth (late winter or early spring); date of commencing flowering; date of dying off (summer); yield of herbage;

time of re-establishment from shed seed ; autumn growth ; rust infection ; winter growth. When all these matters were taken into consideration it was found that the samples could be classified in four groups. The general characteristics of these groups are as follows :--

Group 1.—Each strain included in this group has small dark-green-coloured, indistinctly marked leaves. The plants were stemmy and prostrate in habit. In the year of planting the time of commencing growth was delayed till the beginning of August, and even then the growth consisted of only a few short trailing stems bearing a number of florets but very few leaves. Flowering commenced very early (the first week in August). Subsequent growth was limited in amount,



FIG. 5. SUBTERRANEAN-CLOVER TRIALS SHOWING THE TOTAL AMOUNT OF HERBAGE PRODUCED FROM THE LATE WINTER TILL THE END OF SPRING ON THE SAME PLOTS AS SHOWN IN FIG. 4.

These were cut and weighed on 29th November, 1935.

[Photo by L. W. Gorman.]

and these plants were the first to die off in the summer (last week in December). The total production for this growing-season was extremely low. (See Tables 1 and 3.) As the result of heavy summer rains re-establishment from shed seed was very early (third week in January). For the next three months growth was rapid and production good. After cutting (early in May), these strains, together with all others, remained dormant till mid-July. Leaf-growth then commenced, and production has been quite good, but early maturity is indicated by the fact that flowering has been general during the last week in July of this year.

Group 2.—The strains of this group are leafy and have a leaf-size greater than those of Group 1. In the year of planting growth was early and good right from the beginning of August till the end of

December. The total yield of green herbage was very high. (See Tables 1 and 3.) The commencement of flowering varied between 13th September and 18th October. Good seed-setting followed. Re-establishment of seedling plants commenced before the end of January, and rapid growth followed. This group gave the highest production for the autumn period (see Tables 2 and 3), and has been able to make a moderate amount of growth in midwinter.

Group J.—This group closely resembles Group 2 in that habit of growth, time of flowering, and seasons of production are as given above. The essential differences which define this group are—(1) Growth is very limited till after the beginning of September (one month later than that for Group 2); (2) total production is of good average only, being at all times considerably below that of Group 2. Autumn establishment and growth was good, but from the beginning of May till the end of July this group has been completely dormant.

Group 4.—When in full growth these strains are large-leaved, but throughout the early part of the spring they appear as small leafy rosettes, and productive growth does not start till as late as the 1st week in September. From that time onwards growth is very rapid and within the following eight weeks there is a greater yield of green material than is made by strains of any other group even when these others commence growth eight to ten weeks earlier. Flowering did not occur till after the middle of October, and these late strains continued to make good growth till the end of December, and actual death did not occur till mid-January (two weeks later than for other groups). This late dying-off was followed by delayed germination, and re-establishment was six weeks later than for Groups 1 to 3. Fairly good autumn growth followed till the beginning of May, after which growth remained dormant for a period of two months. Towards the end of July the plants of these strains appeared as small leafy rosettes, giving good ground cover, but not making any productive growth.

TABLE OF DATA REGARDING SEASONAL PRODUCTION.

Some indication of the relative production of each group can be ascertained by reference to Tables 1 and 2, which have been compiled from relative values (0-100) allotted to each strain at fortnightly intervals throughout the growing-period, which extended from mid-July of the one year to the beginning of May of the following year. In these tables each group is compared with Group 3 = 100, since this group has given a fairly average performance at all periods of growth.

Table 1.—Production of each Group of Subterranean-clover Strains relative to Group 3 = 100 for the Period Mid-July to the End of December.

	Number of Lines.	Mid-July to End of December.			
		Mid-July to 31st August.	1st September to 30th September.	1st October to 29th November.	29th November to 23rd December.
Group 1		5.6	14.6	4.5	Nil
Group 2	4	131.0	145.7	33.6	30.8
Group 3	17	100.0	100.0	100.0	100.0
Group 4	7	100.0	86.7	102.9	272.0

This table shows the superiority of Group 2 right from late winter and throughout the spring. The low production and early death, of Group 1 is emphasized, as is also the late-spring and early-summer growth of Group 4.

Table 2 shows the relative growth from the end of January till the end of July.

Table 2.—*Production of each Group of Subterranean-clover Strains' relative to Group 3 = 100 for the Period Late January till the End, of July (i.e., after Re-establishment from Shed Seed).*

	Number of Lines..	Late January to End of July.		
		23rd January to 2nd March.	2nd March to 4th May.	27th May to 30th July.
Group 1	4	38	123	633
Group 2	5	108	124	296
Group 3	17	100	100	100
Group 4	6	7	69	80

Here again Group 2 is consistently above the average. The relatively good autumn and winter growth of Group 1 is indicated, but, although for June and July Group 1 appears twice as productive as Group 2; the total production even for Group 1 is quite low. The figures for Group 4 emphasize its late establishment, which is followed by relatively lower yields. (See also Table-- 3.)

THE STRAINS WITHIN EACH GROUP.

For the purpose of identification a number of "strain" names have been used in Australia, and samples sent to us have been referred to as being under one or other of twenty-five different names. The names of the strains which come within each of the Groups 1 to 4 above are as follows:—

Group 1.—(Early-flowering and low production) : Dwalganup, Daliak, Springhurst, Mulwala.

Group 2.—(Mid-season-flowering, early growth; very good production) : Burnerang, Myall, Nangeela, Bacchus Marsh.

Group 3.—(Mid-season-flowering, good average production) : Mount Barker (commercial); Mount Barker (selected), Western Australia, Kybybolite, Goroke, Wangaratta, Orford, Orford Selection, Hill's Small-seeded, White-seeded.

Group 4.—(Late season-flowering, late growing; but heavy production in the late spring) : Tallarook, Romsey, Bena, Kyneton, Macarthur, Wenigup, Bass.

These names seem to indicate places of origin of these strains rather than strictly distinct strains. In Group 2 Myall and Bacchus Marsh are indistinguishable as separate strains. In Group 3 the strains Mount Barker, Goroke, Western Australia, Orford Selection, Kybybolite, and Orford are morphologically and ecologically alike.

In Group 4 the names Tallarook, Romsey, and Bena are used for three strains which appear identical in every respect.

ECONOMIC IMPORTANCE OF THE DIFFERENT STRAINS.

The strains in Group 1 do not appear to be suitable for use in New Zealand, on account of their low total production (see Table 4) and relatively early maturity, although their autumn and winter growth has been fairly good.

Group 2 contains strains which have grown particularly well at all periods. This is shown in the following Tables 3 and 4, which give actual green weights, also in Tables 1 and 2, which have been computed from figures allotted by an eye-estimation method.



FIG. 6. SUBTERRANEAN-CLOVER STRAIN TRIALS.

The growth shown is the total autumn growth following re-establishment from seed shed the previous summer. At this stage rust infection occurred. The photograph shows the Burnerang in the mid-foreground comparatively unaffected, whereas the surrounding plots each show a considerable amount of rusting. Photograph taken 28th April, 1936.

[Photo by L. W. Gorman.]

Table 3.—Green Weights of Herbage (Pure Subterranean Clover) cut and weighed on 29th November, 1935, and again on 4th May, 1936.

A	29th November, 1935.		4th May, 1936.	
	Average Green Weight per Plot.	Yield relative to Plot. Group 3 = 100.	Average Green Weight per Plot.	Yield relative to Group 3 = 100.
Group 1	6.7	21	16.75	184
Group 2	41.32	129	17.9	197
Group 3	32.0	100	9.1	100
Group 4	44.75	140	13.4	146

The total average yield for both dates then is as shown below :-

Table 4.—The Total Average Yield of Green Material from Both Weighings.

	Total Averag Yield per Plot.	Yield in Tons per Acre.	Yield relative to Group 3 = 100.
	lb.	Tons.	
Group 1	23·45	9·15	57
Group 2	59·62	23·20	45
Group 3	41·10	16·00	100
Group 4	58·20	22·60	142



FIG. 7. SUBTERRANEAN-CLOVER STRAIN TRIALS.

Autumn re-establishment showing delayed germination and growth of the late-flowering strains. Date : 16th March, 1936.

Foreground (left to right) : (a) Kyneton (late). (b) Springhurst (early). (c) Burnerang (early mid-season).

Second row : (a) Bacchus Marsh (early mid-season). (b) Bena (late). (c) Orford (mid-season).

[Photo by L. W. Gorman.]

The two weighings were made at periods when seasonal growth was almost completed, so the figures giving total yields practically represent one year's production from a pure sowing of subterranean clover under local climatic conditions.

Each of the strains Bumerang, Nangeela, Myall, and Bacchus Marsh, which constitute Group 2, is likely to be of considerable economic importance in New Zealand, because of the exceptionally good total production, together with good growth at seasons when any clover-growth is exceptionally valuable--i.e., winter, early spring, and early autumn. In growth-form the Burnerang is quite distinct from all other

subterranean-clover strains tested. The plants themselves are characteristically erect leafy bunches of very slender stems and medium-sized leaves. (All other strains are prostrate and spread laterally.) The Nangeela is 'more like a large-leaved strong-growing white clover. It has leaves very distinctly marked with a white band across them. Both Bacchus Marsh and Myall appear like vigorous forms of the average commercial (Mount Barker) type. The essential difference noted is that in the Mount Barker at the base of the calyx-tube of the floret there is a distinct red-coloured band, whereas the calyx-tubes of both Bacchus Marsh and Myall are colourless at the base. The calyx-tube of Nangeela is light-green-coloured, and has no red coloration. Both the Burnerang and the Nangeela are able to make growth in the winter months and early spring, but Bacchus Marsh and Myall are more winter-dormant. The Myall is particularly good in the autumn.

Practically all of the subterranean-clover seed sold commercially in New Zealand in past years has been of the Mount Barker type. This strain, together with the others of similar type but differently named (see Group 3), can be relied upon to give reasonably good results, and until superior strains are available commercially the sowing of the Mount Barker type is quite worth while. Strains within Group 3 which differ slightly from the Mount Barker are the Wangaratta, Hill's Small-seeded, and White-seeded. The Wangaratta makes autumn establishment and growth rather later than the average for Group 3. Hill's Small-seeded and White-seeded are more slender and leafy than the typical Mount Barker, but the total production of each is low.

A characteristic of Group 3 is its proneness to severe infection from leaf-rust (*Uromyces trifolii*). This was most noticeable in the autumn. Growth since the beginning of February had been very rapid, but by the end of March it had reached a stage of maturity, and at that stage the rust attack developed. The Hill's Small-seeded strain was the most severely infected. The strains in the other groups were only slightly affected, as the following figures show :-

Table 5.—Relative Degree of Infection by Leaf-rust (*Uromyces trifolii*) on Subterranean-clover Strains within Groups 1 to 4.

(Heaviest infection = 100. At date 27th April, 1936.)

Group 3	100.0
Group 2	39.0
Group 1	29.0
Group 4	2.5

It will be noticed that the strains in Group 4 which were still growing were affected only very slightly. In Group 2 the Bacchus Marsh strain, which was quick-growing in the early autumn, was rather severely attacked in this respect, being much worse than any other strain outside of Group 3.

Although the strains of Group 4 give a total yield about as great as that for Group 2 (see Table 4), the herbage itself is of less economic value, since it is produced relatively late in the spring and somewhat late again in the autumn, and, further, this high production extends over a limited period of approximately ten to twelve weeks only in either the spring or the autumn. Of the strains within Group 4 the Tallarook, Bena, and Romsey were outstanding for high total production of green material. The Kyneton, Macarthur, and Wenigup gave much

lower yields. Each of the extra-late strains failed to germinate and establish quickly in the autumn. The Macarthur established the most quickly, and the Tallarook, Romsey, and Bena were next. Comparatively few seeds of the Kyneton had germinated before the beginning of March, and this plot 'remained weak throughout the autumn. The Wenigup completely failed to re-establish itself.' This was most likely due to the date of cutting and weighing (29th November, 1935) interfering with flowering and seed-setting. The Wenigup was the only strain thus, to fail so completely.

Since these extra-late varieties are capable of exceedingly high production, the ecology of this group as a whole requires further study. In any case, the Tallarook, Romsey, and Bena strains have proved superior to other strains of the same group, and it is quite possible that in practice these particular strains may prove equally as good as the commercial types now in use, and most likely at certain times of the year (particularly the early summer) the Tallarook, Romsey, or Bena would excel. The Tallarook, Romsey, and Bena strains each have florets with calyx-tubes either colourless or pale green at the base, and the stipules are green-veined (many other strains are red-veined). Another characteristic feature is that while the plants are in the rosette stage—i.e., towards the end of winter—that portion of each leaflet nearest the petiole is a deep-chocolate colour. This chocolate area may cover half the area of each leaflet. Later in the spring this chocolate colour disappears.

STRAINS IN COMMERCE.

Until recently practically all of the subterranean-clover seed sold in New Zealand was of the Mount Barker type, but now Australian catalogues list supplies of the Dwalganup early and the Tallarook late, as well as the Mount Barker mid-season strain, and it is known that some hundredweights of Tallarook seed have reached New Zealand this year. There is no direct report of any Dwalganup seed having been sown in New Zealand, but it is important to note that although this strain is, being certified to by the Western Australian Department of Agriculture, and is specially recommended for 'use in districts of less than 20 in. of annual rainfall, where early maturity, and seed-setting is essential, there is every indication that this strain is unsuitable for use in New Zealand.

CONCLUSION.

From a study of existing strain differences a classification of strains into well-defined groups has proved possible.

Burnerang, Myall, Nangeela, Bacchus Marsh, Tallarook, and Mount Barker appear to be strains well worthy of extended experiment and field trial. Botanical characters which aid identification of each of the above strains have been given.

Unfortunately, seed-supplies of Burnerang, Nangeela, Myall, or Bacchus Marsh are not available in commercial quantities, but at the present time while we are studying these strains we are also growing seed&crease blocks of the most promising strains: When seed-stocks are available it will be essential to have the growing, harvesting, and distributing of these strains protected by a system of seed certification.

DISCUSSION.

Mr. Bruce Levy: The main point that seemed to arise from the papers was the way to regard subterranean clover—whether as a companion plant for the high-producing pasture or more as a pioneer for the breaking-in of marginal and unimproved land. The matter more or less hinged on the utilization of subterranean clover—whether we should utilize it under a rotational system of grazing or whether we should subject it to hard and continuous grazing. To my mind it is not so much a question of persistency as one of production under the two methods of utilization. The question of taint in cream is a matter of importance. In those instances in which no taint is experienced, are the farmers supplying cream or milk? There was also a certain amount of difference of opinion expressed regarding bloat, and evidence with regard to that would be welcome.

The other question which came but in the papers was whether subterranean clover should be sown in a mixed pasture so as to provide for seasonal phases in that pasture, or whether we should have special-purpose pastures. Lucerne was mentioned as one of these.

Mr. Palmer: Regarding fertility, the country referred to is particularly light and poor. It is too poor to grow oats; in fact, it would not even grow grasses. White clover does not hold in such country, and it is probably through this that subterranean clover was introduced.

As to growth in the autumn; last year, six weeks after rain, the growth from seedlings was as high as 5 in.

Mr. J. Bell: In my district it is a wet climate, and the growth of subterranean clover is poor compared with white clover.

Mr. Cockayne: Firstly, under the name of Mangere clover; the Auckland farmer does not like subterranean clover. There is very little subterranean clover grown there, whereas in the Wellington and Hawke's Bay districts the amount of seed of subterranean clover being sold at present is quite large, indicating, at any rate, that there is a considerable development in subterranean clover in the southern part of the North Island. The objections against subterranean clover brought up from the Auckland end are objections which were used many times, in the earlier days of subterranean clover. We had subterranean clover in the Auckland district, but, were not satisfied it would fulfil any useful purpose. It was claimed that the dying-away of the clover led to excessive development of a plant commonly known as rib-grass. What is the likely position of subterranean clover as a succulent and useful clover in building up the carrying-capacity in the early stages of improvement of land?

Mr. Abraham: Subterranean clover has made a name for itself in the dry Hawke's Bay country, along the sandy coast of Manawatu, and in the Wairarapa, where conditions are too dry for white clover. On the Manawatu alluvial soil subterranean clover has not taken on with the farmers.

Mr. Cockayne: The main development will follow the more or less dry east coast, roughly, from Oamaru to Napier. We would like to know whether, in the improving of country in the Auckland area, there is likely to be any place for subterranean clover, also whether, where farmers are improving land for sheep-production, it has any place.

Mr. Flay: In Canterbury we have large areas of light land on which the subterranean clover has developed enormously; tons of seed have been sown by farmers during the last two autumns. On the hilly land, as well as the plains; there are paddocks that have been sown in subterranean clover, and under proper conditions under grazing where the plants are. Allowed to seed and where it is top-dressed subterranean clover seems, to have, a very definite place in the building-up and maintaining of a permanent pasture where before this was absolutely impossible.

Mr. Cockayne: One of the most significant features with regard to the use of subterranean in Canterbury was that apparently it did not spread and develop to any very great extent, although during the past twenty years much of it was sown. One wonders whether subterranean clover may not have been under a difficulty in these sowings by being kept too closely grazed.

Mr. Flay: There are thousands of acres in Canterbury, at Avonside, Burnham, Hororata, &c., where subterranean clover is extremely encouraging. Subterranean clover has a place on poor types of soil. In haymaking is mowing a real difficulty?

Mr. Hamblyn : It has been estimated that in the southern half of the North Island there are half a million acres of land which can be improved by sowing subterranean clover. This is correct to my mind. The only point to be considered is whether it is worth while. Land carrying one dry sheep to the acre has been changed to land carrying three ewes to four ewes to the acre, and this seems worth while.

Mr. Holford : In Australia subterranean clover is more dependent on phosphate each year than is white clover. Subterranean does better on light soils than white clover. In Canterbury in dry autumns the establishment has been too late to get satisfactory winter production ; this limited the farmers' enthusiasm over it.

Mr. Lonsdale : In the Northern Waimarino the annual rainfall is about 70 in., and after a succession of thirty frosts subterranean clover is growing vigorously on the poor, light soils, on which it has a very big place.

Mr. Scott : It is under low rainfall that subterranean clover finds its best expression. The winter growth of subterranean clover is what has made it so popular on light land and in low-rainfall areas. It can maintain itself on the land year after year, whereas white clover disappears. I know of 30 acres carrying 250 sheep from March till July and 26 acres fattening 250 hoggets.

Mr. Smallfield : In the Auckland Province we have two classes of poor land—light and heavy. Both require phosphating before either subterranean or white clover will grow. On light land white clover is the most satisfactory clover. The general aim is careful cultivation and then keeping white clover vigorous with top-dressing. The difficulty that subterranean clover has is that on very poor land that sets hard the subterranean clover does not re-establish well. On practically all the lands that are not really sufficiently dry to kill out white clover we can grow white clover if we phosphate and lime. Regarding bloat, there is not much difference between subterranean clover and white clover. The position is that the subterranean comes on earlier in the spring than white clover, and it is early in the season that cows bloat on clover. Where there is no subterranean clover they will bloat later just as badly on white clover.

Mr. Galpin : Subterranean clover requires rather dry conditions according to the Auckland viewpoint. The conditions of Mr. Hill's farm are anything but dry, and Mr. Hill asked me to make the point that subterranean clover is growing and doing well under wet conditions.

Mr. Bell : Our experience in Auckland is that subterranean clover definitely will not grow under wet conditions, and white clover will.

Mr. Craig : I am farming light, sandy country, of which a considerable area was practically useless. About four years ago I drilled 4 lb. of subterranean clover an acre on that area, top-dressed it, and it has been top-dressed once since, and at present milking cows are run on it ; they are not the best, but they are giving about 2 gallons per cow on country which four years ago would not keep half a dry sheep to the acre. It is definitely of great value in improving light country. I have sown on light ridges and expect to milk on that country this season. Last year I lost two cows with bloat and lost considerably more with other clovers.

Mr. Levy : The great value of subterranean clover lies in the fact that it enables us to exploit phosphate on country where we could not exploit it without subterranean clover. Immediately we introduce subterranean clover into those marginal lands it means we can also use phosphate, and when the farmers of New Zealand can economically use phosphate they can start a sequence of events which ultimately lead to the rye-grass • white-clover • dominant ideal pasture, and some plan by which stock-carrying can be increased.

Mr. Cockayne : A great deal of the top-dressing experience of the past on the poor hill-country of Wellington and Hawke's Bay has not been satisfactory, but there is every indication that the relationship of subterranean clover and phosphate will make top-dressing of such country definitely a payable business. I feel that, as far as the Auckland country is concerned, it is better to spend more on the initial improvement of such country and go straight into high-class grassland than try intermediate steps.