

. STRAIN DEVELOPMENT IN HERBAGE PLANTS.

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Breeding, feeding and management are prime factors in animal husbandry and the same basic principles are rapidly assuming like significance in grassland development.

In grassland ecology species and strains of these have their specific habitats and this is true also in animal ecology. The feeding of our grasslands - and by feeding I mean the provision of an environment suitable for optimum development - manuring, drainage, soil moisture conservation, soil aeration, etc. - is akin to feeding of stock, and finally the management and utilisation of the herbage produced has its parallel in the care and efficient exploitation of the animal. Choosing species, breeding strains of these, feeding the sward, and utilising to the best advantage the herbage produced - are fundamental to sound grassland development.

Strain in herbage plants is now receiving world-wide recognition, and the strain-testing field laboratories are assuming equal significance to seed-testing laboratories where seed germination and seed purity are determined.

Persistent strains of pasture plants that make a perennial sward hold the ground against weed invasion: high production strains give the greatest return for money spent in manuring and other cultural aids to growth: strains with a long seasonal growth or mixtures of strains that may be evolved extend the grazing period and tend to level out better the seasonal production from grassland: improved strains give greater scope for specialist management and create an added incentive to better farming.

The object of this paper is to indicate the progress in strain testing and strain building as far as New Zealand is concerned.

The species under critical study at one institution or another are Perennial ryegrass, Cocksfoot, Crested dogstail, White clover, Broad Red clover, Montgomery Red clover, Italian ryegrass, Brown-top, Lotus major, Subterranean clover, and *Danthonia pilosa*.

There are two main practical phases in strain-building: (1) the location and isolation of useful ecotypes and the reproduction of these under a system of certification - Hawke's Bay ryegrass, N. Z. No. 1 White clover, and Akaroa Cocksfoot may be cited: (2) the selection from those ecotypes by single plant study, breeding to pedigree standard, and ultimate propagation of bred strains under a system of certification.

The immediate practical outcome of strain work to date in New Zealand is the production of some 236,000 bushels of certified perennial ryegrass, 600,000 lbs. certified cocksfoot, 30,000 lbs. certified white clover, 3,000 lbs. certified Montgomery Red clover, and approximately 200,000 lbs. certified Brown-top. Lincoln College has produced a strain of cocksfoot C.23 that is up to pedigree standard and some 36 acres of this strain is now sown out under the Department's certification scheme. The Plant Research Station is on the threshold of the production of pedigree strains of Perennial ryegrass, white clover, and Montgomery Red clover. Five acres of a selected No. 1 White clover is to be sown this coming spring at the Department's Pure Seed Station at Lincoln. A small crop, some 30 lbs., of a selected Montgomery Red clover is available from the Plant Research Station for distribution as Mother seed or for field trials

on an extended basis. Up to the present year controlled pollination, excepting by isolation by distance, has not been possible for nucleus stocks of pedigree lots. Four glasshouses have now been erected at the Plant Research Station whereby control of pollination of nucleus lots is possible.

Pedigree seed production demands time. Beyond a certain point the process cannot be hastened. Aberystwyth Plant Breeding Station after some twelve years is now commencing to place pedigree seeds on the market on a commercial scale. Unless commercialisation of pedigree strains becomes an accomplished fact the work goes for naught. Certain species of course may not lend themselves to rapid improvement, and the results of many years' work may lead to nothing but disappointment. A rapid survey of the position, however, should soon indicate to anyone worker whether a particular species was amenable to a worth-while improvement by selection.

I would like to indicate briefly the lines of strain building being adopted at the Plant Research Station at Palmerston North.

The work is developing along the following set plan: (1) Collection of material, (2) Testing of material by broadcast plot trial and single plants, (3) Isolation from material of ecotypes that are of outstanding merit, (4) Location and commercialisation of these ecotypes under certification, (5) single plant study of approved ecotypes, (6) Selection of the most promising single plant material, (7) Study of those over a three-four year period (1 - 2 years as single plants and 1 - 2 years further as tiller row and tiller single plants) including selfing (if possible) and crossing of parental material under isolation in cages, (8) Increase of approved parental material under isolation within glasshouses, (9) Increase of glasshouse progeny on Pure Seed Station under good isolation conditions, (10) Increase of Pure Seed Station progeny on the farmers' fields under certification, (11) Progeny testing of Mother seed and its farm-grown progeny to critically study truthness to or deviations from type by outgrowing.

The commercial seed sample has been used largely as a basis of our selection work. Certification affords a remarkable opportunity for the collection of these samples and guarantees the authenticity of origin. A great number of lines are dealt with and the more promising are chosen for critical study, and as a basis for further selection we are endeavouring to put out each year some 4,000-6,000 single plants from (1) the best mother seed lines offering out of those tested for certification purposes, and (2) from the seed stock of the prior year's selections. Four thousand to six thousand single plants should give say 160 first-class plants after two years' study, and these may then be reduced to 10 of the best that become the nucleus lot for the next season's elite strain. From this strain 4000-6000 single plants will be put out and the process of culling a selection repeated. The work to date aims more at a good composite strain rather than a pure line strain, for the reason that a mixture of good strains is more likely to give a longer seasonal spread than is any one pure line strain.

In strain building there are two possibilities: (1) The production of strains for New Zealand's own requirement and (2) The production of strains for overseas requirement. The popular thesis held by workers in strain building is that no strain suits another country so well as the strains that are developed from stock within that country. We in New Zealand view as being the most desirable stock for our own conditions the Hawke's Bay type of ryegrass, the Akaroa type of cocksfoot, the N. Z. Nob 1 White clover, and Marlborough lucerne. Whether this thesis is arising as a result of parochialism or as the outcome of definite trials I

an unable to state, Evidence for and-against the thesis is being gradually accumulated and there is certainly much that conflicts with the general acceptance of the thesis as a sound working hypothesis.

In the case of perennial ryegrass, the best British commercial ryegrass appears almost identical to what we would term good false perennial. It carries on the average approximately a 6 - 1.2 per cent. glow under screened violet light. The British indigenous ryegrass is very like the Hawke's Bay in growth form but its production is lower and its period of growth shorter than the Hawke's Bay when both are grown in New Zealand. In Australia, in the Western District in Victoria, there is a type of ryegrass indistinguishable from the best Hawke's Bay and the dominant note in the Australian experience is that the Western District seed is on a par in Australia with Hawke's Bay seed sown also in Australia. The Australian evidence places the British commercial as being inferior to their own Western District seed and inferior to the N.Z. certified perennial ryegrass. One individual report from U.S.A. indicates greater persistency from the N.Z. certified strain than from American commercial types alongside, and one individual report from Natal asserts that the New Zealand certified strain is the best ryegrass in the world. Other reports from Africa, however, indicate that ryegrass is suitable only on the heavier rainfall belt. Stapledon in his trials at Aberystwyth has stated generally that the lots that do best in New Zealand also do correspondingly well in Great Britain, but that none of the New Zealand ryegrass is as good as the British indigenous. The British indigenous in New Zealand is inferior to the Hawke's Bay strain from two points of view: (1) The low productivity and (2) The comparatively short seasonal growth.

In the case of cocksfoot - Britain condemns Danish cocksfoot for the same reason that we do in New Zealand, i.e. its low leaf yield in relation to seed stalk, its greater tendency to winter dormancy, and its relatively low persistency. The type of cocksfoot being developed in Great Britain is almost identical to the Akaroa strain and this is particularly true of certain Irish selections and those of the Welsh Plant Breeding Station specifically referred to as "hay" types. The pasture type being developed at Aberystwyth is a low-yielding type, leafy, dense and persistent, but too low-yielding for New Zealand conditions,

In the case of white clover - Britain again denounces the Dutch type of white clover as being virtually an annual. It is virtually an annual in New Zealand. The N.Z. No. 1 type - the best in New Zealand - is also the best New Zealand type at Aberystwyth. In New Zealand it outyields two to one the Kentish Wild White type, and up to the present has been more persistent, the Kent suffering badly during the longer dormant winter period by ingress of volunteer winter-growing grasses and weeds. The N.Z. No. 1 carries to Great Britain the tendency to extend the seasonal growth of white clover in Great Britain, but yet the white clover laurel in Great Britain is given to Kentish Wild White clover which in New Zealand yields no more than half the production of N.Z. No. 1 type and has a considerably shorter period of growth,

Montgomery Red clover is a moderately perennial clover in Great Britain and it has also proved more persistent in New Zealand than any other Red clover type. We in New Zealand welcome the Montgomery Red clover type for permanent pastures in New Zealand because we have in New Zealand no red clover sufficiently persistent to incorporate in our permanent pastures. The point, however, that I wish to make is that Montgomery Red growing in New Zealand is identical to Montgomery Red growing in Great Britain - the type does not alter as a result of change in habitat,

In the case of Italian ryegrass, New Zealand would appear weak in relation to trueness to type. Aberystwyth has produced an Italian ryegrass that is superior to New Zealand lots of Italian ryegrass sown at Aberystwyth - they also are superior to New Zealand lots when sown in New Zealand.

In the case of lawn grasses also, the New Zealand Brown-top and New Zealand Chewing's fescue are the best lawn grasses in New Zealand. The work of the British Board of Greenkeeping Research at St. Ives, Bingley, in Yorkshire, also acclaims these two species as the best all-round species for lawns and greens in Great Britain, i.e. of the commercial stocks of lawn seeds available,

In the case of annual crops such as turnip varieties, Swede varieties, flower seeds of leading seed firms in Great Britain, etc., these surely behave in New Zealand almost identically to what they do in Great Britain, otherwise there is a big case for New-Zealand-grown seeds in this class of crop.

From this it will be seen that the evidence for and against the thesis of "home-grown seeds are best" is very conflicting. I have, however, particularly emphasized this point because on the correctness or otherwise of it depends our future policy as far as an export trade in seeds from New Zealand is concerned. Pedigree internationally means nothing unless the type holds under a moderate range of conditions,

Ecologically we may class world types in three groups: (1) The cold habitats of the world, (2) The temperate habitats of the world, and (3) The arid habitats of the world. I feel that free interchange of pedigree seeds could be possible between one cold country and another; one temperate climate and another; and one arid country and another; but in all probability the exchange of seeds between any one of the main ecological groups will not be a success. New Zealand should be in a position to grow strains for all temperate countries of the world and in this there is an enormous field. The East coast of the North Island strains may be more eminently suited for Australian and like conditions, whereas Southland may ultimately develop good types more perfectly attuned to conditions in Great Britain. I put this forward merely as a suggestion without any concrete data to support it,

Within New Zealand itself there is no doubt of the superiority of certified strains, and if we but grow on and improve these strains much greater material wealth will be latent in our sown grasslands. I say "latent" specifically, because it is only good farming that will bring out the latent possibilities in a good strain. Good strains will not thrive in spite of poor farming any more than a good cow will yield to its maximum under ill-treatment; but good strains do make good farming pay better. They make a specialist in grassland management possible. Poor strains limit one as a specialist in management, using the word "management" in the wide sense of cultivation, manuring, drainage, harrowing and utilisation.