

REVIEW OF PLANT INTRODUCTION WORK ON PASTURE SPECIES IN NEW ZEALAND

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Perhaps the feeding value and the soil protection value of herbage plants has been appreciated more extensively in recent years, and it may have been realised, also, that the plants which have successfully resisted soil erosion and provided useful fodder, hay, or seed are those which have become completely adapted to the soil, and to the climate, of the region in which they have been grown. With all useful plants important ecological factors have been the habit of growth, resistance to extremes of temperature, the period of the year in which most growth has been made, resistance to plant diseases, relative palatability, and a prime consideration always has been how much forage any particular plant will yield. For soil conservation work the type of root, whether deep rooting or surface rooting, and whether fibrous or rhizomatous, always is of special importance.

New Zealand, in its native state, was not a grassland country, so all our sown grazing lands, as we know them to-day, have been seeded with species introduced from other countries. Of a total of approximately 18,000,000 acres now in sown grassland, 14,000,000 acres have been won from the forest, the shrublands and the fernlands, and 4,000,000 acres have been reclaimed from the swamps and lowland tussock country. A further 20,000,000 acres of indigenous tussock grassland have been modified, either by ploughing and sowing of the lowland tussocks, or by repeated burnings and some oversowings of the tall tussock grasslands (1).

Comparatively few exotic species seem to have established themselves in the montane tussock country; more have established from sowings made after the primary and secondary growths have been cleared and burnt, but many introduced species have not grown well unless sown on cultivated ground. Altogether some 500 species have been listed by Allan (2)

as having become naturalised in' New Zealand. Botanically these are grouped as follows:—

	Families	Genera.	Species
Dicotyledons . .	5 3	205	390
Monocotyledons	10	56	110

This classification includes trees, shrubs, and herbaceous plants. Approximately 206 of these 500 species are recorded now as occurring, more or less frequently, in pastures (3). The majority of these have been of European origin, , although some have come from Asia, the Americas, South Africa, and Australia.

One realises that the introduction of desirable plants into this country has been in progress for more than a century. Some of the commonly cultivated grasses may have been introduced shortly after the year 1800 at the times of arrival of the early whalers, the first missionaries, and the first European settlers. Since that time many useful plants have been introduced intentionally, and many others have arrived accidentally, as impurities among other seeds or in hay, or in the straw commonly used as a packing material. The useful species have been widely sown and together with some species unintentionally introduced, such as *Agrostis tenuis* (browntop), have become very widely distributed.

Still in New Zealand we have potential grazing areas not adequately covered with a suitable type of vegetation, and there are recognised problem areas, such as the eroded hill-country in Poverty Bay, the wind-swept knolls of some of Hawkes Bay's best sheep country, the montane belt in the South Island with its shingle slides, the depleted tussock grasslands of Central Otago, the steeper hill-country of both islands Where slipping movements occur frequently, and the unconsolidated or partly consolidated sand dune areas along our coastline. It is for the grassing or regrassing of areas such as these that plant introduction becomes necessary, because generally the species which are common; and available commercially, will have been sown on these places, and will have failed. The requirement then is to find other plants of a more hardy nature.

The method of obtaining new material has been for the several interested institutions' to follow up overseas literature and to make their own contacts with sources of supply of seeds of plants deemed likely

to prove useful. The Grasslands Division has obtained seed from the Australian Division of Plant. Industry, Canberra; from the Soil Conservation Division of the United States Department of Agriculture; from plant breeding stations in Canada, Sweden, Rumania, and South Africa; from the Botanic gardens, Kew ; and more recently from Uruguay and Portugal, through the agency of The Plant Introduction Service recently set up by the Botany Division of the Department of Scientific and Industrial Research.

The plant material most sought after has been the hardy 'type of perennials, leguminous and non-leguminous, which would grow relatively well under adverse conditions of soil and climate. Our trials were commenced in 1937 and since that time we have studied, ecologically and botanically, the characteristics of some 258 different species.

Briefly our trials have been of four distinct phases as follows :-

(a) Seedling plants have been raised in glass-houses and then planted out in the field, in short rows, for detailed study and comparison with our best strains of ryegrass, cocksfoot, and white clover. Their growth habit has been noted, and frequently a small quantity of seed has been harvested for use in further trials.

(b) Broadcast plots approximately 20 links square have been sown under sward conditions and grazed by stock.

(c) Any species or strains appearing worthy of further trial have been increased and grown for further stocks of seed.

(d) Trials of promising plants or new strains of plants have been sown or planted in a number of different habitats such as on hill-country in Poverty Bay, Hawke's Bay, and the Manawatu, on the coastal sands at Himatangi, in the Central Plateau of the North Island at an altitude of 2300 feet above sea level, and in the Mackenzie Country in the South Island at an altitude of 1700 feet.

-Other organisations also have carried out trials from time to time. The earliest trial appears to be that recorded by Thomson (4) in which 23 introduced species, were placed in trial plots at Ruakura Farm in 1909. At Whangamomona in 1925 and 1926 Levy (5) and Madden sowed a collection of 59 samples of introduced and less commonly used species. Likewise in more recent years the Department of Agriculture has

made experimental sowings on the Pisa flats in Central Otago, and the Botany Division of the Department of Scientific and Industrial Research has its trial ground at Waiwhetu near Wellington and various trials in the montane tussock belt of the South Island.

Many interesting facts have emerged from our trials at Palmerston North, and in the other localities mentioned.

A number of the seed lots received were non-viable, possibly being from samples which had been stored away for a number of years. Some other samples, mainly of sub-tropical origin, germinated satisfactorily but, could not stand extremes of temperature and were killed completely by frosts of 7 degrees (25 degrees F.). Some species appeared definitely useful, others were of doubtful value, and a number appeared quite unsuitable for use anywhere in New Zealand. Summarised the several groups were as follows:—

Total failures before planting out—	No. of species.
Failed to germinate	30
Killed by frost at seedling stage	34
	—
	64
	—

Results of samples **planted out**—

	No. of species	Previously recorded in N.Z.
Considered useful ———	48	20
Still, of possible value	16	3
Of doubtful value	18	2
Considered useless	83	16
Tests incomplete	63	3
	—	—
	228	44
	—	—

DISCUSSION

The grasses unable to withstand colder temperatures are those which are “warm season” grasses which normally begin growth late in the spring and confine their growth to the frost-free period of the year, making their maximum growth in the summer months providing ample moisture is available. Ex-

amples are plants of the genera *Andropogon* (blue-stem), *Bouteloua* (Gramma grasses), *Panicum* (Panic grasses or millet grasses) and *Lespedeza*.

Most of the species in the useful group are "cool season" grasses which grow early in the spring and make their maximum growth before the hottest months of the summer. These are able to stand considerable drought periods and are relatively hardy. This applies particularly to species of the following genera :—

Agropyron (wheat grasses), *Elymus* (wild rye), *Festuca* (fescues), and *Phalaris* (canary grasses). Amongst the *Bromus* species (brome, grasses) there are annuals and perennials which may 'be useful. *Bromus carinatus*, *Bromus polyanthus*, and *Bromus ciliatus* are annuals which closely resemble *Bromus catharticus* (prairie grass). These species make good winter growth and mature in the early summer. In poor land they make little growth, but in rich soil they produce a good amount of forage, which is palatable to livestock. They seed abundantly, and shed seed germinates and establishes freely.

The smooth brome (*Bromus inermis*) is a perennial which develops strong creeping rhizomes. It grows best on well-drained soils of relatively high fertility. It is more drought hardy than most cultivated species, but it will not withstand the extremes of low moisture and low winter temperatures as well as the *Agropyrons*. If conditions suit, it begins growth early in the spring and continues through the summer; the roots form a dense sod which resists grazing and trampling and bind the soil, thus. protecting it against wind and water erosion. Its good volume of leafy forage is relished by all classes of livestock. In America this species has been found very suitable for growing in a brome-lucerne mixture (6).

The only introduced legumes of promise are those of the *Lotus* species-varieties of *Lotus uliginosus* syn. *Lotus major* (greater birdsfoot trefoil) and *Lotus corniculatus* (birdsfoot trefoil), and some strains of the lesser species of *Trifolium* (clovers).

The fact that a number of the species listed are included in the lists of naturalised species does not indicate that these species already are common in New Zealand, but rather that in most. instances they have been observed, but may occur comparatively rarely. With several of the better-known species, such as *Lotus corniculatus* and *Trifolium fragiferum*

(strawberry clover), the introductions are strains superior to our 'own.

There are several species which may prove extremely useful if used for special habitats. Rhodes grass (*Chloris gayana*); a plant of South African Origin, is a tall-growing, vigorous plant which spreads by stolons up to 6 feet in length and roots at every node. It seeds freely and could be a very useful soil binder, except that it is not winter hardy. Its geographical distribution in New Zealand might resemble that of *Paspalum dilatatum*. For coastal belts perennial veldt grass (*Ehrharta calycina*) is a species which has been found to thrive on sandy country. Kikuyu (*Pennisetum clandestinum*) may have a place on wind-swept knolls in the hill-country of central Hawke's Bay.

Eragrostis curvula (weeping lovegrass) is a most promising introduction. It is a tall-growing and vigorous perennial bunch grass producing a tussocky type of growth quite readily eaten by sheep or cattle. It can resist summer heat and droughts and survive extremely low winter temperatures. It seeds freely and is easily established from seed. It appears likely to be successful on a variety of soils.

GENERAL

In any collection of introduced plants there is an obvious lack of leguminous plants. Apart from the *Trifoliums* (true clovers) the *Lotus* species (the trefoils), and *Medicago* species (lucerne and medicks), there appear to be no other genera containing leguminous plants of interest to New Zealand. In America great successes have followed the use of kudzu (*Pueraria thunbergiana*) the *Lespedexas*, and *Crotalaria* species, but all of these are too frost shy to be of use except perhaps in the northernmost parts of New Zealand. The economically important legumes in each of the first-mentioned groups above are already well established in this country. A number of introduced *Lotus* species and strains of *Lotus major* and *Lotus corniculatus* have been studied in the last twelve months. Some of this material may prove useful to the plant breeder, but in general it appears that any leguminous plants for problem areas will have to come from selections within such species already naturalised in this country.

A systematic study of plants before placing them

in general use is essential. First, the growing of plants under close observation at a research centre is one means of preventing the spread of plant diseases from one country to another. Secondly, there is less chance of undesirable plants being liberated. An example of a plant which has proved useful elsewhere but which may be regarded as dangerous here, is *Agropyron smithii* (western wheat grass), which is considered most useful in the Great Plains of America. It develops aggressive rhizomes which would prevent soil erosion, but in arable land it would become as troublesome as *Agropyron repens* (couch grass or old man twitch) is to-day. Similarly plants of the *Stipa* or needle grass species rank fairly high as forage grasses, but the injuries that the long sharp awns cause on grazing animals; together with the damage to the pelts, are serious objections to their introduction.

CONCLUSION

It will be realised that since the number of new species which are at one and the same time good-yielding persistent and palatable are relatively few, in any plant introduction programme many species will be tried but many eventually will be discarded. Although few new species have been found, considerable success has been achieved by the introduction of new strains of our most commonly used grasses and clovers, e.g., the pasture-hay strain of timothy (*Phleum pratensis*) and the Montgomery strain of red clover (*Trifolium pratense*). The methods of obtaining plant material may deserve some discussion. It is possible that the visit of an ecologist and botanist to institutions overseas doing similar work might lead to the collection of material which would never be obtained except by such personal contact, and these specialists, by the application of their knowledge of the requirements of this country, could save much needless effort in the extensive trial of many species which, although excellent in other parts of the world, could never become acclimatised and useful here.

REFERENCES:

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