EVALUATION OF NEW ZEALAND HERBAGE CULTIVARS OVERSEAS

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Abstract

The agronomic performance of the traditional New Zealand herbage cultivars in several overseas countries is reviewed. Preliminary information is also presented on six new cultivars. In comparison with some locally bred cultivars New Zealand types tend to lack winter-hardiness and drought tolerance and are more susceptible to some diseases. As more countries develop their own plant breeding programmes, it is likely that New Zealand cultivars will be most useful in areas which have a similar climatic and agricultural pattern to New Zealand. The importance of Plant Breeders' Rights legislation in protecting the new cultivars overseas is stressed.

INTRODUCTION

Two RECENT reviews (Brougham, 1974; Rumball and Armstrong, 1974) have demonstrated that most overseas herbage cultivars are inferior to locally bred types under New Zealand conditions. As a result local sales of overseas cultivars are generally very small except where there is no local alternative available — e.g., subterranean clover from Australia; Lotus *pedunculatus* Cav. *(L. uliginosus* Schkuhr) from South America; tall fescue from the U.K.; bacterial-wilt-resistant 'Saranac' lucerne from the U.S.A.; and *Paspalum dilatafum* Poir from Australia.

In contrast; during the past 35 years New Zealand has maintained a substantial if rather erratic export of herbage seeds (Fig. 1) both of cultivars bred by Grasslands Division and of local ecotypes like Southland crested dogstail (Table 1). This trade has been directed mainly to European countries with substantially colder climates than most of New Zealand (Table 2), and its success can probably be attributed to 3 major factors:

(1) New Zealand started seed certification in 1930 and to quote a British seed catalogue "certified seed from New Zealand is of a very high standard of purity and reliability" (Dunns, 1962).

(2) Very competitive prices (Table 3) because of an excellent seed-growing climate and efficient dual-purpose systems of production.

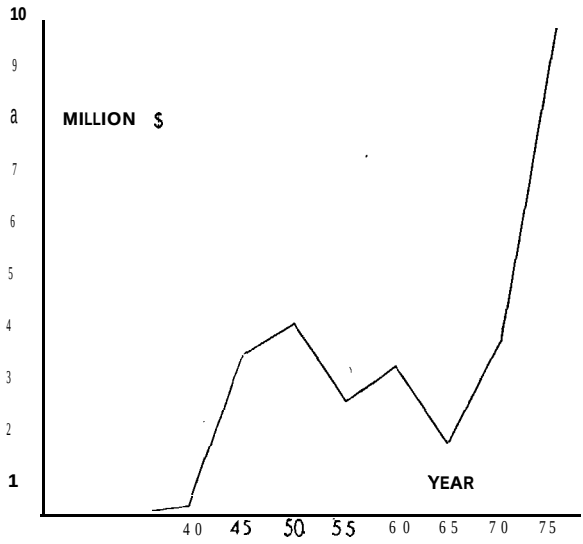

FIG. 1: *Value of herbage seed exports.*

TABLE 1 CONTRIBUTION OF MAIN CULTIVARS TO HERBAGE SEED EXPORTS (%) 1970-5

Cultivar	%
Huia white clover	37
Ruanui and Ariki (hybrid) perennial ryegrass	34
Southland crested dogstail (local ecotype)	10
Manawa hybrid ryegrass	7
Hamua and Turoa red clover	4
Apanui cocksfoot	2
Paroa Italian ryegrass and Tama Westerwolds ryegrass	2
Others	4

TABLE 2: DESTINATION OF HERBAGE SEED EXPORTS (%)

Region	Year 1954	*1964*	*1975*
Northern and Central Europe	65	58	58
Southern Europe	—	—	3
North America	12	5	7
South America	—	1	19
Australia	21	34	6
Other	2	2	7

TABLE 3: TYPICAL PRICES FOR USE IN SEED MIXTURE COSTING IN THE U.K. (p/lb)
(N.I.A.B., 1975)

Perennial Ryegrass		*Italian-type Ryegrass*		*White Clover*	
32					
Ruanui	42	Manawa	30	Huia	80
5.24		S.22	35	S100	120
Gremie	45	Combita	35	Kersey	120
Reveille	48	Lema	38	S184	125
S.23	60	RvP	40	Blanca	130
Dutch cv.	60	Sabrina	45	Kent	150

(3) Good agronomic performance of New Zealand typos compared with local material.

This paper is concerned wtih the performance of New Zealand cultivars at sites throughout the world. However, most of the data are from Europe because: (a) Research and testing organizations are well established there; (b) they are traditionally the major customers for New Zealand seeds; (c) most herbage plants used in New Zealand agriculture originated in Europe.

LEGISLATION AND OFFICIAL TESTING

Many countries now have official testing schemes to evaluate new cultivars. As a result of these trials a National and/or Recommended List is drawn up and only cultivars which are listed may be sold in that country. However, provision is usually made for exemptions so that, in the case of a shortage of seed of a particular species, non-listed cultivars may be sold. The large sales of Apanui cocksfoot to France in 1973-4 came into this category.

The number of cultivars under test appears to be increasing very rapidly in most countries. In 1974 N.I.A.B., Cambridge, had 101 perennial ryegrasses under test, while in the Federal Republic of Germany 178 grasses and 65 clovers and lucerne were being evaluated. As 80 to 90% of these cultivars are rejected because they do not meet the required criteria, various ways of reduoing the number of submissions are being studied. These include raising the fees for testing and asking the breeder for more information on his cultivar — i.e., the breeder does more evaluation.

PLANT BREEDERS' RIGHTS

This is also a relatively recent development whereby plant breeders can obtain Protection for their cultivars, provided they are distinct, uniform and stable, and receive a royalty based on their use. This legislation is simply a plant patent which guarantees the "inventor" or breeder a return on his investment in the development of a new cultivar. In the case of a substantially improved cultivar, which is widely adopted, the rewards can be very great and plant breeding is now becoming big business with large multi-national companies involved on a world-wide basis.

OLDER CULTIVARS IN EUROPE

RUANUI PERENNIAL RYEGRASS

This cultivar has generally been the major bred grass sold overseas since its release in 194 1. Early collaborative trials with the British Ministry of Agriculture in 1941 (Poole, 1946) showed that Ruaaui was consistently better than the commercial strains then available, and at least as good as the equivalent early ryegrass, S24, bred at the Welsh Plant Breeding Station, Aberystwyth. Cutting trials at three sites in Scotland (Copeman *et al.*, 1958)

TABLE 4: THREE-YEAR MOWING TRIALS AT THREE SCOTTISH AGRICULTURAL COLLEGES (lb/ac)
(Copeman et *al.*, 1958)

Ayrshire	8168
Irish	8159
Devon Eaver	8158
New Zealand	8620
Kent	7747
S.23	7764

(Table 4) demonstrated the value of Ruanui, particularly at high fertilizer levels, compared with the more important cultivated ryegrasses available at that time, although there was a suggestion of a lack of cold tolerance at the North of Scotland site. Further cutting trials at the West of Scotland Agricultural College in 1957-9 with 10 previously untested ryegaass cultivars again showed Ruanui in the topyielding group (Hunt, 1964). Frost damage affected early growth in oae year but there was complete recovery by mid-season. By 1963-4 Ruanui was still in the top 5

TABLE 5: RELATIVE YIELDS OF EARLY AND MEDIUM EARLY PERENNIAL RYEGRASSES
(N.I.A.B. 1974-5a)

	Grernie	S.24	*Ruanui*	*Cropper*	*Premo*	*Reveille*	*Barvestra*	*Manawa*	*RvP Hay/ Pasture*
9 cut	99	*loo*	103	106	98	102	1 0 2	100	101
4 cut	89	100	98	102	99	102	107	105	102
Persistence (0-9)	6.5	5	5	6	5.5	4	4	3.5	6
Winter-hardiness (O-9)	7	6	5	7	7.5	7	7	3	-

cultivars of a group of 32 early and intermediate type's that were tested (Hunt et al., 1970a), but lack, of cold tolerance and persistency were increasingly unfavourable characteristics attributed to the New Zealand cultiver. The moist recent classification of grass and clover cultivars for Scotland (Scottish Agricultural1 Colleges, 1975) lists Ruanui as a poor cultivar unsuitable for use in most areas. As an indication of the range of cultivars available it is interesting that 79 cultivars of perennial ryegrass are listed, of which 17 are the early type like Ruanui.

In England and Wales Ruanui is still a preferred cultivar and recent N.I.A.B. results (1974-5a) (Table 5) show that it is still near the top of the recommended early and medium early types. In fact Cropper is the first early cultivar to consistently outyield Ruanui in N.I.A.B. trials and also has the added advantage of greater persistency and winter hardiness.

The pattern in Ireland is similar to that in the U.K., with Ruanui not being recommended in Northern Ireland partly because of lack of winter hardiness (Stewart, 1974) , while in the milder South it is still apparently a preferred cultivar (Ribeiro, 1974) .

Winter-hardiness of perennial ryegrass cultivars in the U.K. has probably not been of great practical importance in recent years and their use is primarily an insurance policy. In fact, in southern Ireland no winter damage has been cvbserved since at least 1967 (T. O'Sullivan, pers. comm.) , while in the north severe winters are rare (Stewart, 1974). Similar conditions have been experienced in England in the past few years and unfortunately, as winter-hardiness tends to be associated with winter-dormancy (Thomson, 1974), it is often the more susceptible cultivars like Ruanui which continue growth throughout a mild winter. However, there are now some local winter-hardy cultivars which respond better than Ruanui to these conditions. In addition, the low soluble carbohydrate levels found in Ruanui in autumn suggest that it is not well adapted to mild, early, winter conditions in Britain but rather; as would be expected, to the higher temperatures land light intensities found in New Zealand (Thomson, 1974).

It should also be pointed out that winter damage may be exaggerated by high nitrogen applications and certain autumn management practices which lower soluble carbohydrate contents. Thus, what was previously a relatively minor limitation through lack of winter persistency may become more impoetant as grassland management is intensified.

ARIKI HYBRID RYEGRASS

In trials in England and Ireland, Ariki has generally been similar to Ruaaui in performance. However, in New Zealand Ariki not only showed a consistent 6% yield advantage over Ruanui, but also a 15% advantage in sheep liveweight gain under ad *lib.* grazing (Lancashire and Ulyatt, 1975). Although digestibility values are measured during cultivar testing at the N.I.A.B., these differences between Ariki and Ruanui in New Zealand do not appear to be r&ted to differences in digestibility. In addition, as data obtained' outside the testing country are not generally recognized by the authorities, there is no way that this important feature of Ariki can at present be credited to the cultivar outside New Zealand. Although this is probably .a reasonable attitude — *i.e.,* agronomic information obtained overseas on foreign cultivars being tested in New Zealand is generally regarded as inadmissible, it does point out some problems in the assessment of the, feeding value of cultivars if they are not related to relatively simple parameters like digestibility.

As Ariki appears to have slightly lower winter-hardiness than Ruanui (5% Ariki compared with 25% Ruanui plants survived a hard winter in Denmark in 1968-9) (H. F. Jensen, pers. comm.), its higher rating than Ruanui in Scotland is because it is compared with other cultivars in a different class — *i.e.,* hybrid ryegrasses — from Ruanui which is in the perennial ryegrass

TABLE 6: FREEZING CHAMBER TEST AT — 12° C
(Frandsen, pers. comm.)

Cultivar	*Source*	*% Plant Survival*
Perma	Netherlands	80.0
Hora	Netherlands	90.6
Dux ø	Denmark	78.6
Ariki	New Zealand	9.5

group. Freezing chamber tests (Table 6) have also shown the poor survival of Ariki when compared with ryegrasses highly recommended in Scotland (K. J. Frandsen, pers. comm.) (Scottish Agricultural Colleges, 1975) .

MANAWA HYBRID RYEGRASS

This cultivar, which was released in 1943, has always been popular overseas, generally being the third best selling bred culti-

TABLE 7: RELATIVE YIELDS OF ITALIAN RYEGRASSES (N.I.A.B. 1974-5a)

	Sabrina	*Manawa*	*RvP*	*Lema*	*Combita*	*Optima*	*S.22*
9 cut	97	95	100	98	90	89	83
4 cut	94	92	100	92	92	87	88
Persistence (O-9)	3	3.5	2.5	2.5	2	2.5	2
Winter-hardiness (0-9)	—	3	5	5	6	5	4

var after Ruanui and Huia. It is a hybrid which combines the cool season growth of Italian ryegrass with much greater persistency than is normally found in this species. In England and Wales (Table 7) (N.I.A.B. 1974-5a) it is still comparable with the best Italian ryegrasses, but as it is particularly susceptible to winter-kill it is only recommended for the south and west where there is little risk of frost damage.

However, it is of interest that despite symptoms of winter damage Manawa performed outstandingly well in a trial in Scotland in 1965 and 1966 (Table 8) (Hunt et *al.*, 1970b), but because of the danger of winter-kill it still could not be recommended. Manawa had apparently been very popular in Scotland during 1945-55 but after a series of cold winters its popularity declined. As one prominent British plant breeding organization is now sending plant material to central Europe for field tests of winter-hardiness because of the lack of suitable weather conditions in the U.K., it is appropriate to ask whether cultivars should be so severely downgraded in that country because of #susceptibility to winter-kill alone.

TABLE 8: TOTAL ANNUAL YIELD OF HYBRID RYEGRASSES AT THE WEST OF SCOTLAND AGRICULTURAL COLLEGE (t/ha) (Hunt *ef al.*, 1970b)

Cultivar	*Source*	*1965*	*1966*
Manawa	New Zealand	12.90	11.06
Itermo	Netherlands	11.00	11.30
Ariki	New Zealand	11.25	10.94
10	France	11.15	10.91
Vertas	Netherlands	10.96	10.90
Ellesmere	U.K.	11.11	9.98
Hg	Sweden	10.09	9.63
Regrid	France	9.63	9.58
Optima	Netherlands	11.29	10.78
S.24	U.K.	11.01	10.94

Similar reasons were suggested for the deletion of Manawa from the French Catalsgue in 1970 in favour of the local cultivar 10 (M. Dandine, Pers. comm.).

PAROA ITALIAN RYEGRASS

In trials in England and Wales (Aldrich, 1968), Scotland, and Northern Ireland, Paroa has slightly outyielded the standard British cultivar S22, but is considered less winter-hardy than this cultivar which is itself liable to damage in cold years. However, in years where winter-kill is not a problem it is still one of the best cultivars available as illustrated by recent results from Northern Ireland (Table 9) (Camlin and Stewart, 1975).

TABLE 9: TOTAL ANNUAL YIELD OF ITALIAN RYEGRASSES IN SECOND HARVEST YEAR UNDER GRAZING IN NORTHERN IRELAND (t/ha)

(Camlin and Stewart, 1975)

Cultivar	*Source*	*Yield*
RvP	Belgium	10.80
Paroa	New Zealand	9.63
Lema	Germany	9.32
Tiara	Netherlands	8.75
Combita	Netherlands	8.18
Optima	Netherlands	9.14
Milamo	Netherlands	8.16
Ellesmere	U.K.	8.02
S.22	U.K.	8.25
Stormont Ibex	U.K.	7.34

APANUI COCKSFOOT

In England and Wales, Apanui is generally outyielded by the standard cocksfoot S37 which is itself becoming outclassed by newer cdtivars (N.I.A.B. 1974-5a). It is also regarded as being susceptible to winter-kill although surprisingly in the West of Scotland it was observed that Apanui remained green with no trace of winter burn (Hunt, 1965). It has also yielded well in Scotland and is recommended as a maderately useful cultivar (Scottish Agricultural Colleges, 1975). In France, Apanui has proved very susceptible to rust, thus confirming earlier work in New Zealand (Lancashire and Latch, 1969).

KAHU TIMOTHY

Kahu has performed well in Scotland and is a well recommended cultivar. It is also listed in France.

HUIA WHITE CLOVER

Since it was first certified on a regional basis in 1932, New Zealand white clover has proved comparable with local cultivars in the U.K. (Gorman, 1936). Trials at the Welsh Plant Breeding Station by Watkin Williams (1945), Ellis Davies (1958) and at the N.I.A.B. (1974-5b) (Table 10) showed that it was

TABLE 10: RELATIVE YIELD OF WHITE CLOVER CULTIVARS IN GRASS/CLOVER MIXTURES IN ENGLAND AND WALES (N.I.A.B. 1974-5b)

	Small-leaved		*Medium Small-leaved*		*Medium Large-leaved*		
	S.184	Kent wild white	S.100	Huia	Sabeda	Blanca RvP	Kersey
	69	61	100	95	114	110	103
Persistence (0-9)	8.5	9	7.5	7	6	6.5	6

very similar in performance to S100. These two medium, small-leaved cultivars combine good yield with high persistence in England and Wales, and, although t-he larger leaved types are higher yielding, particularly under rotational grazing and high nitrogen fertilizer usage, they tend to be less persistent.

Huia is also highly recommended in Scotland and, although regarded as susceptible to frost damage particularly in early spring (Hunt et *al.*, 1972), it usually recovers. Huia is also listed in other colder European countries such as Belgium and France and has survived winters in Germany (Esser, 1961) . However, it did not survive a winter in the Swiss mountains as well as S184 (Marschall, 1958).

As the result of the unsuitable climate, poor yields and low returns have led to a rapid decline in the white clover seed growing area in the U.K., and it is clear that the 60 to 80% of the white clover market held by Huia is an important component of the local farming industry, However, it has recently been demonstrated in the drier arable 'areas of England that the traditional cultivars like Huia and S100 are very susceptible to clover rot (*Sclerotinia trifoliorum*) , whereas a number of continental culti-

vars like Blanca and Pajbjerg Milka arc more resistant (N.I.A.B., 1974-5b). Although the disease is probably relatively unimportant in the. main pasture areas in the West, it is significant that for the first time in nearly 40 years the agronomic advantages offered by other white clover cultivars may offset the large price, quality, and availability advantages of Huia.

HAMUA AND TUROA RED CLOVER

Hamua was outyielded by the local cultivar Essex broad red clover' in England and Scotland (Hunt *et* al., 1972). However, this cultivar is itself substantially lower yielding than the new tetraploid red clovers which persist well for two full years and are more resistant to clover rot (N.I.A.B., 1974-5c).

Turoa is generally outyielded by about 5% by S123, the standard, late-flowering persistent red clover in England and Scotland (N.I.A.B., 1971; Hunt et *al.*, 1972).

OLDER CULTIVARS IN OTHER COUNTRIES

AUSTRALIA

Gorman (1936) reported that New Zealand red and white clover performed well in Tasmania, and the coastal areas of New South Wales, Victoria and South Australia. New Zealand is now the main source of seed of the northern European type cultivars like perennial ryegrass, cocksfoot and white clover, which are the major sown species in these areas of well distributed rainfall and cooler summers in the south-east of the continent (Donald, 1970). In general, New Zealand cultivars are superior to European-bred cultivars because of better adaptation to a warmer, drier climate! However, moire use is now being made of cultivars selected from local ecotypes (Donald,. 1970). For example, Victorian perennial ryegrass is better adapted than Ruanui to the hot, dry conditions in the west of the State (Cade, 1969) and also persisted better through similar summers in South Australia (Silsbury, 1961) and in the Central Tablelands of New South Wales during the 1964-9 drought (Smart and Simpson, 1970). Another cultivar, Tasdale, developed in Tasmania, outyields Ruanui, particularly in the drier areas of the State (Martin, 1971). However, selections fos better summer performance have also been made in New Zealand and Ariki is now replacing Ruanui in Victoria because of better dry season production, and with

Tasdale is recommended as the most appropriate perennial ryegrass for the higher rainfall zone (> 550 mm) (Lawton, 1974).

Manawa ryegrass and Apanui cocksfoot show a similar pattern to Kuanui, although both also do well under irrigation in hot, dry areas, even, in the case of Manawa, as far north as Queensland (Schroder, 1963). However, summer survival of Apanui under dryland conditions is low (Knight, 1968) and other cultivars, particularly Mediterranean introductions with summer dormancy like Currie and Berber, are more persistent (Barnard, 1972).

A similar situation is found with Huia white clover which is well adapted to a moist, temperate climate with 600 mm or more of well distributed rainfall. It is the best cultivar in Tasmania (Martin, 1954) ; in Victoria under natural moderate to heavy rainfall (Barnard, 1972) ; and in the Central Tablelands under rainfall of 630 to 1000 mm (Simpson, 1970). However, in hot, dry areas, even in some cases under irrigatioa, other better adapted cultivars are superior. 'Ladino (from Italy), Louisiana (U.S.A.), Israel, and a local ecotype all outyielded Huia in a subtropical environment (Table 11) (O'Brien, 1970).

In addition seed yields were extremely low (Table 12) (O'Brien, 1970) .

TABLE 11: YIELD OF WHITE CLOVER CULTIVARS IN A SUBTROPICAL ENVIRONMENT (kg/ha)
(O'Brien, 1970)

Cultivar	*1966**	*1967*	*1968*
Israel Selection	9320	3 320	1140
Naturalized	6 560	3 730	570
Louisiana S1	10730	3 850	520
Huia	6740	2 640	120
Ladino	10410	3 380	100

"Yield increased by the effect of cultivation on first year stands.

TABLE 12: SEED PRODUCTION OF WHITE CLOVER CULTIVARS IN A SUBTROPICAL ENVIRONMENT (kg/ha)
(O'Brien, 1970)

Israel	1140
Naturalized	1590
Louisiana S 1	790
Huia	50
Ladino	80

Also, in preliminary evaluations, several Mediterranean introductions outyielded Huia and Turoa red clover at Armidale and Canberra which have cool, dry winters and warm, wet summers. The New Zealand cultivars generally yielded well in the warm season but were markedly inferior to some introductions in the cool season (Lovett and Neal-Smith, 1975).

U.S.A. AND CANADA

The inland area of the northern part of the North American continent is generally too cold for New Zealand cultivars — *e.g.*, Aamodt *et* al. (1939). However, there are considerable areas in both eastern and western coastal regioas, particularly the Pacific north-west, which are suitable. At Corvallis, Oregon., Maaawa was consistently one of the best yielders in each of 5 trials comparing over 20 ryegrass cultivars, while Apanui was top or equal top in 2 out of 3 trials comparing 12 cocksfoot cultivars (W. S. McGuire, pers. comm.). However, perhaps the best indication of the value of New Zealand material in this region is that five cultivars, Ruanui, Manawa, Ariki, Apanui and Huia can be grown for certification in Oregon (Oregon State University, 1969). Although no production figures could be obtained it is interesting that, despite favourable conditions for New Zealand cultivars in many areas, sales to the U.S.A. have fallen in the past 20 years. Also the cultivar Linn perennial ryegrass produced by the Oregon Agricultural Experiment Station is simply a multiplication of seed imported from New Zealand in 1928 (Hanson, 1972).

Results from the warmer areas in the South appear similar to those in subtropical Australia with, for example, Louisiana white clover outyielding New Zealand by 200% in Florida (University of Florida, 1959).

SOUTH AFRICA

Italian ryegrass is the most important cool-season forage grass grown in the higher rainfall areas of South Africa. A recent comparison in Natal (Rhind, 1975) showed that New Zealand annuals were outyielded by several cultivars, with a locally bred type 'Midmar' the best. In contrast, New Zealand types did very well in a trial comparing perennial and hybrid ryegrasses during the cool season (Table 13) (Rhind, 1975), and appeared better adapted to the local environment than European lines. However, all cultivars died out in the following summer at this site.

TABLE 13: YIELDS OF PERENNIAL AND HYBRID RYEGRASS CULTIVARS DURING THE 1973 COOL SEASON AT CEDARA (t/ha) (Rhind, 1975)

Cultivar	Source	*Yield*
Manawa	New Zealand	***9.3***
Victorian	Australia	8.3
Ruanui	New Zealand	8.3
Ariki	New Zealand	8.2
Atempo	Netherlands	8.1
Agresso	Netherlands	8.0
Compas	Netherlands	8.0
Linn	U.S.A.	7.4
Petra	Netherlands	7.4
Vigor	Belgium	7.2
S101	U.K.	7.0
S23	U.K.	7.0
s24	U.K.	6.4

SOUTH AMERICA

In recent years substantial sales of New Zealand seed have been made to a number of South American countries, including Uruguay, Chile and Argentine. Although few data are available, New Zealanders working on projects in the area (F. E. T. Suckling, pers. comm.) consider that New Zealand cultivars are well suited to many parts of the continent.

NEW CULTIVARS

TAMA WESTERWOLDS RYEGRASS

This cultivar has been widely adopted in Australia in the higher rainfall areas (> 550 mm) for cool-season growth. For **example,** in South Australia it outyields the greenfeed cereals and other Italian ryegrasses like Paroa (Lawton, 1974).

In the U.K., Tama has proved fairly comparable to the Dutch tetraploids and, in addition, has recently been given Plant Breeders' Rights. However, in the Natal region of South Africa Tama was outyielded by a number of European cultivars (Rhind, 1975) and in both that country and Japan (T. I. Kawase, pers. comm.) has proved rather susceptible to crown rust (*Puccinia coronata)* .

MAKU Lotus *pedunculatus* CAV.

This cultivar has performed well in a wide range of environments and at present appears to fill a role on wet, acid, low fertility, high country where there are few comparable bred cultivars.

TABLE 14 YIELDS OF MAKU LOTUS AND LOCAJ, ECOTYPES IN HAWAII (kg/ha)
(Whitney, pers. comm.)

Site	Elevation (m)	Local Ecotypes	Maku	Period
Mealani Farm	884	4280	7 100	18 mth
Kulani Farm	1616	3 100	4 120	2 yr
Volcano Farm	1 829	3657	12 880	Standing crop in January

In Scotland (Charlton, 1975) and Hawaii (Table 14) (A. S. Whitney, pers. comm.) results have been excellent, while very promising preliminary data have been obtained at 4000 m in the Andes in Peru (R. Vogel, pers. comm.), and in Ireland. In the U.S.A. Maku appears to be an improvement on Marshfield, a recently released U.S. cultivar which was developed from New Zealand material obtained in 1919 (S. L. Swanson, pers. comm.).

PITAU WHITE CLOVER

Pitau has proved superior to Huia, particularly in the autumn and winter at two sites in Tasmania (Table 16) (G. J. Martin, pers. comm.). Promising results have also been obtained in New South Wales (C. A. Neal-Smith, pers. comm.).

In England, Pitau has shown excellent late-season growth but is susceptible to clover rot. However, in the absence of the disease it outyielded S100 by 16 to 27% in clover yield and 10 to 15% in total grass/clover yield in two trials (D. T. A. Aldrich, pers. comm.).

Nui PERENNIAL RYEGRASS

In Scotland, Nui showed excellent establishment and growth in the first year but displayed a lack of winter-hardiness on a

TABLE 15: YIELDS OF PITAU (% HUIA)[1] AT TWO SITES IN TASMANIA. ACTUAL YIELD DIFFERENCES IN PARENTHESES (kg/ha)
(G. J. Martin, pers. comm.)

Site	Annual Rainfall (mm)	1969 Summer	Autumn	Winter	Spring
Cressey	635	140	447	188	102
		(448)	(661)	(717)	(45)
Elliott	1118	83	170	146	126
		(—246)	(963)	(392)	(179)

1200 m hill site in the first winter (G. J. F. Copeman, pers. comm.),

PAWERA RED CLOVER AND MATUA PRAIRIE GRASS

Although these cultivars are being tested in a number of countries no data have so far been received.

CONCLUSIONS

As more countries develop scientific plant breeding programmes, it appears likely that the sales of New Zealand cultivars overseas will be concentrated more in areas where they are best adapted. In the past 10 years Grasslands Division has sent out over 1000 seed samples of certified and pipe-line cultivars for testing in 51 countries. Recently there has been a steady increase in the proportion sent to areas where the New Zealand material would be expected to perform best (Table 16).

TABLE 16: CERTIFIED AND PIPE-LINE CLJLTIVARS SENT OVERSEAS FOR TESTING BY GRASSLANDS DIVISION (%)

Region	*1968-71*	*1972-5*
Northern and Central Europe	67	40
Southern Europe	0	16
North America	12	6
South America	6	13
Australia	5	12
Others	10	13

Thus Australia, South America, parts of North America, and Southern Europe will become relatively more important in the future; and hopefully the new plant protection legislation should ensure that some recompense is made if New Zealand cultivars are multiplied in these countries.

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