

Description Of Species

The attributes of each species are described in turn, starting with the legume, followed by grasses, and then herbs and shrubs. Within each of these main groups the species are listed in approximate order of their importance within the high country. Where several cultivars of a particular species are available, the most suitable ones are mentioned. With less emphasis on cultivar testing in recent years, some of the recommendations are becoming somewhat dated.

Legumes

Alsike Clover (Trifolium hybridum)

Alsike clover, along with white clover, is among the most important pasture legumes in the high country. It grows in a wide range of conditions and is used as both a grazing and hay species. It is a short-lived perennial under most conditions.

Alsike establishes and yields better under moderate soil fertility and moderate stocking rates than does white clover. However, it does have a period of low acceptability to stock in late spring/early summer. It is more frost tolerant than white clover and is often preferred to red clover for hay as its hollow stems cure more rapidly. Alsike is a stronger competitor against mouse-ear hawkweed than white clover. It is a prolific seeder, so seed is cheap and, once established, much of the further seed supply can come from on-farm harvesting. The rhizobia are the same as for white and red clover. It should be the main clover in mixtures for large scale initial oversowing of moderate rainfall high country.

Alsike is advocated and used more in Marlborough and Canterbury than Otago, though whether this difference is related to human preference or the differences between greywacke and schist soils is not known. Alsike use is mainly a high country phenomenon. It is little tested or advocated in other warmer regions of New Zealand, where virus diseases associated with higher temperature limit its use.

Initial clover oversowings in the high country generally go through a spectacular clover-dominant phase lasting for 2-4 years before falling back to low levels. The reasons for this

are not fully understood, but it is particularly notable in alsike and white clover.

Most of the presently available alsike seed is **uncertified**, locally grown material of Canadian origin. Testing of many lines and cultivars done in the last decade has shown less variation between lines than in other clovers. Results indicate New Zealand and Canadian uncertified seed and Tetra, are the best commercially available seed at present. Canadian, Finnish and Russian material perform better in New Zealand than Swedish or Danish material. A New Zealand cultivar (G50), based on a decade of selection, is due for release.

White Clover (Trifolium repens)

The great virtues of white clover, are its: tolerance to close grazing once closed swards are obtained high growth rates when soil fertility is high and moisture stress low and its ability to spread by both vegetative propagation and seed. However, white clover does have limitations in the high country and these are over-emphasised in order to draw attention to the possible role of other legume species.

White clover is not as important in the high country as it is in the rest of New Zealand. It is important in the highly fertilised, intensive or semi-intensive developed paddocks but is replaced by alsike and red clover under more extensive, moderate fertility conditions. It requires high fertility to express its high growth rates and makes only a limited contribution when sown into low or moderate soil fertility conditions. However, it is persistent, particularly in the moderate rainfall zone.

Currently available material has low tolerance of -moisture-stress-and-therefore--makes-a-limited-~ contribution in the very low rainfall zone. White clover is also very palatable and therefore tends to be selectively grazed. It has the least frost tolerant leaves of the pasture legumes and disappears as a useful diet component after a few severe winter frosts.

Grasslands Huia is currently the most productive available cultivar for the high country but may be replaced by Grasslands Tahora and Grasslands Demand. Grasslands Pitau is slightly **less** suitable. Grasslands Prestige and Prop have not yet been sufficiently tested for high country use.

Description Of Species

These recommendations for pastoral use in the high country are not to be confused with use for commercial seed production. The previous absence of legumes from many regions of the high country often make them potential areas for nucleus production of new cultivars - as was the case for Grasslands Pitau -though the frequency of summer frosts makes consistent year to year seed production problematical.

Red Clover (*Trifolium pratense*)

As one of the three main clover species in the high country, red clover is a tap-rooted perennial which, although relatively short-lived in mixed swards, establishes and produces well under a wide range of conditions. It is most productive under fertile, moist (natural or irrigated) conditions and is used for hay or grazing. With alsike and timothy, it becomes the main component of hay mixtures in the high rainfall/lower temperature zones where lucerne does not persist.

Red clover is also suitable as an **oversown** species even where soil fertility is low, providing the stocking rate also remains low. It is the most frost tolerant of the common legumes, particularly the tetraploid **Pawera**. It is not tolerant of prolonged close grazing and is best used for hay or lax grazing.

Red clover-dominant stands can cause bloat in cattle, and contain oestrogens which have a short-term effect of reducing ovulation in ewes if grazed immediately prior to tugging. However, the same feature promotes high growth rates in **wethers**.

Besides being used for hay, the main virtue of red clover is its ability to produce well in late summer/early autumn, which can be one of the critical feed periods in high country farming. In the high country, with the emphasis on wool and store sheep, the high feeding value of red clover for non-breeding ewes should be promoted.

Of the red clover cultivars commercially available, the tetraploid red clover Grasslands **Pawera** is the best for the high country, in terms of both production and frost tolerance. It is followed by Grasslands Hamua (cow grass) and then by Grasslands Turoa (Montgomery red clover). The new cultivars Grasslands Colenso, Enterprise and G27 have been little tested yet.

Central Otago and the Mackenzie Country, because of their populations of long-tongued bumble bees, are suitable areas in New Zealand for seed production of tetraploid red **clovers**.

Red clover is one of a group of three species, including the grasses Yorkshire fog and timothy, normally associated with high fertility moist conditions but which are also suitable for dry, low fertility conditions.

Lucerne (*Medicago sativa*)

The prime role of **lucerne** in the high country is as pure hay stands in the moderate to low rainfall zone (350-550 mm) and secondly as a potential overdrilled species in the low rainfall, (<450mm) high base soils zone. It requires moderate to high soil fertility and high moisture to express its high growth rate.

There is a definite soil limitation precluding its use in the moderate to high rainfall zone and in the older soils in the low rainfall zone. This limitation is soluble aluminium in the soil, which may be present in soils below pH 5.8 and which can be tested for.

If the soil aluminium test is above 5 units then lucerne is unsuitable and more aluminium tolerant legumes like alsike, perennial **lupin**, red clover and birdsfoot trefoil should be used.

The best sites for lucerne are the young **outwash** soils of the fans, recent river terraces, or lower hill soils. There, in the high fertility intensive paddock situation, lucerne will be the most productive species, under both **dryland** or irrigation, for use as hay or short duration rotational mob stocking. The recommendation for establishment in a cultivated paddock is:

- . Check aluminium levels by soil analysis
- . Pre-spray with glyphosate if any weeds are present
- . Drill with inoculated pelleted seed and lime reverted superphosphate plus molybdenum in the late winter-early spring
- . Use insecticide to control grass grub.

The deep rooted lucerne will be able to use subsoil sources of sulphur when present.

Trial results have also demonstrated that lucerne has good potential as an overdrilled species on the low **altitude** dry slopes in the dry zone. However, in practice there is seldom adequate subdivision to give it proper subsequent grazing control (i.e. short term grazing, even if hard, followed by adequate uninterrupted regrowth periods). Establishment from oversowing is generally poor.

Among the best available cultivars for dryland high country conditions are Grasslands Otaio, Grasslands Oranga, Deseret and Wairau. For irrigated conditions the best are Saranac and Washoe.

Lotus (*Lotus pedunculatus* or *L. uliginosus*)

Lotus is establishing its role as a pasture legume for the Otago uplands and high rainfall zones on soils too acid (pH <5) for good white clover growth. Thus it can be used in preference to white clover when oversowing such areas. These areas are likely to be wet, or of initially low soil fertility and, because of moderate fertiliser rates and continued leaching, will rise to only moderate soil fertility. However, in spite of misleading information to the contrary, lotus grows very poorly without fertiliser on acid and infertile soils but can survive and continue to grow under these conditions because of its superior ability to compete with resident vegetation for limited nutrients. Its response to sulphur and phosphate is very similar to that of other clovers on such soils. It spreads vegetatively by underground rhizomes. It tolerates close grazing, but should be rotationally grazed to provide the spelling it needs to achieve its full potential production.

Elsewhere in New Zealand it also has a role as a special-purpose pasture for non-bloating feed, or where some degree of resistance to insect attack is required.

Lotus establishes slowly because of its small seed, low germination at low temperatures, and poor seedling vigour. Establishment is best if seed is applied to an open sward and not onto bare soil or dense vegetation. Dense resident vegetation should be opened up prior to oversowing by either burning or hoof and tooth. Use high rates of inoculation, and give it two full growing seasons to establish. There is almost no spread from reseeding at higher altitudes and the -sparse-stands-can-be-encouraged to thicken up by vegetative spread if spelled completely in the January to March period.

When grown on acid and infertile soils, lotus contains high levels of condensed tannins, which may restrict voluntary intake by grazing animals and result in lower animal growth rates. This should not be viewed as a deterrent to its use on such soils. On most runs, lotus is grown, not as a specific fattening feed, but as a summer-country feed for ewes to allow spelling of intensive, lower altitude, clover-based pastures.

Stock may need a fortnight adjustment period to lotus.

Grassland Maku and Grasslands Sunrise are similar in performance, though there is much more experience with the former. Seed can have a high hard seed content requiring scarification. This should be checked by germination tests.

Birdsfoot Trefoil (*Lotus corniculatus*)

This is a relatively new species on the New Zealand farming scene. Trials over the last two decades show that birdsfoot trefoil has the particular characteristics of high persistence and continued production under moderate soil fertility conditions in the drier high country regions. It is probably best described as a poor land lucerne. Its probable role is as a grazing species for late summer to autumn feed, on country which, if more fertiliser or subdivision were available, would be considered for lucerne. Overseas it is used primarily as a hay species. Its grazing tolerance is similar to lucerne in requiring a short grazing period followed by adequate regrowth time. One disadvantage is likely to be its slow establishment from seed, but once established it is very persistent. The best guidance on grazing management is to treat it as lucerne should be treated, as it is very similar in growth form and other characteristics.

Birdsfoot trefoil requires a specific rhizobial inoculant at a high rate and, for the type of site for which it is most appropriate, sulphur coated seed should be considered. The seed can have a high hard seed content so scarifying it before inoculating may be advantageous.

About 300 lines and cultivars have been tested in New Zealand and about 200 in the high country. Breeding from these, two New Zealand cultivars have been developed, Grasslands Goldie - selected for the North Island - and one selected for the high country conditions. The best performing overseas cultivars are: Franco, Tana, Cascade, Granger, San Gabriel, El Boyero, Ginestrino and Maitland. Two or three of these are commercially available in New Zealand. Continued farmer experience over the next decade should define the best cultivars of birdsfoot trefoil and their role in the New Zealand high country.

Perennial Lupin (*Lupinus polyphyllus*)

While originally a garden flower, perennial or Russell lupin was sown initially in the Tekapo

Description Of Species

area along a newly formed road. It has subsequently spread along many roadsides and other areas, indicating that it is adapted to the high country environment.

Lupin grows best in loose textured soils with reliable moisture. A decade of research has indicated that it has the potential to become a major pasture legume for the moister regions of the high country. It considerably out yields other legumes under low fertiliser inputs. Its role appears to be as a grazing legume for loose textured soils at 600mm or greater rainfall where only low fertiliser inputs can be afforded. It is particularly tolerant of acid, high aluminium soils. It is proving somewhat difficult to establish. While germinating at much lower temperatures than other legumes it is very sensitive to drought and competition during the first years. Thereafter, it is very persistent, productive and tolerant of periodic hard grazing, with stands thickening up by reseeding. While like alsike it has lower stock summer acceptability, and hence per animal performance, than red clover, it more than compensates with its total feed production.

Seed is becoming commercially available.

The next four species to be discussed, Caucasian clover, zigzag clover, crown vetch and milk vetch, have many features in common: all spread extensively by underground rhizomes or stolons; they are very slow to establish (commonly one or more years before they are seen and four or more years before becoming productive); they need specific rhizobia (except for zigzag, which requires the same as white clover); they are winter dormant, they have moderate spring/early summer growth; and they are generally very poor seeders so seed costs are likely to be high. It may be necessary to contemplate vegetative propagation. Their virtue is their underground spread and persistence once established.

Caucasian Clover (*Trifolium ambiguum*)

The initial New Zealand and Australian interest and testing of Caucasian clover was for high altitude revegetation. However, research over the last decade indicates that it has greater potential of becoming a major pasture legume for the high country because of its productivity and long term spread and persistence, giving sustainability in a range of environments. Its main role will probably be as the long term legume component of grazed pastures under

moderate to high fertiliser inputs. There are current studies to improve its slow rate of establishment.

Caucasian clover is suitable for its early spring growth. It is similar to other legumes during the summer and with some enhanced autumn growth. It is similar to alsike in frost tolerance. Initially, it is a species which is likely to be included as a small component in seeding mixtures to ultimately replace the more rapidly establishing but more transient legumes like alsike.

The hexaploid lines, Monaro and Prairie of Caucasian clover are better suited for pastoral agricultural purposes, than the tetraploid and diploid cultivars, Treeline and Alpine. New Zealand cultivars based on hexaploids are being developed.

Zigzag Clover (*Trifolium medium*)

Zigzag clover is often the only introduced legume surviving in old high country trial areas, with some 30 or 50-year-old stands being present. In relation to the other species in the group, zigzag clover is the best option for lower soil fertilities. Seed is not commercially available at present, though there has been some plant breeding in New Zealand.

Crown Vetch (*Coronilla varia*)

Overseas, crown vetch is used primarily for roadside stabilisation, and has been evaluated in New Zealand for that purpose. It has also been evaluated as a grazing legume, and its role is likely to be in the higher pH and moderate fertility soils of the low rainfall zones under continuing low, or nil fertiliser input. It is slow to establish but then spreads extensively. Yields can be expected only to reflect the lower to moderate fertility of the sites on which it would be used.

A New Zealand line, G34, may soon be available.

Cicer Milk Vetch (*Astragalus cicer*)

A species little tested in New Zealand. Indications are that it is more suited than crown vetch to loose textured soils towards the mid rainfall area, though requiring moderate soil fertility.

Suckling Clover (*Trifolium dubium*)

This introduced annual clover has become widespread, but only locally dense, throughout

the unfertilised mid altitudes. It gives some spring growth but is of unknown nitrogen fixing ability. It is only mentioned because it may represent the best legume that could be hoped for under continued low soil fertility and moist conditions.

It is unlikely to be sown in pasture mixtures, though it is used in some soil conservation mixtures for disturbed sites. Its presence in other legume seed lines would be of no concern.

Haresfoot Clover (*Trifolium arvense*)

Haresfoot clover is an introduced tap rooted annual which can form dense swards. It has become widespread throughout the unfertilised dry high country. It produces spring and early summer growth, but its nitrogen fixing ability and feed value is unknown. It probably only has grazing value in the spring. It responds to superphosphate. Resident plants can give severe competition to oversown, more productive legumes and grasses, though conversely give a useful vegetation response if sown species have failed for other reasons. It has the same rhizobia as the common clovers, so rhizobia coating of these other clovers may be dispensed with when sowing into areas known to have had dense haresfoot clover. The plant flowers and goes to seed early in the season and becomes unpalatable in the rank state.

It would not be deliberately sown. Haresfoot clover is mentioned because it is an introduced clover which may represent the best that can be hoped for under continued low soil fertility and dry conditions.

Sweet Clover (*Melilotus alba* and *M. officinalis*)

Based on natural spread in Otago, these biennial legumes could have an agricultural place in the dry zone at low to moderate soil fertility. Their role could be as a short term lucerne, to be used as a nitrogen fixer and bee or sheep feed while other, simultaneously sown but more permanent, species are establishing. It makes some growth in the first year and yields similar to lucerne in the second year prior to dying off. The bred cultivars are more palatable than the wild form which occurs in many areas. It could be used for a hay crop following initial cultivation of tussock country, but resulting hay must be well cured prior to baling.

Yukon is the preferred cultivar because of its higher yield, low coumarin content, and some ability to re-establish from seed. Other cultivars

which have been tested are Polara, Arctic, Denta and Goldtop.

Subterranean Clover (*Trifolium subterraneum*)

This species is of doubtful relevance to the high country because of its limited tolerance to low temperature and frost. A winter annual, it was once used extensively in the lowlands as the initial legume on moderately fertile soils, and used for winter and spring feed for fat lamb production. It must be spelled from grazing from mid-spring to allow flowering and seed set. High country trials indicate that it produces only in the warm, moist years when all legumes produce well and, unless the first seasons after sowing are like this so that a store of seed can build up, it soon dies out. If it has a high country role then it would be on the lower altitude sunny faces of the dry zone, merging into the dry hill country.

The few trials have indicated that Mt Barker and Woogenellup are still the best cultivars for the high country.

Vetch or Tares (*Vicia sativa*)

This legume is a large seeded, spring annual. Like sweet clover, it could be used as a temporary oversowing species on the lower altitude, warm sunny faces for spring feed. Alternatively, it could be used in a mixed sowing with oats for hay, though it probably would not increase the nett yield. It needs specific rhizobia. Like subterranean clover, grazing would need to cease in mid-spring if reseeding is to occur.

Uncertified lines are commercially available in Canterbury.

Greenfeed Lupin (*Lupinus angustifolius*)

In other regions of New Zealand, this was one of-the-main greenfeed annuals grown in earlier decades. Greenfeed lupins are used spasmodically in the high country, and deserve further consideration because of the adaptation of lupins to moderate fertility acid conditions.

Uncertified seed is commercially available.

Sainfoin (*Onobrychis viciifolia*)

A species little seen in New Zealand outside research stations. Its use is as a special purpose pasture of very high feeding value, which, in the case of cattle, is also non-bloating. The very limited high country experience suggests that it

Description Of Species

falls between lucerne and sheeps bumet in site, management requirements and growth characteristics.

Of the cultivars tested, the preferred order is Krasnodar, **Melrose** and Fakin.

Grasses

Cocksfoot (*Dactylis glomerata*)

At present this is the best of the higher producing pasture grasses for the high country because of its tolerance of a wide range of temperature, moisture and soil fertility conditions. Cocksfoot grows well under moderate to high fertility conditions. It is the common grass accompanying clover and fertiliser oversowing of tussock grassland, where its suitability to the environment, and often low stocking pressure, allow it to express its growth potential. It will spread slowly under low stocking pressure.

Cocksfoot **performs** best during early development, but becomes less prominent with increasing grazing pressure and subdivision unless there is a corresponding change towards rotational mob grazing. The generally better autumn growth of cocksfoot compared with other grasses has **often** made it the basis for autumn saved winter pastures. It is slow to establish relative to **ryegrass** in high fertility (nitrogen) situations. Cocksfoot is one of the principal species for pasture hay paddocks.

Four cultivars are commercially available • Grasslands Kara, Grasslands **Wana**, Saborto and **the** older Grasslands Apanui • and high country trials show some **differences** between them. The more erect cultivars appear to suit the high country best. Grasslands Kara, followed by Saboto, is the most productive under cutting or autumn spelling for accumulating winter feed in the high country. Grasslands **Wana** is considered to be the best cultivar for sheep grazing in lower altitude, improved pasture grazed throughout the year. It is slightly more productive, but less digestible than Grasslands Apanui or Grasslands Kara.

A large number of overseas cultivars have been tested over many years in the high country, but none have shown consistent superiority over New Zealand material bred basically for lowland areas. However, a related species, *Dactylis woronowii*, has shown up well in many trials in dry areas over the years and should be considered as an oversowing species if seed ever became available.

Tall Fescue (*Festuca arundinacea*)

Trial results have indicated that, under high fertility conditions, tall fescue could be a contender with cocksfoot and perennial **ryegrass** as a principal grazing grass of the high country. It will **outyield** both species and has a greater frost tolerance than ryegrass. However, most high country areas do not have the necessary soil fertility for it to do well. Tall fescue grows very well in spring, is tolerant of summer drought, grows reasonably well in autumn, and retains its feed quality well in the winter.

It is slower to establish than **ryegrass** and performs best under high soil fertility. Its main role is in developed, cultivated, moderate to high fertility grazing paddocks rather than general oversowing. Management is similar to cocksfoot. It forms tight swards with periodic close grazing, and a large root mass. Like cocksfoot, it grows better under laxer grazing followed by long regrowth periods. It is not as persistent as cocksfoot.

Trial results have not shown consistent differences between Grasslands Roa tall fescue and the older **S170** of the commercially available lines. The other available cultivars Au Triumph and Johnson have not been **sufficiently** tested in the high country. The cause of tall fescue-induced animal disorder problems (fescue foot), similar to the **ryegrass fungal** endophyte and common in wild tall fescues, is not present in these bred cultivars.

Timothy (*Phleum pratense*)

This is a much under-rated species in the high country because it is seldom noticed, except when flowering. Timothy is the main grass component, along with cocksfoot, in moist or irrigated high country pasture hay paddocks. The accompanying legumes are red clover and/or alsike clover. Timothy is best suited to high fertility and the long regrowth periods associated with hay production. It is tolerant of low to moderate soil fertility conditions, and has been used as a grass component of oversowing mixtures for high rainfall tussock grasslands. Timothy is highly palatable even in the rank state, is small seeded, and slow to establish.

There has been little plant breeding on timothy either in New Zealand or overseas in recent decades, with Grasslands Kahu being the best commercially available cultivar. There have been very few comparative studies of timothy lines in the high country.

Perennial Ryegrass (*Lolium perenne*)

Under high fertility grazing situations, perennial ryegrass can be the main grass, as it is elsewhere in New Zealand. However, it must have moderate to high fertility to perform well, so is of major value only in developed pasture paddocks and not as a component of general oversowings without adequate legume and fertility base. It does not persist in less favourable conditions. Its main virtues are its rapid establishment, production, and tolerance to close grazing and treading under high stocking rates.

Of the commercially available lines, Grasslands Nui is probably better than Ellets and Grasslands Ruanui for the high country because of its slightly greater production and drought tolerance. But the whole perennial ryegrass scene is in a state of flux with the discovery of the relationship between fungal endophytic infection, ryegrass staggers, and resistance to insect attack, and persistence. It is almost certain that the reputation of local lines for greater persistence than bred lines is related to their drought tolerance through endophytic infection and the consequent lower feed value.

Hybrid Ryegrasses (*Lolium hybridum*)

The role of the hybrid ryegrasses like Grasslands Ariki, Grasslands Greenstone, Grasslands Marsden and Grasslands Manawa in the high country is not clear. Under high soil fertility and irrigation, they can out-yield the other ryegrasses. It is doubtful if dryland soil fertility conditions will be high enough for their yield advantage to compensate for their lower tolerance of lower moisture.

Annual Ryegrass (*Lolium multiflorum*)

In other parts of New Zealand, the annual ryegrasses are used as autumn and winter growing species, requiring high soil fertility to produce winter and spring feed, either in rotation with crops or overdrilled into lucerne or existing old pasture. Because of the dearth of sufficiently high soil fertility conditions and because low temperatures greatly limit any winter growth, annual ryegrasses are seldom a useful option in the high country.

There is insufficient simultaneous testing of Grasslands Tama, Grasslands Paroa, Grasslands Moata and Corvette to differentiate between them for possible high country use, but Paroa and Moata are likely to perform better than

Tama under the generally lower fertility levels of the high country.

Browntop (*Agrostis capillaris*)

An adventive, sward forming grass, browntop is abundant in most grazed, unimproved country of the moderate to high rainfall zone. Browntop probably represents the most suitable grass for such lower fertility grazed conditions. It is acceptable to stock when well grazed, but becomes less acceptable when rank, or in seed. Other uses include long-term revegetation and slope stabilisation, and as an amenity grass for lawns and playing fields. A lot of tussock country, originally developed in earlier times, reverts to browntop, probably through lack of adequate fertiliser and grazing management necessary to retain more productive species,

It is occasionally included in oversowing mixtures. Uncertified seed of browntop is freely available. A grazing cultivar Grasslands Muster has been released, and has had limited testing in the high country.

Sweet Vernal (*Anthoxanthum odoratum*)

This is an adventive grass already widespread in areas of dry to moderate moisture and low to moderate fertility. Sweet vernal seldom forms dense swards as does browntop. It is a useful grazing grass where soil fertility is low to moderate and it tends to increase in frequency and growth with increasing fertility. Sweet vernal is slightly less tolerant of close grazing than browntop. It is slightly more acceptable than browntop in the rank state.

It is unlikely to be sown even if seed were available.

Yorkshire Fog (*Holcus lanatus*)

This grass is suited to moderate to moist soils of low to moderate fertility. It is probably the easiest and most rapidly establishing grass in the high country, where trials show it to be a productive grass with proper management. Elsewhere in New Zealand, it is nearly always regarded as a weed under high fertility where other more palatable species could be grown. Its peak growth is in the summer. Feed quality is greatly reduced by frosting. Yorkshire fog requires lax grazing and is intolerant of heavy trampling. It can also be used for first year grass cover in revegetation oversowings.

The cultivar Massey Basyn is available, as is uncertified seed.

Description Of Species

Chewings Fescue (*Festuca rubra* ssp. *commutata*)

This fine-leaved introduced grass is suitable for low to moderate fertility soils in the low to mid rainfall zone. It is adapted to close grazing. Chewings fescue, while widely sown in the past, has been under-used in the high country in recent decades because there are better pasture grasses if soil fertility conditions are improved. Its role is probably best in the low fertility, thin **outwash** soils. In comparison with **browntop** it is more suited to drier conditions, is faster establishing, and about as productive, and persistent.

Uncertified seed lines are available. As with browntop, perennial **ryegrass** and tall fescue, there are a number of Chewings fescue cultivars available bred specifically as lawn or amenity grasses. These should all be treated with caution for grazing purposes.

Tall Oat Grass (*Arrhenatherum elatius*)

Tall oat grass is an introduced grass occurring in the moderately fertile low rainfall zone, where it has been slowly spreading under lax grazing. A tall, stalky grass of moderate acceptability. Opinion is divided on its value as a **herbage** species with the reactions becoming more favourable as investigation continue. It is an extreme drought **tolerant** grass giving the potential of feed in all seasons. Small quantities of seed have been taken. A comparison of the various more leafy cultivars and lines available from elsewhere in the world is underway from which selections will be released.

Fescue or Hard Tussock (*Festuca novae-zealandiae* and *F. mathewsii*)

For most of this century, Fescue tussock was the most predominant and characteristic native species of the lower altitude, lower fertility, tussock grasslands. Historically it is now thought to have been originally a minor species and only increased in early years of European **occupation** to replace tall tussock or other sward forming grasses. It is presently decreasing rapidly throughout its range because of both pasture development and the spread of **hieracium**.

Fescue tussock has a slow growth rate, is probably a long lived perennial, with limited acceptability to stock. It increases in vigour with increased fertility, but is often eaten out under the increased set stocked grazing pressure that accompanies development.

However, fescue tussock declines in vigour in completely ungrazed situations, although *F. mathewsii* appears to be the more vigorous of the two species with slight winter or early spring grazing. In the drier area, fescue tussock shelter increases the establishment of **oversown** legumes. The loss of fescue tussock, and its **consequences**, in undeveloped areas is of concern.

Fescue tussock, like most of the following native grasses, would probably not be sown in grazing pastures even if seed were available, though they are starting to be sown for natural conservation plantings.

Blue Tussock (*Poa colensoi*)

Historically, all native tussock species, except for blue tussock, were burnt as they were unpalatable when mature. This burning encouraged palatable early regrowth. Blue tussock occurs throughout the lower altitude short tussock grassland, is found in the snow tussock grassland, and extends into the high altitude herb fields as well. It occurs on both low and moderate fertility sites and is moderately responsive to increased fertility. As a **herbage** species, it is the most desirable of the native tussocks for stock acceptability, because of its growth rate and response to grazing. Grazing trials at 700-900m show that blue tussock becomes the major native grass component of rotationally grazed hill blocks.

This species might be sown in oversowing mixtures for tussock grasslands if seed were available, though little is known of its establishment characteristics.

Silver Tussock (*Poa cita*)

One of the lower altitude native tussock grasses of the warmer, more fertile soils of river beds, stream edges and other areas of moderate to high fertility soils. As the most fertiliser responsive of all the native tussocks, silver tussock, has the highest growth rate, and tends to increase in frequency of occurrence with development. Like most of the native tussocks, its rank **herbage** is not very acceptable, and it is not tolerant of hard grazing. Its main value is as an indicator of areas which can be expected to give large production responses if developed. It provides a good shelter for the protection of **oversown** legumes, which generally do well on the soils favoured by silver tussock.

It can increase to troublesome density in moist, fertile, laxly grazed foothill country.

Snow Tussock (*Chionochloa rigida*)

C. rigida is one of several species called snow grass which, in early European times, would have been the dominant vegetation on the low fertility soils from mid to high altitudes (400-1200 m) in the mid to high rainfall zone. Like most of the tussocks, it is of limited acceptability to stock except for the regrowth immediately following fire. It is very long lived if not burnt, with indications of only limited re-establishment from seed. It is the dominant vegetation of all high altitude undeveloped land, though most of the forage for stock comes from associated smaller species.

Red Tussock (*Chionochloa rubra*)

Red tussock is a tall native now generally only occurring on moderately fertile swampy sites. There is evidence that in early European times it was much more widespread on the lower country, especially in the mid-rainfall zone, where it was replaced by fescue tussock following burning during the first century of occupation, or by improved pastures (e.g. in Southland).

Crested Dogstail (*Cynosurus cristatus*)

A tufted perennial grass which is best suited to moderately fertile and moderately moist to dry soils. It is extensively but sparingly used on sheep properties in the hill country where it can tolerate hard grazing.

Smooth Brome (*Bromus inermis*)

This is a new perennial grass for the high country, whose role will probably be as a spring/early summer grazing species of dryland of moderate soil fertility, and on moderate to low rainfall high country sites. It is an erect broad-leaved species with high spring production, and some summer and autumn production in dry environments. It is winter dormant in the high country situation and has good digestibility. While swards are slow to establish compared to other improved grasses, over time its vegetative spread thickens up stands, which are then highly persistent. It is palatable in the rank state. Smooth brome is tolerant of occasional hard grazing.

A cultivar, Grasslands Tiki, is now available.

The place of grazing brome (*B. stamineus*, Grasslands Gala) in the high country is being assessed.

Upland Brome (*Bromus sitchensis*)

A species similar to prairie grass but more suited to cooler, drier conditions. It is erect, and broad-leaved, and can be used as a pasture for high spring production under fertile dryland conditions, where it produces highly digestible material. One of its roles, like prairie grass, is likely to be as special purpose lamb finishing feed under lax grazing. It is palatable in the rank state. It is a short lived perennial.

A cultivar, Grasslands Hakari, is now available. While much of the testing and development of the species within New Zealand was done in the high country, its probable greater role is in the downland and hill country.

Prairie Grass (*Bromus willdenowii* or *B. catharticus*)

An upright short term perennial grass, it is usually used on high fertility, moist soils under rotational grazing, lowland conditions, where it produces throughout the year, with particularly good winter growth. Grazing should be of short duration, though it can be hard. Adequate regrowth periods are required. It is susceptible to grass grub attack.

At present there is only limited experience with it in the high country, where it could be used as a special purpose pasture. Like all species in these hard inland areas, it has no winter growth here, but it is productive in other seasons on high fertility soils under both irrigation and dryland. Its role is likely to be as a high quality spring/early summer/autumn feed. Seed requires de-awning, and it should be considered only for sowing into fully cultivated land of high fertility. It is very palatable at all stages of growth and is highly digestible.

Grasslands Matua is the recommended cultivar. Seed of all bromes should be fungicide treated before sowing to prevent ergot development on seed heads. --

Kentucky Bluegrass (*Poa pratensis*)

Another fine-leaved adventive grass, this rhizomatous species occurs abundantly in the dry to moderately moist high country, where it forms swards and is adapted to close grazing. Kentucky bluegrass has some spring production, which browns off very rapidly in summer, and is often rust infected. It has no advantage over other grasses under moderate or high fertility conditions.

Description Of Species

While an important forage grass in other parts of the world, it has shown no potential in any New Zealand trials and is generally regarded as a weed due to its competitive effect on more productive species.

Pubescent Wheat Grass (*Elytrigia intermedia*)

An introduced grass under trial for the dry, moderately fertile areas where its sod-forming growth habit make it suited for disturbed and eroded soils. It would need to be drilled and given time to establish. Yields are moderate. The cultivars tested are **Mandan**, Luna and Greenleaf. These along with other related North American wheat grasses tested have the common features of good vegetative spread but low forage production relative to cocksfoot and tall fescue.

Adventive Annual Grasses

A number of introduced annual grasses have spread through the moderate to low rainfall regions of the high country. These include cheat grass (*Bromus tectorum*), goose grass or soft brome (*B. mollis*), hair grass (*Vulpia myuros*), rats tail fescue (*V. bromoides*), silvery hair grass (*Aira caryophyllea*), and barley grass (*Hordeum* spp.).

All would be regarded as weeds in moderate or high fertility pastures, but probably make a contribution in the low fertility dry areas where they commonly occur. The young foliage of late winter and early spring is acceptable to stock, but all become highly unacceptable with the advent of flowering from mid spring on. Cheat grass has the greatest growth and is widespread in the high country. It is regarded as a weed here as in other range pastures of the world and indications are that it is increasing in New Zealand. Cheat grass and barley grass respond to increased soil fertility, with barley grass often being a good indicator of high fertility soils.

All these species are undesirable contaminants in pasture seed.

There are very few native annual grasses. The success of the adventive annual grasses, and the annual legumes like haresfoot clover and suckling clover, in the lower rainfall areas of low to moderate fertility high country suggests that other, more productive annual species should be investigated for moderate to high soil fertility sites during development.

Ryecorn (*Secale cereale*)

This is an annual cereal used both as a cereal crop and in the high country as a special purpose winter greenfeed crop. As such, it is better suited to the moderate fertility conditions likely in the high country than the other greenfeed cereals, with their higher fertility requirements. Ryecom, like some of the oat and barley varieties, can be fed off in early or mid winter after autumn establishment and growth; it holds or makes some further growth in milder winter conditions; and gives good growth for feeding off in late winter and spring.

Grain cultivars are available and used, but there are local selections which, from long use, have a more prostrate leafy habit.

Mountain Rye (*Secale montanum*)

Black Mountain mountain rye is a new species under evaluation and is best described as a perennial ryecom. Like ryecom, it has good autumn and early spring growth and is best used under occasional mob stocking.

Danthonias (*Rytidosperma* spp.)

These are a group of several native and introduced species which have shown good adaptation to low to moderate soil fertility, and close grazing. They occur widely in the drier regions of hill and high country. The country on which they occur is difficult to develop, because of the poor environment for legumes and other **oversown** species. At least some of the danthonias have a strong chemical inhibitory effect on sown legumes. They do show some response to increased fertility.

Phalaris (*Phalaris aquatica*)

A perennial grass, which has good autumn/winter growth where milder temperatures permit, and a reputation overseas for very good drought tolerance. Many old high country trials showed that **phalaris** should have a role in the drier high country because of this drought tolerance and persistence. Phalaris requires moderate to high soil fertility, performs well in irrigated and **dryland** conditions and is superior to cocksfoot in spring production. Summer growth is low. Its potential role should be in the semi-improved low rainfall zone but there are few recent trial results and some of these have been disappointing.

Like lucerne it is sensitive to soil **aluminium**. This could explain why it has not done as well in the high country as might be expected. In

other areas it combines well with lucerne, and as a component of other mixtures, to give both grass grub resistance and winter growth where temperatures are favourable.

In recent times a new cultivar, Grasslands Maru, has been tested and found to be superior to other lines in developed cultivated pastures.

Herbs

Sheeps Burnet (*Sanguisorba minor*)

Sheeps burnet is a herb introduced into early high country trials in the Mackenzie Country. It has been notable for its persistence (along with zigzag clover), and early spring growth in the lower rainfall areas. It is a large seeded species with slow initial establishment. It has a deep taproot. While spring and autumn growth is good, it has only limited summer production. Sheeps bumets probable role is for early spring feed under moderate soil fertility, or as standing summer feed. Lucerne is more productive if high fertility conditions exist. Sheeps bumet is moderately palatable at all stages. While it grows in the same conditions as hieracium, there is no evidence that it has particular competitive abilities against hieracium. It does not grow successfully in the mid to high rainfall zone of more leached soils.

Seed from some of the more productive lines of Spanish origin is commercially available.

Sheeps Sorrel (*Rumex acetosella*)

One of the most widespread adventive species, sheeps sorrel is now found from the highest, wettest areas to the lowest, driest areas. It is eaten by stock if little else is available, so is often a common part of their diet, though not by choice. There is a general belief that it indicates acid soils, which may well be true, but measurements show that it makes soils more alkaline.

Sheeps sorrel would not be sown and its seed should be regarded as an unacceptable contaminant in other pasture seed.

Broadleaf Species

A number of dandelion-like plants have come into New Zealand and spread throughout the high country. They are generally acceptable and preferred by stock under low to moderate fertility conditions and are notable for their high mineral content. The variety and success of such adventive species, including the hieraciums, suggests that the high country

environments suit this type of plant. Catsear (*Hypochaeris radicata*) is the most widespread of these next to the hieraciums, but they also include hawksbeard (*Crepis capillaris*), hawkbit (*Leontodon taraxocoides*) and dandelion (*Taraxacum officinale*).

While none of these species would be deliberately sown, their occurrence (other than hieracium) as contaminants of other pasture seed should be of no concern.

Hieracium or Hawkweeds

Ten hawkweed species have been inadvertently introduced into New Zealand and some have reached epidemic weed proportions in the high country. The worst of these is mouse-ear hawkweed (*Hieracium pilosella*) followed by king devil (*H. praealtum*), tussock hawkweed (*H. lepidulum*) and field hawkweed (*H. cuspitosum*).

Mouse-ear hawkweed is a major weed which has spread extensively in recent decades, reducing pasture production in the moderate to low rainfall zone. It establishes on moderately fertile undisturbed topsoil, in over-grazed short tussock grasslands. The species is regarded as a weed, not because of its unacceptability or low feed quality but because its low stature makes it low producing, and its competitive exclusion of other species limits the total feed available.

King devil is a coloniser of disturbed, low to moderately fertile soils in open situations, where it can increase under nil or low grazing pressure, either as open mats, or in combination with other species. It is moderately productive and is more accessible to stock than is mouse-ear. It is acceptable to sheep so it is doubtful whether it has a weed status under sufficient grazing pressure.

Tussock hawkweed and other single stemmed hieracium species occur in scrub and rubbly grassland soils in Otago and along boundaries of grasslands, shrublands and forests.

All hawkweeds should be regarded as undesirable contaminants of any pasture seed used in the high country because of their competitive growth habit.

Yarrow (*Achillea millifolium*)

Yarrow is an adventive herb occurring spasmodically throughout the high country. While it is regarded as a weed in lower altitude cropping land, its palatability, moderate growth, and vegetative spread make it a suitable grazing

Description Of Species

plant in the high country. It is more prevalent in moderate soil fertility conditions and little is known about its management requirements as a grazing species or the most suitable conditions for its use. Small quantities of yarrow are used in revegetation. It survives well under dry conditions. Rabbits have a preference for yarrow

This species is being reassessed as a desirable grazing species in other areas of New Zealand. Its presence in other seed lines would be an advantage. Selections of it are being developed.

Chicory (*Cichorium intybus*)

Chicory, a herb now used in lowland pastures, may have a place as a special purpose spring feed on high fertility soils in the high country. On moderate or low fertility soils its production and persistence is unknown at this stage.

Grasslands Puna is the only available cultivar.

Plantain (*Plantago lanceolata*)

Like chicory, this is a herb which is starting to be reassessed for use in the lowlands. Its potential in the high country is under consideration.

Forage Shrubs

A number of trials have looked at the possibility of introduced shrub species as potential forage plants for the high country. In general, very few species have shown any great potential. The difficulty appears to be the lack of high growing season temperatures and the frequency of growing season frosts in New Zealand, which

preclude most of the forage shrubs from overseas continental areas being suitable here.

The few species which have shown limited potential are tagasaste or tree lucerne, (*Chamaecytisus palmensis*); tree saltbush, (*Atriplex halimus*, *A. nummularia*); mountain mahogany, (*Cercocarpus montanus*); bluebush, (*Kochia prostrata*); and tree medic, (*Medicago arborea*).

Tagasaste can be established from either seed or transplants and has its major growth in summer.

Two slow establishing, small shrub canary clovers, (*Dorycnium hirsutum*, *D. pentaphyllum*), are showing promise for medium fertility, low rainfall country of near neutral soil pH. These clovers will nodulate with *Lotus corniculatus* inoculum. Shrubs can be established from seed.

A number of shrubs which are regarded as weeds in other parts of New Zealand, and in any sheep farming area, are worthy of a second thought as forage shrubs in the high country if diversification into goats is seriously considered. It has already been demonstrated in the high country that briar, *Rosa rubiginosa*, is a preferred species, and can be controlled, by goats. Similarly, gorse, *Ulex europeus*, is not a vigorous shrub in the high country and it has been demonstrated that goats prefer, and can control, gorse in the hill country zone where it is much more vigorous. However, neither briar nor gorse are likely to be acceptable species to sow, either by farmers or conservationists. Tree lupin, *Lupinus arboreus*, does occur in the high country, is a legume, and wilted foliage is eaten.