THE AGRICULTURAL VALUE OF PHALARIS TUBEROSA.

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INTRODUCTORY:

Of the twenty-six species of the. Phalaris genus of plants; Phalaris tuberosa has proved the most useful from the agronomic point. of view, The species has been variously known as Phalaris commutata, Phalaris bulbosa, Toowoomba grass and Canary grass. It has been grown in New Zealand mainly as a constituent, of certain pasture mixtures but has not proved. its value for certain reasons which will be indicated later. Mainly as a result of investigations at the Waite Research Institute, South Australia, this grass has given promise of being a valuable addition to the useful pasture species, and the result has been that it i's being cultivated with considerable success in many parts of the Commonwealth. During the past two years it has been sown on a number of properties throughout Canterbury and numerous enquiries are being made concerning the agronomic features of the grass and its future possibilities. The plant itself is a tall, strong-growing perennial with *one* or more swellings in the region of the lower stem internode. The blade of the leaf is very long, broad, flat and bluish-green in colour. The ligule is one of the longest in any of the grasses being almost as long as the leaf is wide. In habit, the plant, if not grazed, grows in clumps up to 3 ft. high producing a great bulk of herbage. The tall stems terminate *in* very closely compressed panicles bearing a rather low yield of seed. Usually the yield of seed per plant is 2-3% of the total weight compared with 20-30% in the Ryegrass. The seed is oval, flattened, moderate *in* size (300,000 per lb. compared with 240,000 per lb. in the case of Perennial Ryegrasses.

Phalaris tuberosa may be confused with certain other species particularly Phalaris minor and Phalaris canariensis. The Botanical differences between the various Phalaris species, have been fully described by Allen and Zo tov (1). There has been considerable controversy regarding the origin of Phalaris tuberosa. According to Trumble (2) the grass appears to have been introduced into Australia under the name of "Phalaris Commutata." It is believed that this was obtained from Italy by the Mew York Department of Agriculture and forwarded to Toowoomba about **1884.** Since then it has. been distributed through the Southern parts of Australia and. in scattered areas of Canterbury, The grass is the same Taxonomically as Phalaris Tuberosa L of the Medi terranean regions. It is, however, superior as a pasture plant under. Australian conditions, to those forms of the species which have recently been obtained direct from the Mediterranean region. Hand crossing between the Mediterranean Phnlaris Tuberosa and the Australian form indicates -that the two types are completely compatible and give rise to normal progeny. The arguments put forward by Ewart (3) and Kennedy (4) as to the hybrid origin of the Australian form have bten generally rejected but there is a weight of evidence in support of the belief that the Australian forms are variants or ecotypes isolated from populations naturally occurri ng in the Medi terranean region .

SOIL AND CLIMATIC ADAPTABILITY:

A feature of the grass is its ability to persist on soils of a wide range of fertility. Although under Canterbury condi t-iihs the grass has not been under observation for a sufficient period to determine its yield and persistence on soils ranging from light to heavy, it is true that the seedling development on'

the light dry plains, near Burnham and at Aylesbury has been good *when* sown on a fallowed and well prepared seed bed.

The Phalaris species are suited to climatic conditions characterised by winter rainfall and summer dryness, Under Australian conditions Phalaris Tuberosa has been found to thrive well on areas of 17 inch to 30 inch rainfall or over and at altitud'es up to 4000 feet. In dealing with the relation of the grass to soil and climate, **one** of the outstanding features of the grass should be considered; namely, its high degree of drought resistance.

DROUGHT RESISTANCE:

This feature has accounted for ***some*** of the popularity of the grass ***under*** certain Australian conditions. The need of a drought enduring grass is not of such concern in New Zealand as in parts of Australia, but nevertheless this attribute, plus that fact that the grass grows well on light soils, at least suggests the usefulness of Phalaris tubcrosa on some, of the dry plains land. Drought resistance in Phalaris tuberosa is associated with several factors. First of all the swollen internodes at the base of the stem play a part. There is a downward migration of food nutrients in the spring - the material stored assisting the plant to withstand drought in the drier periods. Drought resistance in Phalaris tuberosa appears also to be associated with the fact that the plants possess relatively few main roots which penetrate the soil deeply and are not distributed very densely in the surface layers. At the Wai te Insti tute, first year penetration through a heavy sub-soil clay has reached a vertical distance of 76 inches, The roots, especially those in the upper layers, possess a downy covering which is corky in nature. This is thought also to be effective in preventing ***loss*** of moisture, from the roots during a time when the soil is very dry.

THE SEED:

The germination capacity of the seed is usually only moderate - rarely exceeding 75% under laboratory conditions. It has been found that "after-ripening" is usually necessary with Phalaris tuberosa seed, This is especially so when a seed crop has been grown in a cool moist district or when it has been harvested under damp conditions such as occurred throughout Canterbury during the autumn. of 1936-37. In **two particular** samples harvested during March this ***year*** the laboratory germination immediately after harvesting was 42% and 47% respectively. After one month's storage the figures were 51% and 56%, and after two months the samples germinated 61% and 64%. It will be observed that even after this period of storage the germination was low. It is unwise, then, to sow new **season's** seed during the same year. A common impurity of. commercial seed samples is Phalaris Minor - an annual. Unfortunate comparison between this annual, and the perennial species has been one of the causes of lack of appreciation of the qualities of Phalaris tuberosa. Reliable identification of the two species from seed characters appears to be difficult although one reliable distinguishing character is the pink root tip of Phalaris minor, (5) compared with the white tips produced by Phalaris tuberosa.

SEEDLING DEVELOPMENT AND ESTABLISHMENT:

The seedling development of Phalaris tuberosa is vigorous compared with such a grass as Cocksfoot but is not so vigorous as Ryegrass in the seedling year. Cashmore (6) has shown that Perennial Ryegrass is more vigorous in establishment and early growth than Phalaris tuberosa. In his trials single plants of Perennial Ryegrass outyielded Phalaris tuberosa by more than, 100%

at every monthly harvest in the first year. Perennial ryegrass produced from 2½ - 4 times as many tillers and 5 times as many leaves as Phalaris tuberosa *in* the first year. In the second year however, Phalaris tuberosa was the heavier yielding species. At maturity the Phalaris outyielded the ryegrass by 100% both in terms of leaf and total herbage. Cashmore's results have indicated that Perennial Ryegrass is a more rapidly establishing and a more *aggressive* species than Phalaris tuberosa in the first year but that, when well established, Phalaris is more persistent and productive. Such a conclusion has been confirmed by observation upon single Ryegrass and Phalaris tuberosa plants, now six years' old *growing* at Lincoln.

'The chief reason for past failures of Phalaris tuberosa in' New Zealand lies in the fact that the susceptibility of the species to competition in the seedling year has not been generally **appreciated.** The presence of any form of competition, perhaps due to the sowing of, this, grass in a seed mixture or through the. presence of weeds, is a serious detriment to good seedling establishment. Trumble (7) has shown that under South Australian conditions the inclusion of even 8-10 lb. of Perennial Ryegrass in the seed mixture is sufficient to suppress the est blishment of Phalaris tuberosa. His figures are:

Pasture sown May 1931 with Phalaris 50% - Ryegrass 50%
He rbage 1931 contained Phalaris 7% - Ryegrass 93%
" 1932 " " 35% - " 65%.

Pasture sown May 1931. with Phalaris 75% - Ryegrass 25%
Herbage 1931 contained Phalaris 21% - Ryegrass 79%
" 1932 " " 65% - " 35%.

The areas sown with' Phalaris throughout Canterbury during the past two years have been *sown* alone - about 10 lb. seed per acre or with white clover (8-10 lb Phalaris + 2-3 lb White Clover). Where the White Clover has been sown with Phalaris it seems to have developed 'to the detriment of the Phalaris. On the other *hand, even* where the Phalaris has been sown alone on medium - good land during 1936 and 1937 there have been few cases in which the strike of Phalaris tuberosa was fair. In all these cases of poor establishment, weed competition has been severe. This has resulted in unjustified condemnation of this pasture plant. On lighter areas weed competition has been negligible and the better seedling development of Phalaris has been noticeable, This position concerning weed suppression of Phalaris is of course bound up with neglect of early cultivation. The deep ploughing of *an* area to be sown in Phalaris must be performed early in order to reduce possible weed competition by permitting time for light surface. cultivati on during a summer fallow. January to March is the most satisfactory time for *sowing* throughout New Zealand. Hence the need for initial cultivation in the spring. Six to eight lb. of seed 'per acre is recommended, to be mixed with 1 cwt. of superphosphate per acre and broadcast or dri lled on medium-heavy land and drilled on lighter soils. Seeding must be shallow commensurate with the presence of soil moisture near the surface. The records given below of eight Phalaris crops sown in Canterbury show that the seed ha's been *sown* on hastily prepared seed beds, cultivated in the autumn and in *'some* cases the seed was sown as late as the end of Apri 1. These ***reasons*** for failure are the ones well known with many attempts at pasture establishment.

PRODUCTIVITY AND EARLY MANAGEMENT:

A very critical period in the life of a. newly sown Phalaris area is during the first, year after sowing* Plants which survive this period and are in vigorous condition are likely to remain permanent. Total production during this first *season* after sowing

is rather low. With this in mind grazing during this period should be adopted solely in the interests of developing the Phalaris plants rather than from the point of view of seeking a high return from the pasture. Grazing should not be started until the plants are well established, possessing 3-4 tillers per plant. This stage is reached about 10 weeks after sowing. Rotational or judicious grazing *in the winter* and *early* spring seems essential. A fatal *policy in* some of the Canterbury areas has been that of *using* the young Phalaris field in the first year as a odd area on which sheep cows and horses have been allowed free run for an indefinite. period, The Phalaris plants will be firmly established by the second autumn provided careful- grazing has been practised in the seedling year. It is from then on that the great value of the grass is evident, namely the vigorous productive growth during autumn and early winter.

The grass has been aptly described as the "King of. Winter' Grasses," on *account* of the remarkable development which commences during *the* autumn and early winter while other permanent grasses become dormant. The autumn regeneration in the case of the Phalaris tuberosa is due to the fact that the swollen basal internode-stem provide a means of storage of food material which is utilised for the production of herbage, at a time when absorption of nutrients is low. The plant must be given an opportunity to store this reserve food in the period preceding the autumn and winter. This is the basis of a very important point of management which will be referred to a&n: viz. ; spelling the Phalaris in spring when translocation of food is active. Growth records are being kept of six year old Ryegrass, Cocksfoot and Phalaris tuberosa plants. So far such records have not been completed over a period of a year but the relative growths during the early part of this year indicate that during the months of March, April, May, June and July, the Phalaris tuberosa was in a high yielding, green and succulent condition compared with partially dormant Ryegrass and Cocksfoot.

NUTRITIVE VALUE:

A chemical analysis of Phalaris tuberosa has been made at the Canterbury Agricultural College using green-leaf material in typical grazing condition - 2 inches long two weeks after cutting. The *analysis* on a 100% dry matter basis is as follows:

Total ash	...	14.0%
Line	...	.285%
Phosphate	...	.810%
Chloride	....	2.08%
Crude protein	...	**22.37%**
Crude fibre	...	**20.7%.**

The lime figure is very low (c.f. Prairie Grass .875%). The chloride is high but similar figures have been obtained for mixed pastures in parts of Canterbury. The protein content is normal for a pasture in this condition. There is a bad balance' between the lime and phosphate and it is likely that animals fed on pastures of similar composition would benefit' from a lick containing a large percentage of lime. The above figures refer to succulent leaf growth two weeks after cutting. The nutritive value varies remarkably with the stage of growth.

Richardson and Trumble have examined this matter in some detail. They found that the crude protein content of the herbage of Phalaria tuberosa fell from 33% at the early tillering Stage to 3.37% at maturi, ty . The percentage of crude fibre and nitrogen-free extractives increases continuously from tillering to maturi ty . . The ratio of protein to oarbonacsous material in the herbage was 1: 1.6 at early tillering and reached a value of 1:26 at maturity and the amount of Nitrogen, Phosphoric Acid and Potash in the herbage at maturity was considerably less than that present at earlier stages.

THE DEVELOPMENT OF CER-TAIN PHALARIS AREAS IN CANTERBURY:

Field 1: Deep heavy loam. 10 lb. Phalaris tuberosa sown broadcast at the end of April 1936, with 1 cwt. of ammoniated super immediately after green feed barley has been ploughed in. The strike was very poor and in the spring the area was covered with wild turnip and other weeds, In the Autumn 1937, the Phalaris plants were very sparsely distributed but those which had survived the weed competition were vigorous.

Field 2: Light-medium loam. Area grubbed and deep ploughed after wheat. Two- weeks cultivation' before sowing at the end of March, 1936 - 10 lb. Phalaris + 3 lb. white clover with 1 cwt. super, broadcast. In November 1936 the Phalaris plants were very thin and stunted and the sole of the ground was a mat of annual weeds mixed with white clover, In April 1937 there was only a trace of Phalaris.

Field 3: Clay loam. Area skim ploughed after barley, cultivated and harrowed. No deep ploughing - 15 lb. Phalaris + 3 lb. white clover with 1 cwt.' super sown in mid-April 1936. In October top-dressed ½ ton line + 1¾ cwt. super. There was a dense mother of weeds in the spring but the area was grazed with cattle during September and October. In the autumn the phalaris plants which survived were not vigorous and were sparsely distributed (1 plant per 2 sq. ft.) in a very dense uat of white clover.

Field 4: Heavy clay loam. After yeas, harvested in January 1935 the area was deep ploughed, cultivated and 10 lb. Phalaris + 1 cwt. super was sown broadcast at the beginning of April. No grazing in first year. A light yield of seed in February 1936. Area grazed with cattle throughout 1936 and shut up in November. During the second autumn a seed crop was taken. One month after harvesting, dense leafy plants 4" high covered the area. This is the most successfully established stand of Phalaris which has been observed,

Field 5: Medium sandy loam. Area in wheat 1935. Stubble deep ploughed in April and 10 lb Phalaris + 2 lb white clover sown immediately, after ground had been surface cultivated. A light seed crop obtained from a very thin covering of plants in first autumn. Grazed with cattle after the harvesting of the seed and in March 1937 there was only a trace of Phalaris in the mat of white clover and weeds.

Field 6: Sown broadcast after peas in early April 1936 using 10 lb Phalaris + 3 lb white clover after 3 weeks fallow following deep ploughing. The strike was fair but at the end of' September the area was grazed with 140 ewes on the 8 acres for 6 weeks with the sheep on for 4 hours daily. In the first autumn there was a dense covering of white clover with only a moderate distribution of rather spindly Phalaris plants.

Field 7: Wheat stubble skim ploughed in February 1935. Later deep ploughed and worked thoroughly with cultivator and harrows. After a month's fallow 8 lb seed with 1 cwt super was broadcast in aid-April. The seedling covered in the first yeat was dense but growth was slow, In the spring 1 cwt of sulphate of ammonia was applied and a seed crop obtained in March 1936, The field was grazed during the first autumn and heavily during the second spring and summer ('1936). By the second autumn 1937 the Phalaris area was much, less promising than in the autumn 1936 and eventually became a cover of weeds and other grasses.

Field 8: Light stony land. Area ploughed after turnips, summer fallowed and drilled with 10 lb. phalaris in February 1937. Six weeks after sowing there was a good covering of Phalaris - the plants being two-thirds the size of oat plants sown the same time.

From the above outline of the history of some of the fields which have been sown in Phalaris tuberosa during the last two years it is apparent that from our local evidence we are not able to estimate the attributes of the grass. In few cases has the grass been sown under conditions in, which it had even a slight chance of successful establishment and where a successful, strike was obtained, the pastures have been ruined by continued grazing during the spring and summer after the seedling year,

THE MANAGEMENT AND UTILISATION OF PHALARIS TUBEROSA:

Some consideration of the information already given should indicate that a field of Phalaris tuberosa needs special attention concerning establishment and early management. The important points may be summarised:

(1) The use of good viable seed - preferably seed harvested during the year preceding sowing;

(2) Proper cultivation of the seed bed. As for any permanent pasture the ideal is for a seed bed which is firm, moist, weed-free and fertile - conditions obtained after early cultivation and a summer fallow;

(3) Shallow sowing of the seed early in autumn. The seed should not be sown more than half an inch deep. With such a slow establishing plant, the advantages of sowing early and with the seed and manure in close contact need no emphasis,

(4) The avoidance of anything but very light brazing in the seedling year. Better establishment will be obtained if brazing is avoided in this first year.

The sowing of clover (white or subterranean at the rate of 2.3 lb. per acre) will probably prove necessary to provide Nitrogen which will be needed especially in later years. The clover may be introduced at the time of sowing the Phalaris but it is suggested that this will be better introduced by broadcasting without manure immediately, after the Phalaris has been drilled., In this way the drilled Phalaris will have a better chance in its seedling stage of overcoming the clover competition which has been apparent in the local areas where Phalaris and Clover have been drilled together. Once the Phalaris is established it will not be affected by the clover but will respond to the Nitrogen supplied.

Management of established Phalaris tuberosa should be in keeping with the two recognised features of the grass - Productivity in autumn asd winter, Persistence and drought resistance, Phalaris tuberosa is particularly susceptible to defoliation in the spring and early summer, At this time there is a marked downward movement of nutrients which assist in the development of the root system and are used later for autumn regeneration and to provide the means of withstanding a dry. period. The downward movement of reserve foods is indicated by the obvious enlargement of the basal internodes during October and November. Defoliation during this period is bound to, check. the extent of downward movement and thereby limit this accumulation of food, and reduce both ability and vigour of autumn regeneration. The inference then is (1) for intermittent grazing from autumn to spring; (2) complete spelling during the spring and early summer when there is an abundance of feed from the main pastures; (3) utilisation of the final development as (a-) hay - cut at the early heading stages, (b) for seed production, or (c) as mature standing herbage. Any decrease in fertility should be overcome by annual top-dressing in the winter with 1 cwt, per acre of superphosphate and ½ ton lime

in addition every 2 or 3 years depending upon the nature of the soil. After a time the grass may tend to become sod bound and there may appear to be a lack of persistence, This applies particularly to cases in light land. The sod bound condition is to be avoided by mechanical fenovation using disks in the early autumn and by the further introduction of subterranean clover on light land or white clover on the heavier land. At this stage these should be drilled with manure at the rate of 3 - 4 lb. on a surface which has been disced or grubbed.

On medium to good land this grass should be of some value when sown alone in one field of the farm, to be used for green feed for all classes of stock during autumn and winter, when the main holding fields are unproductive.

When suitably sown on light dry land the grass certainly grows well in the seedling stage as evidenced in the fields growing at Burnham and. Aylesbury in Canterbury. The ability of the grass to withstand dry conditions also points to its possibilities on light land. Then again it grows well in association with subterranean clover. However, in spite of the fact that Phalaris tuberosa is successful on the Sight lands of Australia and although its early growth on the light lands of Canterbury has been good so far, it is. felt that this early promise on light land nay not be maintained. On such land with the alluvial shingle very near: the surface the nature development of the grass is not likely to be so good as in the case of nany of. the Australian dry land areas in which there is deep silt and sand over a clay subsoil.

The grass has not been growing under Hew Zealand conditions for a sufficiently long tine to allow for marked enthusiasm concerning its future. In spite of the unfavourable but unjustified inyressions obtained fron the evidence of the local areas which have been described above, the attributes and features of agricultural value of the grass have been accepted and proved. If Phalaris tuberosa is managed along the lines suggested it seems likely that this grass will occupy a most useful even if limited place in our grassland economy.

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DISCUSSION.

The Chairman:

A flaxmiller in the vicinity of Palmerston North about the year 1898 went over to Australia and bought a small amount of Phalaris commutata, and paid an enormous price for the seed.

He grew it in his garden for the first year, and in the second year harvested it for seed and had enough seed to sow approximately 20 acres at £5 an acre. There was 100 lb. of seed. That was on extremely rough ground in the Linton area. During the period that the field remained in Phalaris tuberosa (or commutata) this man cut it each year for seed, and over a period of about 8 or 9 years sold seed to the extent of about 5 to 10 tons. It was the only crop on that area, and was handled by Barraud & Abraham and shipped to South Africa. After about eight years unfortunately a fairly heavy infestation of tall fescue took place, and it did not seem possible to clean out the seed sufficiently to get rid of the ergot which was in the line. The South African Government refused to take delivery of the final lot that went, and the man did not get it to seed any more.

That was the earliest account of Phalaris tuberosa in New Zealand, but as far as this man was concerned, he was not at all interested in the grazing of it - he grew it entirely for seed purposes.

A relative of this man living at Cambridge had an area of 3 to 4 acres sown with seed from the Linton area. For a year or two he supplied Phalaris tuberosa seed to Australia.