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DEPARTMENT OF AGRICULTURE AND FISHERIES, SOUTH AUSTRALIA

Agronomy Branch Report

BARLEY IN SOUTH AUSTRALIA

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Report No. 76

NOVEMBER, 1976

DEPARTMENT OF AGRICULTURE AND FISHERIES, SOUTH AUSTRALIA

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November, 1976.

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BARLEY IN SOUTH AUSTRALIA

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Although originally barley was a crop of comparatively minor importance, it has been grown in South Australia for many years. South Australia is unique as a barley growing State because so much of the arable cereal country is near the coast. These coastal districts have proved most suitable for the production of good quality barley for malting purposes.

By the 1950s South Australia became the main barley growing State in Australia producing 75 per cent of Australia's barley grain.

Barley production increased greatly in South Australia after World War II until the early 1960s. Despite a slight decline in production for a few years the area devoted to barley has increased since 1970.

South Australia was rivalled by Western Australia for the position of main barley growing State in the early 1970s when more barley was sown or more grain produced in Western Australia.

BARLEY GROWING DISTRICTS

Barley is a quick-growing, hardy cereal, able to mature on relatively limited rainfall. To produce good quality grain, suitable for malting, however, it requires a somewhat cool and prolonged grain ripening period. This is provided in the coastal and peninsula districts which receive the benefit of cool sea breezes and cool nights. Early barley production was largely for malting purposes, and consequently its cultivation developed mainly in more favoured districts of the State. However, with the recent further expansion of barley production it is now grown in many of the more marginal districts.

Map 1 shows the areas where barley is sown and the intensity of sowings in these areas. The map is based on the mean sowings of barley in each statistical hundred for the five year period 1970/71 - 1974/75.

Using the boundaries of barley sowings as determined from Map 1, Map 2 shows the intensity of production of barley. Again, the map is based on the mean production of barley in each statistical hundred for the five year period 1970/71 - 1974/75.

Appendix 1 summarizes the data used in the preparation of the maps. It shows the mean area sown, mean production and mean yield for 1970/71 - 1974/75 of barley grown in the counties of South Australia.

County Fergusson, which comprises central and southern Yorke Peninsula produced 21% of the State's barley during the five year period. The area sown, represents 15.7% of the State's barley area, also the largest in any county. The area sown is greatest and production most intense in the northern part of the county.

County Daly, which consists of northern Yorke Peninsula is second in quantity of barley produced with a mean annual production of 13% of the State's total. This is produced on only 10.1% of the total barley area.

County Buccleuch in the southern Murray Mallee is the third most important county for barley production, producing 6.4% of the State's total. The average area sown to barley in County Buccleuch increased from about 6400 hectares for the 10 year period ended 1942 to 31,764 hectares for the 5 year period ended 1952 to 65,464 hectares for the 5 year period ended 1974/75. This increase in barley production was accompanied by a decrease in wheat sowings. Although all 17 hundreds in this county produce some barley the central part from Coomandook to Geranium produces the most grain.

County Jervois on Eyre Peninsula is the fourth largest producing county in the State. County Jervois is very large and the production is not intense (Map 1).

North of Adelaide Counties Gawler and Stanley produce considerable barley, together accounting for 11.8% of the State's production. In County Stanley the barley is mainly grown to the west of the Clare Hills.

BARLEY QUALITY

Map 3 shows the quality of barley delivered to the Australian Barley Board from the different areas. The boundaries shown were determined from map 1. For each barley receival point the proportion of No. 1 and No. 2 grade barley received in the five year period 1970/71 - 1974/75 was calculated. The area from which barley is received at each receival point was estimated. It is difficult to determine the quality of grain from each district because over half of the grain received by the Australian Barley Board is received at the terminals (see Appendix 2). The requirement that the first load from paddocks eligible for No. 1 or No. 2 grades must be delivered to an "On-the-Spot" classification agency adds to the difficulty of determining the area from which the barley comes.

CLIMATE

Climate, which includes rainfall and its incidence, temperature, frosts, winds, storms, etc., has a more important bearing on barley growing than soil type. The South Australian climate with its winter and spring rain incidence, mild temperatures without undue strong winds and only occasional storms, is generally very suitable for barley growing.

Barley is the quickest growing cereal under these conditions. It can be sown late, after other cereal crops, and will ripen quickly in the spring, enabling it to be harvested before wheat crops mature. The State's main cultivar Clipper is slow growing in the early stages, especially in cold soils, or low fertility soils. Therefore, except in the higher rainfall districts, late sowing of Clipper is not recommended unless soil fertility is high and weeds and soil erosion are not likely to be serious problems.

Under some conditions, on fertile soils in the wetter cereal growing districts of the State, barley can be sown as late as August, or early September, and be harvested within four months.

Early sowing of barley, particularly in the Murray Mallee and Upper South East, can result in severe frost damage. Early sowing brings the crops to flowering when there is still a high frost risk. Damage is most prevalent and generally most severe in the Lowaldie - Karoonda - Wynarka area. In some years severe damage occurs in the Lameroo - Pinnaroo area also.

Sowing is often delayed until July or August in the Upper South East because of frost but this late sowing increases the risk of reduced yields, particularly in the lighter soils, due to early finishes to the season. Oats and lupins are becoming more popular in this area because of a lesser frost risk with early sowing.

Weather conditions whilst the crop is maturing are important and can govern the quality of the barley grain. Hot dry conditions occurring early in the spring induce a quick ripening of crops and this often results in thin grains with coarse skins, undesirable for malting. Better quality grain is obtained when the ripening period is somewhat prolonged by cool conditions without high temperatures or drying winds. Hot or strong winds are at times detrimental to yields and quality of barley causing severe losses if they occur at flowering or within a few days of maturity. The loss is greatest from cultivars that have weak straw, grain being lost through heads breaking off above the top node. Crops can be windrowed or rolled (see later) to safeguard against possible wind damage.

SOILS

Barley has been grown successfully in practically all agricultural districts of the State indicating that South Australian soils are generally suitable for the crop. Soil type is however one of the factors affecting the quality of the grain produced.

The highest yields are obtained on the well drained black plain soils of the South East, the heavy alluvial soils of the southern Adelaide plains and the loamy mallee soils of Yorke Peninsula. High yields are also obtained from the shallow sand over clay soils of southern Eyre Peninsula and the grey mallee soils of Yorke Peninsula.

With the increasing use of legume based pastures to develop and maintain soil fertility soil type *per se* has become less a governing factor for cereal yields than rainfall and other climatic conditions. This applies to barley as much as to the other cereals, higher fertility encouraging quicker and more luxuriant growth.

Some attention must be given to the degree of soil fertility if good quality grain is to be obtained. Rank growth due to excessive available nitrogen will be detrimental to grain quality as will poor health of plants due to insufficient available nitrogen. The former can be overcome, to some extent, by later sowing but under some climatic conditions this will result in high grain protein levels. Growing better legume based pastures or other legume crops on the land between cereal crops will help overcome the latter.

Unfortunately there is no easy or quick method available for measuring fertility of soils and no precise knowledge concerning the fertility needed to produce the desired quality of grain. Soil fertility and rainfall are so complexly inter-related that it is impossible to predict reliably the final effect of one or the other on grain quality. Consequently it has to be determined by the practical experience of farmers, who should be guided by the structure of the soils of their farms and individual paddocks.

PLACE IN THE ROTATION

For many years barley sowings in most districts followed on the stubbles of wheat, but in recent years the importance of legume pasture in the rotation has been realized and a change has taken place.

On lower Eyre Peninsula 90% of the barley crop is now sown after leyland. In the Yorke Peninsula - Lower North area and on Upper Eyre Peninsula this figure is 85% and 60% respectively. In each case the remainder is sown on stubble.

In the Murray Mallee practically no two-row barley is sown on wheat stubbles, unless sown as feed, often with medic seed.

Sowing on legume based pasture land prepared in the autumn is a popular method. Barley follows one, two or three years of pasture according to development. Once the annual legumes, medics and subterranean clovers, are established it becomes a maintenance phase.

To maintain good medic pastures alternate cropping or cropping with a close rotation is essential. Because of the hardseededness of medics, optimum regeneration is achieved where an alternate year cropping programme is practised. Better germination occurs after the cropping year because the medic seed is incorporated into the top soil. Medic pastures can become weedy or grass dominant because of the fertility build up if the land is not cropped frequently. Barley lends itself to a close rotation on the alkaline soils in the mallee districts, with adequate soil preparation and without fallow.

On the neutral to acid soils where subterranean clover is grown, two or three years of clover should be grown on poor soils to develop the pasture satisfactorily. Two cereal crops can then be grown in succession to utilize the fertility. However the lack of hard seeds in subterranean clover may lead to the elimination of clover following 2 successive crops and resowing of clover will be required. Some farmers have achieved carryover of subterranean clover on short rotations. The early maturing cultivar Geraldton is more successful in this situation.

SOIL PREPARATION

Barley is mostly sown on prepared leyland or stubble land; very little is sown on fallow.

Pastures should be well grazed during the late spring and summer. Following a satisfactory summer or early autumn rain the land is worked either with plough or cultivator, working it evenly and not more than 7 cm deep. This is followed by cultivations or harrowings, when necessary, to kill weeds and prepare a seedbed.

Wheat stubbles should be grazed to reduce the residues to a minimum. The land can be ploughed or cultivated, leaving straw on the surface, or well mixed with the soil. If too much straw is buried, problems of seedbed preparation are increased and the seedlings can suffer a severe nitrogen deficiency because all available nitrogen is used in the breakdown of organic matter. In some years burning may be necessary to remove heavy cereal stubbles. If the problem of excessive straw mixed into the soil cannot be avoided, it can be corrected by the use of nitrogenous fertilizers.

Particularly on Lower Eyre Peninsula, an increasing area of barley is being sown using minimum tillage methods e.g. Imperial Chemical Industries "Spray-Seed" (R). The chemicals used in this technique act through plant leaves so a full germination of weeds is necessary before spraying. The paddock is hard grazed from the break of the season to restrict leaf and root growth. Livestock are taken off the "hard-grazed" paddock 3-7 days before spraying, so that fresh leaf growth, free of dirt and dust, can be fully wetted by the spray mixture. The spray is a mixture of diquat and paraquat which kill broadleaf and grassy weeds, respectively, on contact. The crop is sown with a spring release combine, with at least 10 cm points on the tynes, 3-5 days after spraying. In some cases, mainly heavy soils, one working with the combine is necessary before sowing.

In the heavier rainfall districts of the Lower South East, where good pastures are grown, early spring sowing of barley is practical, and in preparation for the crop the pastures should be kept well grazed through the winter months. Land can then be well ploughed during August, harrowed and immediately sown.

FERTILIZERS

As with other cereals the use of superphosphate on barley is essential. The amount applied varies considerably from one district to another depending mainly on the soil type and rainfall. For example in the Northern Murray Mallee 50-80 kg/ha of superphosphate are applied with the crop, in the Kimba district 90-120 kg/ha are applied, and around Cummins rates as high as 150-180 kg/ha are common.

As a general rule, to meet the needs of the crop only, each tonne of barley produced requires about 35 kg/ha of superphosphate. The amount of superphosphate required depends on the superphosphate and cropping history of the paddock. On newly cleared land or land with a poor superphosphate history higher rates may be required. Where it is intended to return the land to pasture immediately following the barley crop some growers apply extra superphosphate with the crop for use by the following pasture as well. Although this saves the cost of top dressing it is generally agreed that superphosphate for the following pasture is better top dressed onto the pasture than applied with the previous crop, especially on soils that rapidly fix the superphosphate so that it is unavailable to plants.

Besides superphosphate, minor elements are required on certain deficient soils, but these do not comprise a large area of the barley districts. The chief of these is manganese, which is required for the soils on southern areas of Yorke Peninsula, and on Eyre Peninsula and can be applied at sowing at the rate of approximately 20 kg manganese sulphate per hectare with the superphosphate or as a 2% manganese sulphate foliar spray. On Southern Yorke Peninsula it is necessary to apply the manganese both at seeding and as a foliar spray.

Other trace elements, such as copper and zinc, are necessary on certain soils of southern Yorke Peninsula, Eyre Peninsula and the Upper South East, but one application may last for a considerable period so that application will not be necessary each cropping year.

As high concentrations of nitrogen in grain are undesirable for malting, growers aiming for No. 1 or No. 2 grade should exercise caution when applying nitrogen fertilizer to barley. However, the cultivar Clipper has a higher yield potential than its predecessor Prior, and so may use more nitrogen in increasing grain yield without the quality of the grain deteriorating.

The need for applied nitrogen on cereals often depends on the amount of nitrogen fixation in previous pastures. If good medic or subterranean clover pastures have been grown recently then nitrogen fertilizer will not be required.

Nitrogen dressings (about 20 kg per ha N) are recommended for Clipper barley grown after heavy crops of wheat, especially where the wheat stubble is incorporated in the soil. Nitrogen

(10-20 kg per ha N) may also be beneficial on barley sown into stubbles for winter grazing or on sand dunes subject to drift.

Sulphate of ammonia, usually as superphosphate - ammonia mixtures, and urea are now widely used on barley, particularly on light deep sandy soils. This enables the crop to grow faster in its early stages thus reducing the chances of wind erosion and improving the plants ability to resist the effects of sand blasting.

CULTIVARS OF BARLEY

Both two-row and six-row types are grown in the State. Six-row types represent less than 5 per cent of the total sowing and the proportion is declining.

Two-row types

The main two-row types grown are Clipper, Prior, Ketch and Noyep. These cultivars together represent about 95% of the area sown to two-row types.

Clipper (Prior x Proctor)

Clipper is the main cultivar. Since its release in 1968 the area sown to Clipper has rapidly increased until now it represents 70-75% of the two-row sowings. Clipper was selected by Dr. D.H.B. Sparrow at the Waite Agricultural Research Institute and was extensively tested by the Waite Institute and Department of Agriculture, using finance from the Barley Improvement Trust Fund, before it was released. It is well suited to the soils and climatic conditions of the main barley growing areas and has now largely replaced the previously widely grown Prior.

Short moderately strong straw and small compact heads without the characteristic swan neck droop of Prior make Clipper moderately resistant to wind damage although, under severe conditions, big head losses can occur. Rolling and windrowing are useful methods of ensuring against loss.

Clipper makes only slow early growth, especially on less fertile soils, but later, it grows rapidly with a large number of tillers. The grain is slightly smaller than that of Prior with good shape and appearance. In extensive trials Clipper has outyielded Prior by an average of 18 percent.

The cultivar has excellent quality characteristics, and in South Australia Clipper is the only cultivar accepted into the No. 1 and No. 2 grades by the Australian Barley Board.

Ketch (Noyep x Lenta)

Ketch was selected at the Waite Agricultural Research Institute by Dr. D.H.B. Sparrow from the cross made by Dr. K.W. Finlay. Ketch is very early maturing and is adapted to the drier (less than 350 mm) short growing season areas. It was released in 1970 as a replacement for Noyep since it is superior to that cultivar in straw strength, grain yield and grain quality. In Department of Agriculture trials Ketch has yielded 12% more grain than Noyep but about 10% less than Clipper. Ketch makes rapid early growth and so is useful for grazing.

Ketch can replace Noyep in a few limited areas where Noyep was recommended but results indicate that Clipper out-yields Ketch in most of these areas and Clipper is now grown in most of the old Noyep areas as well as the Prior areas.

Prior (English Archer selection)

Although it is thought to be developed from English Archer the origin of this cultivar is not definitely known. It was first grown about 1900 by Mr. S. Prior of Brighton, South Australia from seed of unknown origin.

The then high malting quality of the variety was recognized by Messrs. Barrett Bros , maltsters of Adelaide, who distributed seed from Prior's crop to a number of growers. The results secured from the planting were very satisfactory. Growers obtained much higher yields and grain of better malting quality than they did from other cultivars planted on their farms, and consequently Prior barley spread throughout South Australia and from there into Victoria and Western Australia.

Prior was the main malting barley cultivar in South Australia from the beginning of this century until the late 1960s. In 1939/40 it occupied 86 percent of the area sown to two-row barley. The proportion sown to Prior declined following the release of Maltworthy and during the late 1950s Prior occupied 75 percent of the two-row area. The percentage area sown to both Prior and Maltworthy declined following the release of Noyep until in 1969/70 Prior occupied 60 percent of the two-row barley area in South Australia.

Prior has two major deficiencies. Firstly, it is susceptible to neck-break and shattering if strong winds are experienced when the crop is nearly ripe. Secondly, it is not well adapted to conditions of high soil fertility, tending to produce harsh steely grain. This problem became serious in South Australia with the increased use of legume-based pastures. Also, by today's standards Prior has only medium malting quality.

Clipper was developed as a replacement for Prior and following its release the area sown to Prior rapidly declined, until it occupied less than 10 percent of the two-row barley area in 1975/76.

Noyep (Prior selection)

Noyep arose in South Australia as a single plant selection made from a Prior crop by a farmer, Mr. J.J. Noyce of Warramboo on Eyre Peninsula, in 1947.

The farmer built up some seed and the selection - known as Early Prior - spread through parts of Lower Eyre Peninsula, an area where it was distinctly inferior to Prior. The South Australian Department of Agriculture acquired seed, tested it against Prior and after its registration it was first recommended in 1961 in restricted areas.

The areas in which it was recommended are those characterised by a sharp finish to the rainfall season where Prior consistently produced relatively low yields and grain of poor quality. In these limited areas Noyep produced higher yields than Prior and also grain of better quality.

Noyep produces vigorous early growth.

Other two-row cultivars at present grown in South Australia include Dampier, Weeah, Bussell, Maltworthy and Resibee.

Dampier (Olli x Research)

Dampier was bred by the Western Australian Department of Agriculture and released in 1967. Dampier matures several days later than Clipper and generally yields below that cultivar. A considerable quantity is being grown in the south-western Murray Mallee, mainly in an area bounded by Murray Bridge, Mannum, Karoonda, Geranium, and Ki Ki.

Weeah (Prior x Research)

Weeah was released in 1967 to replace Prior in the Victorian Mallee and Wimmera districts. Weeah is at present the most widely grown barley cultivar in Victoria.

Weeah has been grown for a few years in the Murray Mallee area of South Australia and in both 1973 and 1974 large quantities were delivered from the Pinnaroo-Lameroo area. Weeah spread considerably in 1975 and as well as larger sowings in the Pinnaroo-Lameroo area it was grown in the Upper South East and northern Yorke Peninsula areas. Smaller areas were sown in the northern Murray Mallee and on Eyre Peninsula. Present indications are that Weeah will continue to spread in 1976 to replace Clipper particularly on some low fertility sandy soils, and Ketch where the maturity of this variety is too early, and Prior in other areas.

Department of Agriculture trials have shown that on average Clipper and Weeah produce similar grain yields but in drought years Weeah does yield better. Wind loss is similar to Ketch.

Bussell (Prior x Ymer)

Bussell was developed by the Western Australian Department of Agriculture and named in 1967 but was not released on a wide scale. It flowers about 8-11 days before Clipper.

Limited trials have indicated the yield to be similar to Clipper in South Australia. Small grain size is a problem with Bussell.

A small area is grown around Karoonda and Cleve.

Maltworthy (Prior x Beavan's Special)

Maltworthy was released from the Roseworthy Agricultural College in 1942 and since then has made up a small proportion of the South Australian barley crop each year. Since the release of Clipper the proportion of the crop sown to Maltworthy declined rapidly. In trials Maltworthy slightly outyielded Prior.

Resibee (Research selection)

Resibee was developed by the Victorian Department of Agriculture for the high rainfall districts of southern Victoria. In South Australia Resibee has given grain yields and quality similar to Prior. A small amount is delivered each year from the Coonalpyn-Tintinara area.

Six-row type.

Beecher is the main six row barley grown in South Australia. It is sown mainly for grazing. The market opportunities for South Australian six row barley are not as good as for two row barley and consequently the payments made and the facilities available for six row grain are thus not as good as for two row grain.

ADMIXTURE OF CULTIVARS

Despite the publicity given to this problem in recent seasons samples of mixtures of two or more cultivars are still being delivered to the Australian Barley Board. The number of times other cultivars are mixed with Clipper continues to cause concern. Some Clipper samples contain six-row as well as two-row contaminants. The direct consequences of mixing cultivars is the frequent downgrading of No. 1 or No. 2 grade barley to No. 3 grade and a loss by the grower of several dollars per tonne. The problem is avoidable and the assistance of farmers is sought in trying to eliminate it - particularly where Clipper is concerned.

Farmers should sow only that seed which they know is "true to type" with respect to cultivar. Seed of doubtful standard should not be bought from neighbours, nor feed grain purchased from the Barley Board be used as seed. Pure seed is available from Registered Growers, a list of which is published annually, or the names of these growers are always available from District Agronomists. When a farmer knows his seed is pure with reasonable precautions, he can save some of the grain harvested for next season's seed.

If a farmer is uncertain about the purity of his seed he should have a sample checked before it is graded and pickled. Checking may be done by the Department of Agriculture and Fisheries, or the Australian Barley Board.

When a farmer knows he has sown a mixture of cultivars, or has mixed two cultivars in a truck load, he should inform the receival agent so the grain is correctly binned.

If the mixing of other cultivars with Clipper continues, an increasing quantity of potential No. 1 and No. 2 grade barley will be downgraded.

SEEDING

Time of Seeding

Being the quickest growing cereal, barley required for green feed should be sown immediately following the first good autumn rain. For grain crops it can be sown late, and is usually sown after oat, wheat or pea crops. The time of sowing varies with districts and extends from late May to July for the bulk of the crop, to August sowings in the later districts where soil fertility is good. On the more fertile soils later sowing tends to shorten the growing period, reduce rankness and height of growth, and may improve grain quality.

On Kangaroo Island barley is sown early because wet soil conditions during the winter make it impossible to get onto the paddocks until spring. Spring seeding has been considered but is risky because the ironstone soils rapidly dry out at the end of the season.

In the lower South East, it is not unusual for barley to be spring sown, until late September.

Rate of Seeding

About 42 kilograms per hectare is the recommended rate of sowing barley, using graded and pickled seed. Lighter sowings on clean weed-free land are conducive to better quality grain.

Treatment of Seed

Seed should always be pickled before seeding to reduce the chance of losses due to smuts. Although smuts of barley are not often seen and large losses from them are rare they are still present throughout the cereal growing areas of South Australia. If smuts were not consistently controlled with seed pickling some of these diseases could rapidly pose a threat to the barley industry. Details of the smuts are included in the section on Diseases.

WEED CONTROL

Although barley tends to be more competitive against weeds in later stages of crop growth than wheat it is still highly susceptible to competition from weeds in the early period of tiller formation. Conventional cultivation practices for seedbed preparation can be quite effective in reducing the levels of weed infestation. But often cultivation alone is not sufficient to ensure a weed free crop because of subsequent germination of weed seeds. In such cases the use of herbicides is essential. Other management practices such as the reduction of seed set by annual weeds by mowing or grazing in years prior to the cropping year of the rotation can also help to produce weed free higher yielding crops. Annual weeds such as annual ryegrass, wild oats, three-corner jack, sheepweed and wireweed mainly compete with barley crops in the critical period before crop tillering when yield potential is determined. The use of herbicides such as trifluralin, diallate and triallate applied at, before or shortly after seeding and early post-emergent herbicides such as diuron, linuron, methabenzthiazuron, prometryne, terbutryne and bromoxynil have sometimes been necessary to ensure adequate control of the above weeds in the early stages of crop growth. Hormone type herbicides e.g. 2,4-D and MCPA, have sometimes been found necessary to control weeds such as wild turnip and cut-leaf mignonette at tillering to prevent sample contamination and harvesting difficulties. Brome grasses remain a problem in sample contamination in some areas as satisfactory control procedures for this weed have yet to be developed.

BARLEY DISEASES

Diseases of barley can sometimes cause big losses in yield. The damage caused by some diseases is usually obvious and spectacular. Severe cereal eelworm is an example of this. Other barley diseases are not so obvious because they usually occur fairly evenly across barley crops. These diseases can also cause some loss in yield because they are widespread and occur in most years. Leaf scald and powdery mildew are examples of this type of disease.

There may be several reasons why the yield of a crop is below expectation. For example, the plants may be infected with a parasitic fungus, the soil fertility may be poor, or the plants may have been damaged by insects or adverse weather. This section describes the main diseases of barley due to infection by a nematode, several different fungi, and a virus. These are the leaf diseases powdery mildew, leaf scald, stem rust, and barley eyllow dwarf virus, and the root diseases cereal eelworm, haydie and rhizoctonia.

Leaf Diseases

1. Powdery Mildew

Cause and effect

This disease is usually common in barley crops from tillering to ear emergence. In the wetter barley-growing areas of the State the disease may persist to crop maturity.

The powdery mildew fungus (Erysiphe graminis hordei) causes yellowing and early death of leaves. Crops may recover from this if the fungus does not spread to the upper leaves, stem, and head. Heavy mildew infections after ear emergence can reduce crop yields. Estimates of yield losses range up to 25%. The loss is mainly due to shrivelling of the grain.

The white, fluffy fungus on the leaves can be easily seen. The tiny, white spores produced by the fungus are readily blown long distances by the wind, spreading the disease to other barley plants. Unlike most other leaf diseases, powdery mildew will multiply without rain or dew on the plant. Older spots of powdery mildew will become brown. Occasionally tiny black specks form in the older infections.

This fungus does not cause powdery mildew in other cereals - these diseases are caused by different fungi - and no alternate grass hosts are known in South Australia. Powdery mildew is not seed-borne. This disease most likely carries over from one season to the next on the stubble.

Control

No resistant commercial cultivars are available. In some situations spraying with a fungicide may possibly be worthwhile, however, no fungicides have been registered for this use in South Australia. Trials to select and assess suitable fungicides are in progress.

No stubble treatments or crop rotations will effectively control this disease because the spores can readily be blown onto a healthy crop from diseased crops in the district.

2. Leaf Scald

Cause and effects

Leaf scald is a common disease in barley crops from early growth to maturity. The causal fungus (Rhynchosporium secalis) grows into the leaves after a rain or dew and, a week or so later, produces over or elongated olive-green blotches. The infected part of the leaves die leaving straw-coloured areas (usually 0.5-1.0 cm in diameter) with brown margins. The fungus can also infect the head producing blotches on the grains. Rain-splash spreads the fungis, and hence the disease, from plant to plant. The disease causes slight grain shrivelling; this can often reduce yields by as much as 10 percent.

The fungus survives from one growing season to the next on barley grass, barley stubble, self-sown barley, and to a small extent, barley grain.

Control

No commercial cultivars are resistant. However, resistant cultivars have been bred by Dr. S.M. Ali, at the University of Western Australia, and are presently being tested in trials in South Australia and Western Australia.

The carry-over of the fungus from one barley crop to the next can be reduced by

- keeping paddocks free of barley and barley grass for at least one year,

- burning or ploughing infected barley stubble, and grazing or ploughing infected self-sown barley in paddocks sown with barley for the second successive year,

- eradicating infected barley grass growing next to barley crops.

No effective commercial seed pickle is available at present to control seed-borne scald.

3. Stem Rust

Cause and effects

The same fungi that cause stem rust in wheat (*Puccinia graminis tritici*) and rye (*Puccinia graminis secalis*) can also infect barley producing orange-brown rust on the leaves and stem.

Current commercial barley cultivars appear to be more resistant to stem rust then susceptible wheat cultivars and yield losses in barley crops are small.

Control

No control measures have been developed for this disease on barley because it has occurred infrequently and has had a relatively small effect on yield.

However, late summer rains may produce rusted self-sown barley plants that can be a source of rust for wheat crops sown nearby that year. This barley should be grazed wherever possible.

4. Barley Yellow Dwarf Virus

Cause and effects

This disease is caused by a virus that is transmitted from plant to plant by aphids. The leaves of diseased plants turn bright yellow. This starts from the left tip and moves towards the stem. It is brighter than the yellowing of naturally dying leaves or of leaves of plants with a nitrogen deficiency. The boundary between the yellow and green leaf tissue is usually striped and distinct.

Infected young plants are severely stunted and may tiller excessively. These plants may produce little or no grain. If plants are older when infected, crop yields can still be reduced due to grain shrivelling. The disease often occurs in patches several metres wide although isolated infected plants are also common.

The disease also occurs in oats and occasionally wheat as well as in several volunteer and pasture grasses; these include barley grass, brome grass, rye grass, fescue, and cocksfoot.

Control

No control measures have been developed for southern Australia. Some of the overseas research aims to control the disease with resistant cultivars and insecticide sprays.

Other Leaf Diseases

In addition to the leaf diseases mentioned here, barley plants may be infected by several other fungi which produce characteristic leaf spots and blotches. These diseases are not very common but their importance could increase if new commercial cultivars are more susceptible to these diseases than are the present cultivars.

Root Diseases

1. Cereal eelworm

Cause and effects

Infection of roots by cereal eelworm, also known as cereal cyst nematode (*Heterodera avenae*), can cause stunting and yellowing of barley plants. The diseased plants usually occur in patches in the crop. The infected roots are stunted, excessively branched, and shallow. Diseased plants then do not have access to as much soil water and nutrients as healthy plants and so suffer more easily from drought. High levels of infection will reduce crop yields.

Young eelworms infecting the roots are too small to see. However, the females remain in the roots and swell to form white egg cysts 1-2 mm in diameter. These can be seen if the soil is washed from diseased plants at about flowering. The cysts contain many eelworm eggs which survive over summer in the soil. Most of the eggs hatch the following year and the young eelworms infect roots of host plants growing close by. The eggs in some of the cysts may survive for several years in the soil.

The common hosts of cereal eelworm are barley, wheat, oats, wild oats, barley grass, wimmera ryegrass, and brome grass.

Control

Management - Growing a non-host such as medics or clover for at least one year in a cereal rotation will reduce the amount of eelworm in the soil. The amount of eelworm disease in a subsequent cereal crop then, should be less than if the crop followed a cereal or grass pasture. Improving soil fertility should increase the tolerance of the plants to the disease and so reduce yield losses. Resowing badly affected crops may be worthwhile in some situations.

Resistant cultivars - Resistance is currently being bred into some commercial cultivars. These should be available in the near future.

Chemicals - Cereal eelworm can be controlled by treating the soil with nematicides. Some of these are being tested at present. In some situations these may prove to be worthwhile. However, more research is necessary to test the efficacy, economics, and safety of these chemicals before they can be recommended.

2. Haydie

Cause and effects

Haydie is the premature death of plants in head. These plants usually produce shrivelled grain and in some cases no grain at all. The diseased plants are conspicuous in a crop because they are straw-coloured while nearby healthy plants are still green. Haydie often occurs in patches in a crop and is usually worse in wheat than barley.

The disease is caused by infection of the roots by a fungus (*Gaeumannomyces graminis tritici*). This fungus causes rotting and a characteristic blackening of the roots and base of the stem. This reduces the ability of the infected plants to extract moisture from the deeper layers of the soil. At the time when the grain is filling the upper soil layers are usually dry and so the infected plants die from water stress.

The fungus also infects several volunteer grasses as well as barley and wheat.

Control

No commercial cultivars are resistant.

Improving soil fertility will reduce the effects of the disease and so yield losses will not be as great.

Sowing a non-host cereal (oats) or grass-free pasture (e.g. medics or clover) will reduce the amount of fungus in the soil. This should reduce the amount of haydie in a following barley or wheat crop.

3. Rhizoctonia or bare-patch

Cause and effects

This disease is the result of infection and rotting of the roots by a soil-borne fungus (Rhizoctonia solani). Seedling infection by the fungus can seriously reduce early growth of crops. Where the disease persists plants are severely stunted. These occur in distinct circular patches several metres across. The root tips of diseased plants are rotted and pinched. The yield of these plants is less because the shortened root system cannot obtain as much moisture and nutrients from the soil as the roots of healthy plants.

The fungus has a very wide host range which includes volunteer and pasture grasses, medics, clovers, and all cereals.

Control

Although this disease has been studied extensively no satisfactory control measures have been developed. Crop rotations have very little effect because of the wide host range of the fungus. No commercial cultivars are resistant to this disease.

A long fallow before a cereal crop can be beneficial. Often there is less rhizoctonia if crops are sown early and become well established quickly.

Other Root Diseases

Several other fungi can infect the roots of plants causing root rotting and subsequent poor plant growth. Some of the disease occur at seedling establishment, e.g. take-all (caused by the same fungus that causes haydie), and damping-off (caused by Pythium species). Others (e.g. Fusarium) can occur throughout the growth of the plants.

For All Diseases

The District Agronomist should be consulted to help identify the cause of the disease and to advise on suitable control measures.

Smuts

There are two smuts of barley, covered (Ustilago hordei) and loose (Ustilago nuda).

Covered smut is caused by a fungus that replaces the seeds with a mass of black spores. The powdery masses or smut spores are embedded in plant tissue and stay intact until harvest. The spores are spread to healthy grains during threshing or are blown from the header onto the standing crop. After contaminating the grain, the spores survive over summer on the surface of the grain. When this is sown the following season, the spores germinate and infect the growing shoot before it emerges. The fungus grows within the infected shoot and at harvest replaces the seed contents with spores.

Besides reducing yield, covered smut can bring further loss. Covered smut is the type most likely to show in grain delivered to silos and grain detected with it will be rejected.

Loose smut is caused by a fungus that replaces the barley head with loose masses of black smut spores. The spores usually blow away leaving only the central rachis of the head. The black infected heads mature earlier than healthy heads and obviously contrast with the green crop. At this time, the smut spores blow into the healthy flowering heads and under suitable conditions germinate and infect the developing grain. Infected seed is not visibly different from healthy seed because the smut rests within the germ. Contact smuticides which only kill smut on the surface of the grain are therefore ineffective. Systemic smuticides are now available which are taken up by the seed when it commences growth, killing the fungus inside the developing plant.

The smuticides available for the control of covered smut and loose smut are constantly being improved and information on those currently recommended may be obtained from District Agronomists.

INSECT PESTS

Barley grub - Persectania ewingii (Noctuidae)

Description:

Barley grub, is a native grassfeeding cutworm which causes extensive damage to cereal crops (barley especially) on lower Eyre and Yorke Peninsulas, Kangaroo Island, the Adelaide Hills and the South East.

The moth can be recognised by the colour and pattern on the forewings, which are greyish in colour streaked with brown or black. Near the middle of each forewing there is a white "fish-shaped" mark and the hind end of the wing is crossed by 5-7 white lines.

The larvae are smooth caterpillars with longitudinal stripes the full length of the body. Body colour varies from light green to almost black, but the head, "collar" behind the head, and the "tail-piece" are always brown and marked with 3 longitudinal white lines.

Damage:

During their early development barley grub larvae feed on leaves. As the crop ripens they eat into the last green tissues just below the head. Uneaten heads fall to the ground.

Damage is rapid and can be severe. One larva per square metre can cause severe damage.

From mid-October a close watch must be kept for infestation. This is best detected by looking for the greenish yellow pellets of excreta on the ground. With hay dry conditions in October, crops often ripen so quickly that very little damage takes place. Very substantial losses have occurred by gambling on rapid ripening weather when dense infestations are present. Weather conditions which retard ripening may also prevent aerial spraying - making the use of ground spraying equipment essential.

Control:

Control of barley grub depends on insecticides. For many years DDT was used, but this leads to unacceptable residues on harvested grain and so must not be used.

The only material currently approved for spraying is trichlorphon. Experience has shown that this must be applied as early as possible to ensure fully effective treatment. Other insecticides are likely to be approved for barley grub control in the near future. Before spraying check current recommendations with your District Agronomist.

WINDROWING AND ROLLING

Each year maturing barley crops in most areas of the State are subjected to a few days of hot blustery winds. Some of the barley cultivars grown have weak straw which can snap and allow heads to fall. Big grain losses can occur in windy conditions.

Clipper, the currently recommended malting barley cultivar, has moderately strong straw, but can still suffer damage in strong wind. Rolling and windrowing protect the crop by placing heads out of the wind.

In crops not windrowed or rolled, the main protection against wind damage is to harvest the crop as early and as rapidly as possible, but this is not always practicable.

A windrowed or rolled crop may be left in the field to ripen properly and reach acceptable moisture levels before reaping. There is less need to rush harvesting, so machines can be properly adjusted and reaping speed regulated to keep grain damage at a minimum.

Harvest can also be safely delayed for some time after the grain is ripe to allow reaping to fit in with delivery schedules to the silos. The delay can also be used to carry out other essential farm operations.

Windrowing

Windrowing simply cuts the crop and leaves it formed in rows lying on the stubble where it is held together by the interlaced straw.

The crop can be windrowed in any direction, but usually travel is across the line of sowing so that the windrow does not fall on the ground between the rows of stubble. To obtain best results it is important to:

- Leave enough straw on the head to keep the windrow together. The windrow must be kept off the ground but can sit close to it if there are no stones.

- Adjust the windrower with correct canvas speed, reel height and forward speed so that an even windrow with well interlaced straw is formed.

Moderately heavy rain may cause some staining of windrowed barley, but usually it does not affect malting quality. Raking or shifting the windrow causes some loss of grain and is usually not warranted. The windrow should be harvested by travelling along the row in the same direction as it was cut so that the heads enter the machine first. A pick-up attachment is used to lift the crop into the harvester.

Correctly timed windrowing has no effect on the grain quality, but if it is carried out too early, pinched grain of poorer quality will result.

Rolling

Barley crops usually have a natural lean which is often to the east as a result of prevailing winds during the growing season. Because of this it is usual to roll in roughly an east-west direction and reap across the direction of rolling. The rolled crop is lifted into the harvester by means of crop lifters or pick-up fingers.

Crops should be rolled or windrowed when grain formation is complete, but before the straw becomes brittle. This stage in barley corresponds to the medium dough stage, when the grain has begun to harden, but can still be dented with the thumbnail. The medium dough stage is usually reached 7 to 10 days before the grain is ripe.

Rolling does not affect grain quality because the straw is not severed.

HARVESTING

The harvesting of barley is most important, and no matter how well a crop of barley is grown, its value can be greatly depreciated by incorrect or careless harvesting because its quality for malting is spoiled. Firstly, the crop must be thoroughly ripe before harvesting. Secondly, the harvesting must be done without damaging the grain by cracking or skinning. Causes for skinned barley include:-

Drum speed too fast
Concave too close
Excessive returns

Uneven feeding across the front
Machine not feeding evenly because forward speed too slow

To obtain best financial returns from barley crops by careful harvesting these points should be attended to:-

1. Be sure the header drum and concave are level and parallel to each other. Do not use bent or twisted rasp bars or damaged concave units.

2. Check to see that the drum is centred between the sides of the machine.

3. Keep drive belts tight so all units operate at proper speed.

4. Clean the inside of the header periodically.

5. Adjust the straw walkers for field conditions.

6. The machines should be adjusted as the crop and conditions change throughout the day.

7. The forward feed chain should have some slack, to allow it to "grab" all material entering the combine.

8. Maintain proper tension on elevator chains.

More details on barley harvesting can be obtained from Extension Bulletin 2.76 "Better Care in Harvesting Malting Barley".

BARLEY CLASSIFICATION

Until the mid 1950s classification of barley grain was entirely by visual means. The main aim of classification was to estimate the suitability of the grain for malting. A great deal of experience was required before a person was capable of visually grading barley with satisfactory results.

Physical measurements were introduced in the mid 1950s to increase the efficiency and reliability of visual testing.

Firstly the 100 grain check was used. A one hundred corn slotted tray is used to facilitate the checking on a percentage basis of foreign grains (e.g. 6 row barley, wheat, oats, rye-corn). At the same time the percentage of defective (e.g. skinned, broken) grains is counted.

The 100 grains are then weighed to establish the 100 corn weight. The theory underlying this test is quite simple. Heavy barley usually means high carbohydrate content and that is an important characteristic sought for malting requirements.

Later the screening test was introduced. Screening is through a 2.235 mm slot screen oscillating at 300 times per minute for 30 seconds. An initial sample of 100 grams is used.

Moisture testing of all samples was introduced soon after the 100 grain test as a means of checking against the possibility of the barley sweating after receival. At the same time further information with a bearing on classification was thus provided.

It was not until 1967 that the Udy Analyser was installed, at the Central Classification Laboratory, for the determination of grain protein (nitrogen) content. This method was replaced by the Neotec "Grain Quality Analyser" as from the 1975 harvest. The use of the Neotec machine means that the protein content of a grain sample can be obtained faster and more accurately. The Kjeldahl method which is slow but very accurate for protein determination, is used for the constant checking of the other analysers.

Until the 1965-66 season all barley was classified by the Central Classification Committee in Adelaide. This committee included Officers of the Australian Barley Board, and representatives of the Maltsters, and the Department of Agriculture and Fisheries. There is provision for a growers representative on the Committee.

"On-the-spot" Provisional Classification

With the receival of barley in bulk, which started in the 1962-63 season, it was necessary for the classification procedure to be speeded up. The Central Classification Committee laid down the quality requirements for the various grades. With these figures "on-the-spot" classification was introduced at Karoonda for the 1965-66 season. The local agent tested such things as skinning, weed seeds, and moisture and then binned the barley according to the grading which he had determined.

This system was not completely satisfactory. In some cases otherwise good barley was placed in a lower grade because it was slightly over one of the limits set by the Committee. Other samples which were just under the limit for 3 or 4 characters were given a grading which, if all the factors had been taken together, would have received a lower grading. To overcome this the Points Classification System was introduced to "on-the-spot" classification in the 1971-72 season. The Points Classifications System allows for emphasis to be placed on those features of a sample which are considered most important. It also reduces the chance of a sample being down graded because one characteristic e.g. skinning percentage is just over the previously specified maximums whilst all other characteristics are well below the old limits.

For the 1976-77 harvest "on-the-spot" classification will be available at fifty South Australian Centres (See Appendix 2).

Details of the points allotted for the various tests are available from the Australian Barley Board.

PRE-DELIVERY PROTEIN DETERMINATION

Until the 1970-71 season the protein content of the grain had only been available to assist the Central Classification Committee with their official classification. "On-the-spot" agents had only been able to use physical characters such as 100 corn weight, percentage screenings, skinning, and moisture content. With the 1970-71 season a system of pre-delivery protein determination was introduced on a trial basis to assist "on-the-spot" agents with their appraisal.

With this determination, if a grower has a paddock that he thinks might make No. 1 or No. 2 grade a truly representative sample of heads is taken and the grain sent to the Australian Barley Board's Central Classification Laboratory, usually through the local "On-the-spot" agent. The sample can be taken from the crop 5-9 days before the barley is ready to reap. The protein level of the crop changes very little in the last 10 days before it is ready for harvest. Alternatively, where the barley is held in temporary storage on the farm prior to delivery, it is better if a pre-delivery sample is drawn from that storage. Again the sample must be truly representative of the grain in the storage.

The agent is informed of the protein content and he uses this when classifying the actual delivery. Final classification for payment is still carried out by the Central Classification Committee on the Delivery Sample.

If a grower is prepared to accept no higher than a No. 3 grade, he can still deliver his barley, subject to normal physical classification checks without sending a pre-delivery sample for protein testing.

The current recommendations of the Australian Barley Board for collecting pre-delivery protein determination samples are set out below. Before collecting a sample the farmer must satisfy himself that the crop is Clipper barley, and is potential No. 1 or No. 2 quality.

A. Head sample collected from standing or rolled crop 5-9 days before the crop is ripe and ready for harvest

1. Make sure the grain has reached the medium dough stage (that is, it can be dented with a thumbnail but not squashed). If the moisture content of the sample exceeds 20%, it cannot be tested.

2. Pick the heads completely at random - not only the plumpest or those on the tallest straw. It is suggest that farmers walk across the paddock and back again in 2 different paths, and pick a head at regular intervals so that at least 150 heads are collected.

3. Allow heads to dry. When dry, rub out the grain, put the cleaned sample in a sample packet and despatch

promptly to the O.T.S. agent or the Board.

4. Samples should be a minimum of 120 g - note mark on the packet.

5. When despatching direct to the Board, sample packets are available at O.T.S. and "Through-put" agencies. A sample number must be obtained from the "On-the-spot" agent and written in the allotted space on the packet.

B. Sampling from Farm Storage

If barley is stored on the farm awaiting availability of silo space several samples should be drawn, mixed thoroughly and a representative portion forwarded.

After forwarding the sample allow time for it to reach Adelaide and be processed before delivering grain.

MARKETING

The Australian Barley Board has continued to serve barley growers in South Australia and Victoria under State legislation since 1948. Originally orderly marketing for barley functioned under Commonwealth legislation set up as a war time measure in 1939.

Since 1948 orderly marketing in South Australia and Victoria has been continued under Marketing Acts by the respective State Governments. All barley grown within the State for marketing can only be delivered to the Board.

The exceptions are:-

1. Barley for use on the farm where it is grown.

2. Barley previously purchased from the Board.

3. Barley sold privately with the approval of the Board or auctioned in accordance with a Board permit, or

4. Barley subject to trade interstate.

Otherwide the marketing is under the sole jurisdiction of the Board.

The State legislation also provides that the Board shall have regard for the reasonable requirements for domestic use. The functions of the Board operating thus on a two State basis have been carried out efficiently ever since 1948. There are some aspects where local conditions produce differences in the pattern of barley disposals in one State as compared with the other. In Victoria the usual pattern over the years is for the malting industry to purchase from the Board the whole quantity of barley accepted into the Malting grades. This means that generally the whole quantity of barley in those grades for export purposes is shipped from South Australia. In a good season there is an exportable surplus of barley from Victoria. Increased sowings and excellent spring weather conditions resulted in an exportable surplus of malting grade barley being available in Victoria in 1975/76

In recent times the main export markets for barley have been Japan, United Kingdom, Europe, Taiwan and Russia. There are numerous other destinations for smaller lots, with sometimes a cargo in one order. The demand from overseas for South Australian barley has increased greatly over the last few years. The strong enquiry for Feed descriptions has been one of the consequences of a running down in world stocks of Feed grains coupled with ever-increasing total consumption.

Malting quality Clipper barley enjoys the added demand resulting from the reputation it has attained for its excellent malting quality, and while that reputation can be preserved there is an assured outlet for a large tonnage each year. The first and second malting grades are used extensively for manufacturing malt in the United Kingdom, Europe and Japan. More recently the U.S.S.R. has started to use Clipper barley for malting purposes. Taiwan also buys Malting Grade Clipper to produce malt for its breweries. There are other countries too that purchase malting Clipper spasmodically to cover deficiencies when their own crops do not produce essential quantities of malting barley.

The export of malt made from Clipper by local malsters is assuming large proportions and has all the symptoms of further expansion. Two new malthouses at Port Adelaide will have the capacity to cater for a further substantial increase in export malt trade. The Victorian malthouses produce a much greater tonnage of malt for export markets than their S.A. counterparts.

Large quantities of barley are processed annually in Japan in the manufacture of staple food for human consumption. For this purpose No. 3 Grade is used and this business is a valuable outlet for that grade and supplements the large quantities of the same grade and lower grades purchased from the Board by Japanese importers for animal and poultry feed. Taiwan is also an important buyer of our Feed Grade Barley, with varying quantities to Europe and sundry other destinations.

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ACKNOWLEDGEMENTS

The assistance of Mr. R. Webb of the Australian Barley Board and of Officers of the Department of Agriculture and Fisheries in the preparation of this bulletin is gratefully acknowledged.

Appendix 1 Mean area, mean production and mean yield for 1970/71 - 1974/75 (five years) of barley grown in South Australia - based on counties.

District and County(1)	Area sown		Production		Yield
	hectares	%	tonnes	%	tonnes/hectare
Central					
Adelaide	5066	0.7	8798	1.0	1.74
Carnarvon	2877	0.4	3216	0.4	1.12
Hindmarsh	5699	0.8	8147	1.0	1.43
Sturt	17621	2.5	17862	2.1	1.01
Yorke Peninsula					
Fergusson	109996	15.7	177825	21.0	1.62
Daly	70591	10.1	109610	13.0	1.55
North					
Gawler	35933	5.1	52075	6.2	1.45
Light	15129	2.2	24237	2.9	1.60
Stanley	33453	4.8	47079	5.6	1.41
Eyre	3973	0.6	4390	0.5	1.10
Burra	1947	0.3	2048	0.2	1.05
Victoria	28793	4.1	37904	4.5	1.32
Dalhousie	4869	0.7	5033	0.6	1.03
Frome	7575	0.1	8873	1.1	1.17
Eyre Peninsula					
Buxton	14390	2.1	13112	1.6	0.91
Dufferin	4515	0.6	4363	0.5	0.97
Flinders	32373	4.6	40915	4.8	1.26
Jervois	51325	7.3	52344	6.2	1.02
Kintore	3669	0.5	2827	0.3	0.77
Le Hunte	16188	2.3	14801	1.8	0.91
Musgrave	28461	4.1	34806	4.1	1.22
Robinson	23496	3.4	23130	2.7	0.98
Way	9231	1.3	7987	0.9	0.87
Murray Mallee					
Albert	16942	2.4	10672	1.3	0.63
Alfred	15476	2.2	9793	1.2	0.63
Buccleuch	65464	9.4	53950	6.4	0.82
Chandos	35367	5.1	29934	3.5	0.85
Russell	17889	2.6	15578	1.8	0.87
South East					
Buckingham	7764	1.1	9282	1.1	1.20
Cardwell	6421	0.9	5957	0.7	0.93
Grey	1134	0.2	2019	0.2	1.78
McDonnell	1497	0.2	1872	0.2	1.25
Robe	1256	0.2	1371	0.2	1.09
State (all counties)	699659	100.0	845101	100.0	1.21

Appendix 2 Summary of quantity and quality of 2 row barley received by the Australian Barley Board - 1970/71 - 1974/75

Shipping Division and Receival Point	Type of Receival Point (1)	Mean Receival of 2-row barley (tonnes) (2)	Quality (percentage of grain in each grade to nearest percent)			
			No. 1	No. 2	No. 3	No. 4
THEVERNARD DIVISION						
Penong	Through-put	1695	7	15	76	2
Thevernard	Terminal-O.T.S.	17017	10	22	67	1
Wirrulla	Through-put	1590	17	22	61	0
Streaky Bay	Storage-O.T.S.	5007	12	23	65	0
Poochera	Storage-O.T.S.	7757	13	30	54	2
Witera	Through-put	3310	8	37	55	0
Minnipa	Through-put-O.T.S.	2941	12	29	58	1
PORT LINCOLN DIVISION						
Wudinna	Storage-O.T.S.	4363	4	15	80	1
Dyancutta	Through-put	4365	5	24	70	0
Buckleboo	Through-put	3797	11	15	51	3
Kimba	Storage-O.T.S.	4830	6	12	68	4
Waddikee	Through-put	2140	7	20	72	1
Darke Peak	Through-put	3098	10	23	67	0
Mangalo	Through-put	566	0	0	100	0
Cowell	Through-put	N.A.	-	-	-	-
Elliston	Storage-O.T.S.	4565	9	41	50	0
Lock	Storage-O.T.S.	9392	5	29	63	5
Murdinga	Through-put	1991	4	29	65	1
Rudall	Storage-O.T.S.	9780	6	20	67	7
Arno Bay	Through-put	2519	2	15	83	0
Kapinnie	Storage-O.T.S.	5313	28	39	34	0
Yeelanna	Storage-O.T.S.	13509	18	37	44	0
Cummins	Storage-O.T.S.	6425	30	30	40	0
Edillilie	Storage-O.T.S.	4112	13	37	50	0
Port Neill	Storage-O.T.S.	5587	11	27	61	1
Tumby Bay	Storage-O.T.S.	6216	12	36	53	6
Port Lincoln	Terminal-O.T.S.	47570	12	30	57	1
PORT PIRIE DIVISION						
Booleroo Centre	Through-put	410	13	2	84	0
Yongala	Through-put	389	0	3	92	4
Jamestown	Storage	2296	11	23	65	0
Gladstone	Storage-O.T.S.	13619	25	30	44	1
Crystal Brook	Storage-O.T.S.	4177	24	29	46	1
Redhill	Storage-O.T.S.	1183	25	37	38	1
Gulnare	Through-put	2895	15	34	51	0
Port Pirie	Terminal-O.T.S.	30563	12	23	65	1

Shipping Division and Receival Point	Type of Receival Point (1)	Mean Receival of 2-row barley (tonnes) (2)	Quality (percentage of grain in each grade to nearest percent)			
			No. 1	No. 2	No. 3	No. 4
WALLAROO DIVISION						
Brinkworth	Storage-O.T.S.	5891	19	37	44	0
Snowtown	Through-put	4113	15	21	63	1
Bute	Storage-O.T.S.	9996	11	32	56	0
Balaklava	Through-put-O.T.S.	3326	7	33	61	0
Nantawarra	Through-put	1049	5	24	69	2
Paskeville	Storage-O.T.S.	7033	4	30	65	0
Wallaroo	Terminal-O.T.S.	54497	8	26	65	1
ARDROSSAN DIVISION						
Ardrossan	Terminal-O.T.S.	10922	14	28	56	1
PORT GILES DIVISION						
Port Giles	Terminal-O.T.S.	92025	17	30	51	3
PORT ADELAIDE DIVISION-NORTH						
Burra	Through-put	834	8	30	61	0
Farrell Flat	Through-put	783	17	42	41	0
Saddleworth	Through-put	3161	12	40	49	0
Eudunda	Through-put	950	1	7	90	2
Tarlee	Storage-O.T.S.	2106	6	29	43	1
Owen	Storage-O.T.S.	12989	10	28	60	3
Kapunda	Through-put	1604	15	28	58	0
Roseworthy	Storage-O.T.S.	12977	15	41	44	0
Long Plains	Storage-O.T.S.	2356	7	20	74	0
Mallala	Through-put	1442	7	20	74	0
Port Adelaide	Terminal-O.T.S.	38535	11	28	60	2
PORT ADELAIDE DIVISION-SOUTH						
Strathalbyn	Storage-O.T.S.	5535	9	32	59	0
Monarto South	Storage-O.T.S.	2670	10	34	57	0
Apamurra	Through-put	2367	11	35	55	0
Cambrai	Through-put	2464	10	29	62	0
Murray Bridge	Storage-O.T.S.	6039	10	26	64	0
Tailem Bend	Storage-O.T.S.	6139	5	22	72	1
Karoonda	Storage-O.T.S.	13491	2	17	78	2
Copeville	Storage-O.T.S.	1667	15	34	51	1
Waikerie	Through-put	N.A.	-	-	-	-
Wunkar	Through-put	1002	29	26	45	0

Shipping Division and Receival Point	Type of Receival Point (1)	Mean Receival (tonnes) (2)	Quality (percentage of grain in each grade to nearest percent)			
			No. 1	No. 2	No. 3	No. 4
Loxton	Through-put	1610	7	25	66	3
Taldra	Through-put	780	17	13	69	2
Meribah	Through-put	1704	12	27	59	2
Alawoona	Storage-O.T.S.	2433	14	36	50	0
Wanbi	Storage-O.T.S.	1839	5	22	74	0
Peebinga	Through-put	595	20	21	59	1
Gurrai	Storage-O.T.S.	2041	11	25	63	0
Kulkami	Storage-O.T.S.	505	0	0	100	0
Pinnaroo	Storage-O.T.S.	5542	5	23	70	1
Lameroo	Storage-O.T.S.	8529	3	20	67	10
Geranium	Storage-O.T.S.	5190	2	24	61	5
Peake	Storage-O.T.S.	7304	2	14	77	5
Coomandook	Storage-O.T.S.	8508	4	20	73	3
Coonalpyn	Storage-O.T.S.	7834	20	26	53	1
Tintinara	Storage-O.T.S.	2413	3	14	74	12
Keith	Storage-O.T.S.	2701	7	21	67	4
Bordertown	Through-put-O.T.S.	1836	5	21	69	6
Wolesley	Through-put	368	13	26	61	0
Frances	Through-put	366	12	34	50	4
Millicent	Through-put	N.A.	-	-	-	-
Kingscote	Storage	1135	26	39	35	1
Other (4)	-	1573	-	-	-	-

(1) Type of receival point as for 1976/77 harvest:

Through-put - grain is not stored in the silo but is direct trucked to the terminal.

Storage - grain is stored in the silo before forwarding to terminal

Terminal - storage point from which grain is shipped

O.T.S. - "On-the-Spot" classification facilities.

(2) For many centres the receivals from near-by bag receival points in 1970/71 have been included.

(3) For some silos, particularly in the marginal areas, receive no grain in poor years.

(4) Includes a few minor areas with bag receival agencies in 1970/71, but where grain is now not received; and bulk receival agencies where deliveries are irregular.

N.A. - Not Available.

Commencing with the 1976/77 season the following additional centres will receive bulk barley on a through-put basis.

Port Lincoln Division:- Kielpa, Warramboo, Ungarra, Wharminda

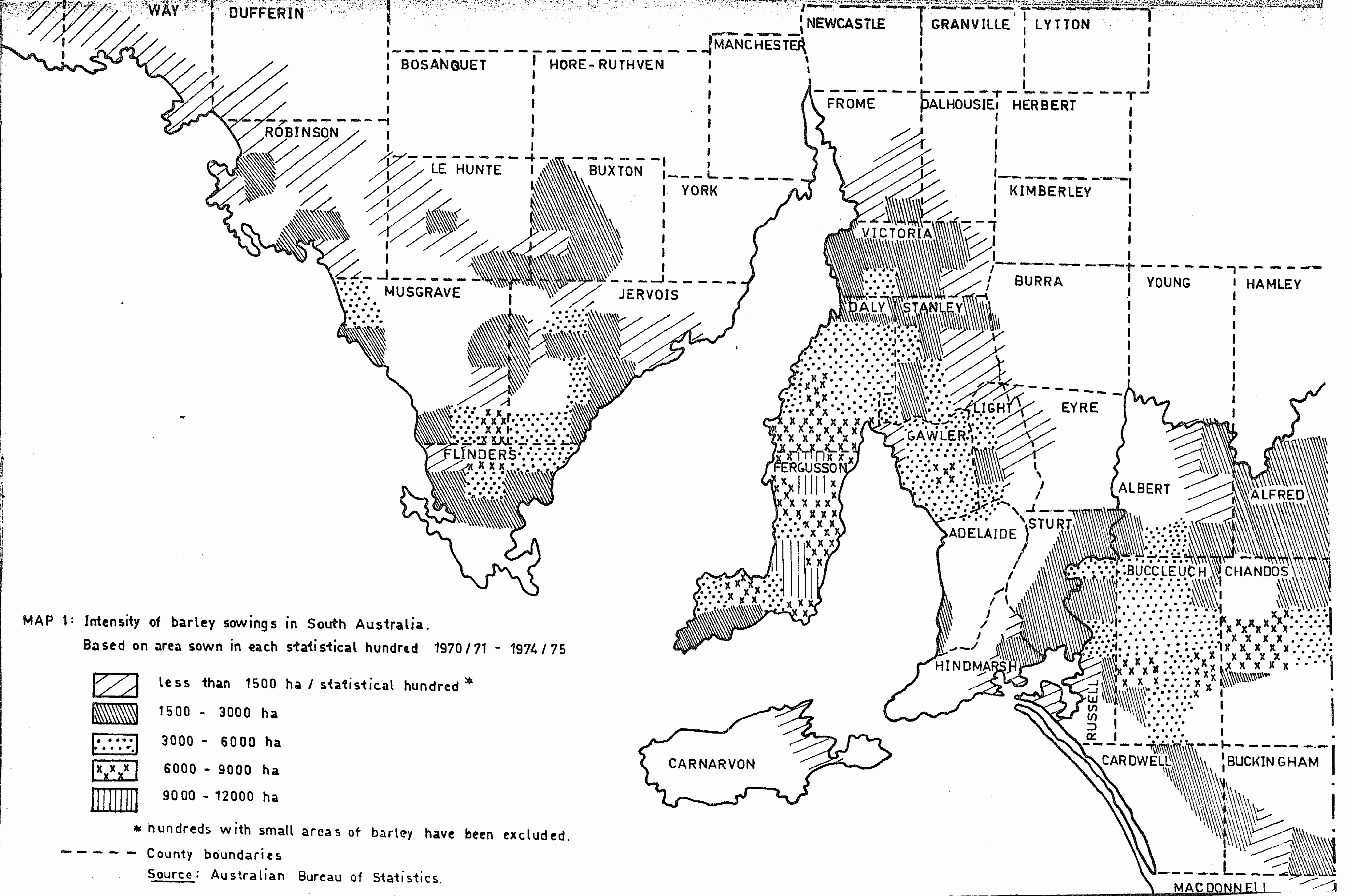
Port Pirie Division: - Wirrabarra

Port Adelaide Division - South:- Parilla, Wirrega, Naracoorte

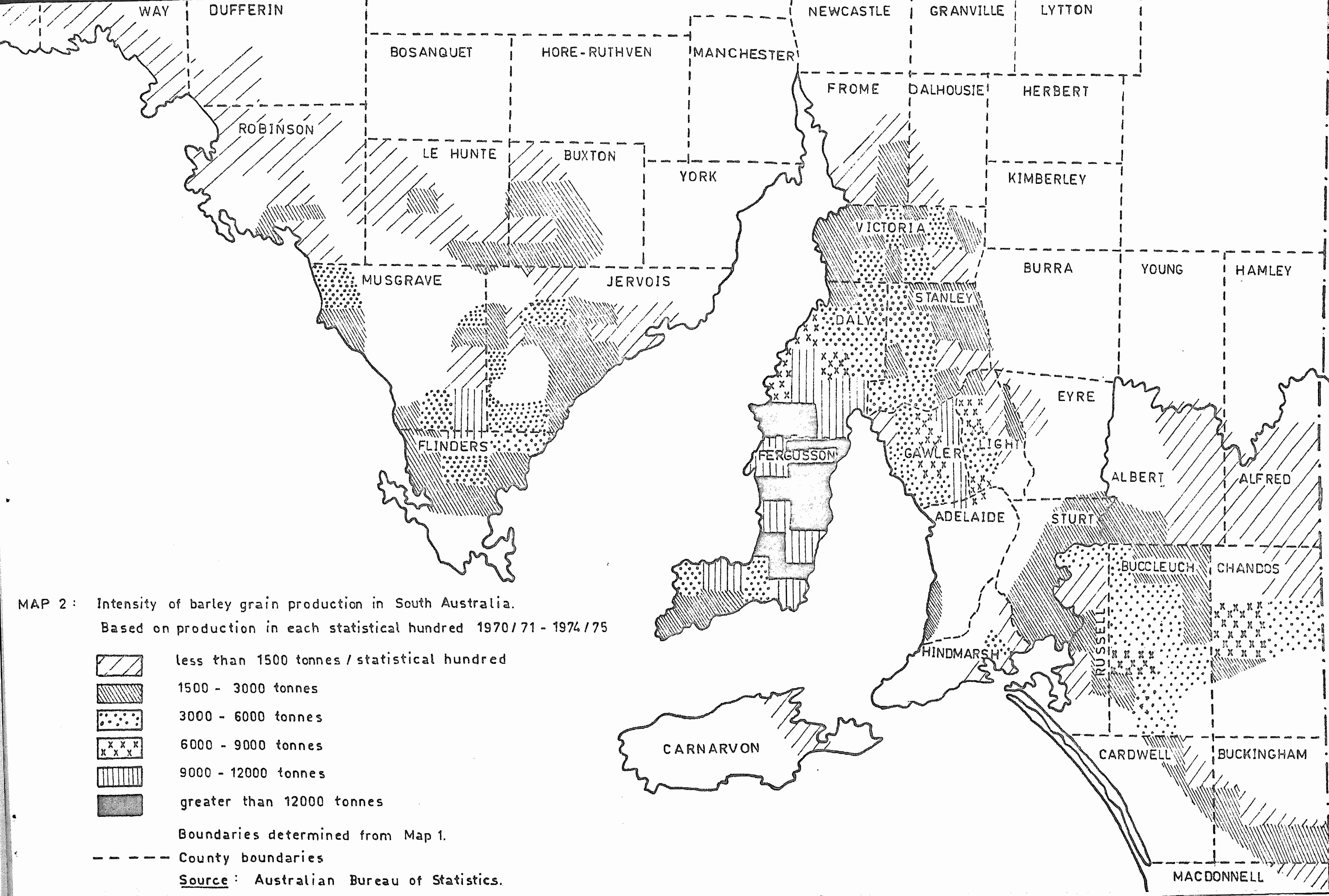
Planning is underway for barley storage silos to be constructed as follows:

Thevernard Division:- Witera

Port Lincoln Division:- Mangalo



MAP 1: Intensity of barley sowings in South Australia.
Based on area sown in each statistical hundred 1970/71 - 1974/75



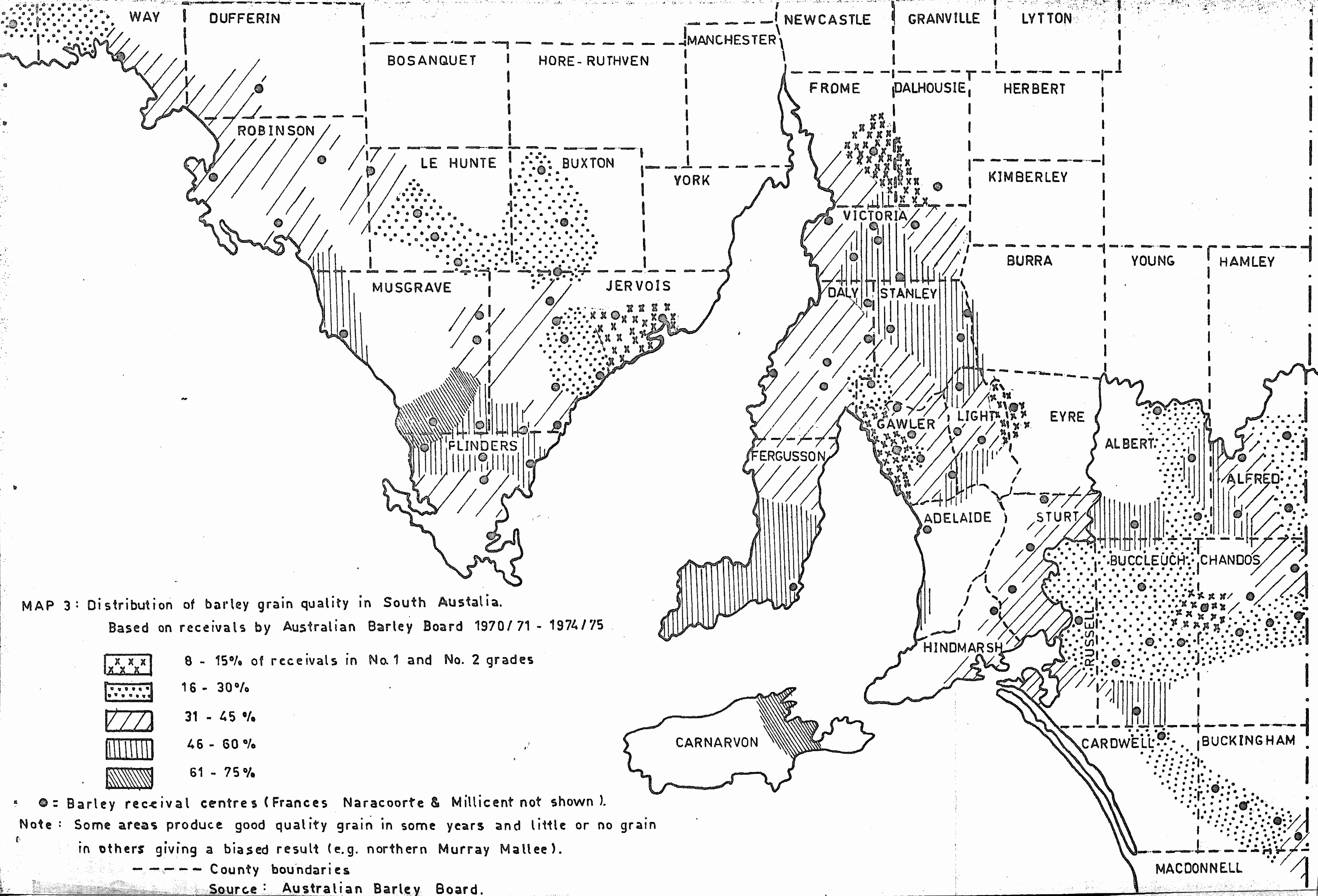
MAP 2 : Intensity of barley grain production in South Australia.
Based on production in each statistical hundred 1970/71 - 1974/75

less than 1500 tonnes / statistical hundred
1500 - 3000 tonnes
3000 - 6000 tonnes
6000 - 9000 tonnes
9000 - 12000 tonnes
greater than 12000 tonnes

Boundaries determined from Map 1.

County boundaries

Source : Australian Bureau of Statistics.



MAP 3: Distribution of barley grain quality in South Austalia.
Based on receivals by Australian Barley Board 1970/71 - 1974/75

8 - 15% of receivals in No. 1 and No. 2 grades
16 - 30%
31 - 45 %
46 - 60 %
61 - 75 %

●: Barley receival centres (Frances Naracoorte & Millicent not shown).

Note: Some areas produce good quality grain in some years and little or no grain in others giving a biased result (e.g. northern Murray Mallee).

------ County boundaries

Source: Australian Barley Board.