Feeding lupins to sheep and cattle

Department of Agriculture, Western Australia

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By Officers of the Sheep and Wool and Cattle Branches.

Ever since lupins showed potential for grain production, agricultural research workers have been exploring ways to get the best stockfeed value from both the grain and the stubble.

Some of the earliest research tested lupin grain as a potential high-protein constituent of poultry feed compounds. This work established that if extra quantities of the amino-acids methionine and lysine were added, lupin meal could be substituted for expensive imported soy-bean meal. Since then, poultry and pig feed manufacturing companies throughout Australia... and in parts of Europe... have accepted lupins in this role.

Meanwhile lupins, both as grain and stubble, have been acknowledged as valuable summer feeds for sheep and cattle.

Grain feeding sheep

Sheep growth

Since 1978 the Department's Sheep and Wool Branch research workers have been conducting feeding experiments aimed at getting more precise information about lupin feeding. In particular, they wanted to determine whether sweet lupin grain, with the low protein content of about 28 per cent, could help producers prepare prime lambs and sheep for out-of-season markets.

Trials at Badgingarra Research Station in 1978 indicated that if lupin grain were added to oat grain at rates of up to 50 per cent, and fed to adult Merino wethers grazing dry pasture, the sheep's feed conversion rates improved, as did their growth rates. Those receiving oats from self feeders whilst grazing dry pasture gained an average of five kilograms of liveweight in 77 days, those on 25 per cent lupin grain gained nine kilograms and those on 50 per cent gained 11 kilograms. Higher proportions of lupins made no further improvement.

A follow-up experiment at Badgingarra in 1979 produced smaller response when lupin grain was added to oat supplements. Sheep receiving rations containing lupins made better gains than those fed the straight oats ration. However the responses to differing proportions showed no clear trend. Research workers believe this was because of the higher protein content in 1979.

Those oats provided near-adequate protein levels... about 12 per cent... for growth of adult wethers whilst in 1978 the oat grain only supplied 9 per cent crude protein.

Similar trials with Merino wether weaners were conducted at Newdegate Research Station in the same two years. Here also the sheep were grazing dry pasture, and were given supplements of oats and oats/lupin mixtures. In this case, growth rates and conversion efficiencies improved as the percentage of lupins in the ration was increased.

In the summer of 1980, the Sheep and Wool Branch team conducted three detailed trials at the Wongan Hills Research Station to compare the responses of four types of sheep to oat and lupin feeding, to test two types of feedlot and to compare feeding management systems.

In the first trial, groups of Merino wether weaners in an indoor feedlot were fed on oats, a 60:40 oats-lupin mixture and commercial feed pellets. The sheep on the oats-lupin ration made faster growth, reached higher weights, and gained more weight for the feed they ate than those on any of the other feeds.

The second trial compared the growth performance of weaner wethers, starting in store and backward-store condition, with ram weaners and hoggets. All were in an outdoor feedlot. The groups were fed on oats and 60:40 mixtures of oats and lupins. All types of sheep on lupin mixtures performed better than those on oats alone.

In the third trial, groups of Merino wether weaners in good condition were fed rations similar to those in the second trial, but on three different management systems... indoor feedlot, outdoor feedlot and by self-feeders in paddocks of dry pasture. Once again the oats/lupin mixture brought the best performance from each management group.

Although the sheep being fed rations containing lupins out-performed those on oats alone in all trials since 1978, lupins were not always the cheapest source of protein. The relevant prices of lupins and oats generally would favour the oats if the protein content were adequate to produce reasonable growth rates. The farmer who is considering using lupins in a sheep feeding programme should take account of this, and be sure to compare the prices and protein contents of both.

Sheep and Wool Branch research workers have concluded that adult wethers on pasture, being fed supplements for live export, need about 12 per cent crude protein. If oats are to be used as the basis of the ration and their protein levels are below 12 per cent, then lupins can be used to bring the protein up to the required level.

If weaners are to be fed for the out-of-season lamb market, the crude protein level should be brought up to 15 per cent.
If the farmer finds it difficult to have the oat grain analysed, the researchers recommend that 20 to 25 per cent of lupin grain be added to the oats supplement as an ‘insurance policy’.

Further trials are being conducted to assess the prospects of using urea to substitute for protein supplements.

**Sheep fertility**

In some circumstances the fertility of mature (6-tooth and older) Merino ewes can be improved when they are fed sweet lupin grain. The improvement may occur without any change in liveweight... a result of more ewes having lambs and a higher proportion of them having twins. In many experiments conducted by Sheep and Wool Branch research workers the lamb marking from supplemented ewes was 15 per cent or more higher than that of unsupplemented ewes. Increases should be at least this high if the practice is to be an economic proposition.

Research has demonstrated that fertility is more likely to be stimulated when flocks are joined in January or February rather than in December. On Badgingarra and Wongan Hills Research stations where entire rams are joined early in January, ewe fertility has been increased regularly by lupin feeding.

The best fertility responses have been obtained from flocks in which fewer than 80 per cent of ewes normally lamb. In flocks of higher fertility, responses to lupin feeding tended to be variable and low. Therefore, it seems that the prospect of obtaining an economic response to lupin seed feeding is best if the flock has a history of low fertility... say less than 70 per cent lambs marked.

The best strategy for farmers who decide to feed lupins is to give mature ewes the equivalent of 250g of sweet lupin grain per head per day starting from the day teasers are put with the ewes... 14 days before joining is due to start... and continuing until the 17th day of joining, feeding three times weekly, on Mondays, Wednesdays and Fridays.

It is important that the ewes be teased so that nearly all will cycle while being supplemented, because the stimulation of ovulation from the supplement drops off rapidly when lupin feeding stops. Because lupin grain is expensive there is no point in continuing feeding after the 17th day. Relatively few ewes are served after that time.

**Stubbles**

Experiments conducted by the Sheep and Wool Branch have shown that the damage to sheep livers which develops when the fungus *Phomopsis leptostromiformis* is on lupin material, is more severe at high stocking rates. This is probably because the increased grazing pressure allows less grazing selectivity, thus forcing the sheep to eat more toxic and possibly less palatable material such as stems, earlier and in larger quantities. To minimise the risk of lupinosis research workers suggest that lupin stubbles should not be grazed at rates higher than 20 per ha. At this stocking rate paddocks can be grazed for up to 10 weeks, with resulting increases in weight.

As would be expected, unharvested lupin crops also can provide good feed for sheep. However, unless the farmer has good reasons to use the crop for fodder rather than harvest it for grain, he would use only poor unharvestable crops for this. These are useful for promoting growth or for improving ewe fertility.

**Beef cattle**

**Lupin grain as a supplement**

Beef Cattle Branch research workers have compared the performance of beef steers about a year old fed a basic diet of 80 per cent barley and 20 per cent hay, with others on a similar ration supplemented either with meatmeal, urea, or lupins for finishing out of season.

Those on the meatmeal supplement gained 7kg of carcase weight more than the steers on the basic diet, took four days less to reach market weight, and ate 8kg more feed. Those receiving urea gained an extra 7kg carcase weight, took six days less to reach market weight and ate 6kg more feed. Those on the lupin supplement gained an extra 10kg carcase weight, took three days less to reach market weight and ate the same amount of feed as those on the basic ration.

The research workers calculated that adding a crude protein supplement to a barley/hay ration would be profitable as long as: adding meatmeal did not increase the cost per kilogram of the ration by more than 9 per cent; adding urea did not increase the cost by more than 7 per cent and adding lupins did not increase the cost by more than 13 per cent.

If the barley, at 13.5 per cent crude protein, cost $130 a tonne, lupins $180 and urea $280, either urea or lupins could be used in the diet and incur similar feeding costs.

If the prices of cereals and urea rose relative to that of lupins it would be more profitable to use lupins to boost the protein content of the diet.

The research workers pointed out that if high protein cereal grains were used, only about 10 per cent of lupins needed to be added to the diet, but if low protein grain such as oats at 10.5 per cent crude protein were used, up to 20 per cent of lupins would be necessary to make up a diet suitable for finishing one year old cattle.

**Grazing lupin stubble**

In a trial at Chapman Research Station, eight to ten month old weaner steers grazing either Unicrop or Ultra lupin stubbles over summer gained weight at up to 0.3 kg per head per day. The length of the weight-gain period increased as the stocking rate decreased.

![Cattle grazing lupin stubble.](image-url)
Using lupins in pig feeds

By N. W. Godfrey, Senior Research Officer, Pig Branch

Lupin seed is now used widely as a pig feed ingredient, especially in Western Australia where grain lupins have become an important cash crop since suitable varieties and agronomic techniques have been developed.

Lupin seed has gained a place in pig feeding because it is generally the only alternative to meat meal as a source of supplementary protein. Western Australian pig feeds are based on wheat and barley which contain about 10 to 13 per cent crude protein (CP). Meat meal, containing 50 per cent CP and lupin seed, 28 per cent CP, are mixed with these cereals to provide 14 to 18 per cent CP in the diets of various classes of pigs.

Some of the earliest experiments evaluating lupin seed for pig feeding were carried out at the Medina Pig Research Station in 1972 and 1973. Since then further experiments have been conducted at Medina and at research centres in other States. These early experiments demonstrated that, in addition to vitamins A and D, there was a need for B group vitamins in diets composed of lupin seed and cereals. This is not the case if the chief source of supplementary protein is meat meal, when the only requirement is for vitamins A and D. The marked response to B group vitamins was to be expected since diets composed entirely of feeds of vegetable origin are known to be deficient in certain vitamins of this group.

 Calcium and phosphorus needed

If lupin seed is used to replace meat meal in cereal based pig feeds, supplementary calcium and phosphorus must be provided. Common sources of these elements are Christmas Island rock phosphate (CIRP) dicalcium phosphate, ground limestone and meat meal. To avoid kidney damage and slow growth, CIRP should not comprise more than 1.0 per cent of the diet.

The most practical methods of supplying calcium and phosphorus to growing pigs fed lupin seed diets are:

- Include 3.0 per cent meat meal and 1.0 per cent CIRP in the diet.
- Include 7.0 per cent meat meal in the diet.
- Include 5.0 per cent meat meal and 0.4 per cent ground limestone in the diet.

Breeding stock should not be fed CIRP.

Other minerals

If diets are based on lupin seed, supplementary salt (sodium chloride) and several minor elements are needed. Salt should be included in the diet at a rate of 2.5 to 3.0 per cent. The minor elements needed include copper, zinc, manganese and iron. These are usually included in the proprietary mineral/vitamin premixes available to pig producers and should be used at the rates recommended by the manufacturers.

Also it has been shown that selenium-vitamin E deficiency can occur in rations based on cereals and lupins grown in the higher rainfall areas. This can be prevented if 10 milligrams of vitamin E is added per kilogram of feed, along with 0.1mg of selenium.

‘Grower’ pigs can die suddenly from selenium-vitamin E deficiency, a result of liver damage and/or skeletal and heart muscle damage... white muscle disease.

Lupin seed compared to meat meal

Growing pigs fed diets of lupin seed plus cereal grain have performed a little better than those fed meat meal...
with cereals. This is probably because lupins contain more digestible energy (DE) that meat meal. The DE in lupin seed is comparable to that in wheat, while that of meat meal is about 20 per cent less.

Because lupin seed contains less protein than meat meal, bigger quantities must be used in mixtures with cereal grains to produce the protein levels pigs require. This must be taken into account when comparing the costs of these two protein sources for ration formulation.

Generally the higher the cost of cereal grain per tonne, the more attractive lupin seed becomes when compared to meat meal, because it replaces more of the cereal in the feed mixture.

The prices per tonne at which meat meal and lupin seed are of equal value as sources of protein for pig feeds can be determined roughly from the equation:

\[
0.34LS + 0.15M + 0.19G = 3
\]

where

- \( LS \) = lupin seed price per tonne
- \( M \) = meat meal price per tonne
- \( G \) = grain (wheat or barley) price per tonne

If, for example, the cereal grain cost $140/t and meat meal $320 then lupin seed would be a better buy than meat meal at all prices up to $210/t.

If meat meal were at the same price ($320) but cereal grain up to $160/t, lupin seed would be better buying than meat meal at all prices up to $222/t.

At times, the lupin seed price has been lower than that of cereals. In such circumstances, it would pay to increase the dietary lupin seed level beyond that required to satisfy the need for protein. However, trials have shown that growing pigs’ growth rates can be depressed when the lupin seed content exceeds 50 per cent of their ration. Generally, between 20 and 40 per cent of lupin seed is used in growing pigs’ diets, depending on the relative costs of lupin seeds, cereals and meat meal, and on the crude protein level required in the diet.

**Lysine needed**

Lysine, an amino acid, is a natural component of the protein in all common pig feeds. It must be pre-formed in the pig’s diet. However, the levels of protein-bound lysine in most pig feed mixtures are too low for the animals to grow at their best, so it is now common practice to mix in from one to three kilograms of lysine per tonne of pig feed with worthwhile results.

Whether meat meal or lupin seed is the main protein source, supplementary synthetic lysine is still required.

The amount of synthetic lysine required in a pig feed depends not only on the total protein-bound lysine in the main feed ingredients, but also on the availability of the lysine in each.

The availability of lysine in cereals is relatively high, about 85 to 90 per cent, while it can vary in protein concentrates. The availability of lysine in soybean meal and fish meal is 90 per cent, compared to meat meal with 50 per cent. Also it has been found that the availability of lysine in lupin seed is about 55 per cent; slightly better than that of meat meal but not as good as soybean or fish meal.

Obviously the availability of lysine significantly affects the real value of a protein concentrate, and must be considered by those formulating pig diets. However, in Western Australia, the choice of protein concentrate is limited to meat meal or lupin seed, which have similar lysine availability levels. Thus the choice of constituents is determined by factors other than lysine availability.

In general, pig diets based on lupin seed will require no more supplementary synthetic lysine than those based on meat meal.

**Other essential amino acids**

Methionine is another amino acid essential in pig nutrition. Although the methionine content of lupin seed is low, it is not so low as to make synthetic methionine necessary when fed to growing pigs with cereal grains. Only once was a response to methionine recorded. This was in a diet of wheat and lupin seed fed to three-week old pigs. It would be uncommon to feed a diet of this composition to such young pigs. Usually, more complex feed formulae, containing several more ingredients, ensure an adequate supply of methionine. For growing pigs, more than six weeks old, simple feed mixtures of lupin seed and cereal grain seem to contain enough methionine and other amino acids.

**Lupin varieties**

Most lupins available for pig feeding are varieties of *L. angustifolius* such as Unicrop, Illyarrie and Marri. These have similar nutritional values. Some farming areas of Western Australia are suitable for growing Ultra, which is a variety of *L. albus*. Ultra has a higher protein content...36 per cent...than *L. angustifolius* varieties...28 per cent.

Thus it is potentially more valuable because less would be needed in a pig diet of specified protein content.

However, *L. albus* seed has been found to accumulate manganese to higher than normal levels. Although manganese is an essential minor nutrient, too much in the diet (more than 500 mg/kg) can be toxic to pigs. To avoid this possibility, the Department recommends that Ultra should not exceed 15 to 20 per cent of the pigs’ diet.

The level of manganese in *L. albus* is extremely variable, so individual lots could need analysis to ensure that their manganese contents do not exceed the tolerance level. Samples of Ultra from various sites in the south west contained an average of 446 (± 174) mg/kg of manganese and a range of 31 to 2010 mg/kg.

In all other respects, *L. albus* is similar to *L. angustifolius*, having much the same digestible energy content and requiring supplementary synthetic lysine when used in pig diets.

**Alkaloid levels**

Alkaloids are the substances responsible for the bitterness in "bitter" lupins. The pigs may be reluctant to eat rations containing much alkaloid.

Fortunately, cases of high alkaloid content in sweet lupins are rarely recorded.
Lupin market prospects

By N. F. Brown and F. Curtis, Rural Economists

Because of its high protein content, lupin grain competes with other high protein meals on both the local and export markets. In the medium-term (five to 10 years), lupins probably will continue to be sold as a protein ingredient in livestock feeds. In the longer-term (10 to 20 years), lupins also may become a more important protein ingredient of human foods.

The sheer extent of the world protein market—with today's world trade at about 35 million tonnes—should ensure that Western Australia's lupin crop can be disposed of on world markets with little difficulty, provided they can gain wider acceptance by buyers, and are priced competitively with other protein meals. If lupins are to gain acceptance by livestock feed compounders, producers must offer continuity of supplies of grain with assured low alkaloid levels. Also buyers must become more familiar with sweet lupins as an ingredient in feed mixes. Lupins' acceptance as a human food ingredient also will require firm proof that they are safe for this use and can substitute for soybeans in many food uses.

World prices for protein meals will remain volatile. However, if growth in demand for meals starts to slowly outstrip growth in supplies during the 1980s, as seems possible, then in the medium-term there will be less prospect of short term meal prices falling below costs.

Lupin grain being loaded for export.

100
Marketing

Apart from 1974/75, lupins have been marketed by the Grain Pool since they were first grown on a commercial scale in 1971/72. From 1971/72 until 1973/74 the Grain Pool conducted a voluntary pool—the Western Australian Voluntary Lupin Pool. In 1974/75, lupins were marketed through a compulsory pool operated by the Western Australian Seed Board, though the Grain Pool acted as the managing and selling agent for the Board. Between 1975/76 and 1979/80, the Grain Pool compulsorily acquired and marketed the Uniwhite, Uniharvest and Uncrop cultivars of *L. angustifolius* and the Weiko III cultivar of *L. luteus*. In 1980/81, Illyarrie (*L. angustifolius*) was added to the compulsory pool.

For the 1982/83 and future seasons, all narrow-leaved (*L. angustifolius*) varieties produced in Western Australia will be compulsorily marketed by the Grain Pool, while other lupin species may be traded freely. However, there is scope in the Grain Marketing Act for varieties of other lupin species to be added to the compulsory pool from time to time.

As described elsewhere in this Journal, drought in the northern cereal belt reduced sweet lupin production to between 20,000 and 25,000 tonnes a year between 1976/77 and 1979/80 after peaking at about 89,000 tonnes in 1975/76. After the return of better seasonal conditions and the release of several new varieties, production has recovered sharply reaching a record 95,000 tonnes in 1981/82. Because of the possible wider use of lupins in rotation with cereal crops, and the release of new varieties more adapted to the environment, lupin production in Western Australia should continue to expand in the next few years, and certainly will remain an important crop in this State. Indeed the area sown here is estimated to have more than doubled to at least 180,000 hectares in 1982/83, and production is expected to rise to about 120,000 to 150,000 tonnes.

As indicated in Table 1, most of this State’s production has been exported in the past 11 years, except for the drought years from 1976/77 to 1979/80, when production was low. Because the Western Australian market is relatively small and stable, the proportion of the lupin crop exported has been higher in years of high production and lower in years of low production. In most of the drought years, the domestic market proved to be a reliable ‘backstop’ for the small quantities being produced. The only export during these years was of 6300 tonnes in 1978/79. This was included with a bulk shipment of barley to keep freight costs down.

Most exports so far have been to Western Europe, except for about 5000 tonnes shipped to Taiwan in 1975/76, about 4000 tonnes to South-East Asia in 1974/75 and a small quantity to Japan in 1971/72.

The Eastern States so far have not been major markets for Western Australian lupins—the only sale being 3500 tonnes in 1973/74—and they are unlikely to be in the medium-term at least. The protein requirements of feed mills in the Eastern States are met mainly from large local oilseed industries, particularly in New South Wales and Queensland, and from expanding local lupin production. Moreover, high transport costs from Western Australia to the States make export markets a more attractive economic proposition for Western Australian growers.

Domestic Market

Livestock feed

In Western Australia sweet lupins have been used almost entirely for livestock feed.

They have been used in rations to partly replace soya bean meal for broiler hens and meatmeal for layer hens and pigs. Commercial broiler rations in Western Australia use about 10 per cent crushed whole lupinseed with meatmeal and fishmeal, while layer hen rations contain about 7 to 10 per cent lupins and some meatmeal as protein components. Most of the domestic sales by the Grain Pool listed in Table 2 would have been to the compounders. The long term potential of this market is estimated to be about 20,000 to 25,000 tonnes a year.

Also, there is a market for lupins on-farm in Western Australia. Today it is common for farmers to mix their own feeds, containing lupins, for pigs and poultry. Also, lupins are fed to sheep in the dry summer months. Table 2 indicates that the quantity of lupins not delivered to the Grain Pool has in the past eight years ranged from just under 12,000 tonnes to 28,000 tonnes.

Western Australia’s yearly lupin use has ranged from slightly more than 15,000 tonnes to almost 30,000 tonnes since 1971/72. The large variation has resulted mainly from seasonal conditions and intermittent exports by the Grain Pool, rather than from fluctuating demand. About 25,000 to 30,000 tonnes have been used locally in recent years, for other than seed use.

Because the demand for lupins derives from the demand for meats, particularly those of pigs and poultry, the main determinant of Western Australia’s future lupin use will be the future demand for these meats.

Pigmeat consumption is expected to level out during the 1980s, while the growth in poultry meat consumption should moderate. If this trend occurs in Western Australia and the State’s population continues to increase, our lupin use will increase at a moderate rate beyond the present 25,000 to 30,000 tonnes... provided that the lupins are available.

Human food

Small quantities of lupin flour have been used in Western Australia in pet foods and to replace soybean protein in camp pie and similar canned goods in the past. This was discontinued for some time pending the outcome of an inquiry by the Australian National Health and Medical Research Council (NHRMC) into whether it should give its official approval for the use of lupins for human consumption. In June 1980 it approved the use of lupin flour in making bread, cakes, pastry, biscuits and the like, provided that it does not exceed 10 per cent of the flour used, and that the alkaidol content of the lupin flour does not exceed 0.02 per cent.
This should open the way for greater use of lupin flour, particularly as a replacement for soybean flour in bread production. Lupin flour has been incorporated into bread in many baking experiments. These experiments generally have included about 10 to 20 per cent lupin flour and mostly have produced very satisfactory loaves of bread.

If lupin flour were to completely replace soybean flour in flour used for bread in Western Australia, and blended at the 1.0 per cent rate recommended by the Bread Research Institute in all flour used in Western Australia, a small additional domestic market (1000 to 1500 tonnes) would be available for Western Australian lupins. However, if lupin flour were used up to the 10 per cent allowed by the NHMRC a much larger market would be available.

Lupin grain may be used to replace soybeans in most of their food uses, but its acceptance for such uses, particularly on the local market, is likely to be much slower than in bread production.

**Export Markets**

Because lupin consumption in Western Australia is expected to rise at only a moderate rate, an increasing proportion will need to be sold on export markets as Western Australian lupin production increases.

**World protein market**

As meat is the main source of protein in human diets, particularly in developed countries, vegetable sources of protein have come to be used principally as ingredients of livestock rations on world markets.

The proteins used for livestock feeding are derived from a variety of products, including meals made from soybeans, peanuts, sunflowerseed, cottonseed, and rapeseed. Fishmeal has been an important non-vegetable protein source, but its importance has been declining as supply decrease. Meal from other animal sources such as meat, bones, blood, and feathers as well as brewery by-products, synthetic products and some cereal products (e.g., corn gluten) are used also, but to a lesser extent than vegetable meals and fishmeal.

World protein meal production has averaged about 80 million tonnes (Mt) in recent years, with a large proportion—about 35Mt or 45 per cent of production—being traded. In contrast, the quantity of coarse grains traded represents only about 12 per cent of production.

In addition to the large proportion of production traded, the most important characteristics of the world protein market are the dominance of soybean meal as a protein source, the United States of America as the major exporter, and the EEC as the major importer. Soybean meal represents about two-thirds of world meal production and three-quarters of the world meal trade. The United States produces about 45 to 50 per cent of the world’s protein meal and accounts for some 50 to 50 per cent of world meal exports—though Brazil has become a major competitor with the United States as a soybean meal exporter in recent years. The EEC takes about 50 per cent of world imports. The other major importing countries are Japan and Eastern Europe.

**Feed grain markets**

Consumption and imports of protein meals by most of the countries likely to be the main potential markets for Western Australian lupins are summarised in Table 3. The main prospective markets for Western Australian sweet lupins for livestock feed are likely to be:

<table>
<thead>
<tr>
<th>Year</th>
<th>Area sown (hectares)</th>
<th>Production (tonnes)</th>
<th>Receipts (1000 tonnes)</th>
<th>Exports (1000 tonnes)</th>
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<td>77,151</td>
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<table>
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<tr>
<th>Year</th>
<th>Domestic sales by Grain Pool (1000 tonnes)</th>
<th>Used locally not delivered (1000 tonnes)</th>
<th>Total local use (1000 tonnes)</th>
<th>Held for seed (1000 tonnes)</th>
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<table>
<thead>
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<th>Imports</th>
<th>Disappearance*</th>
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<tr>
<td>Taiwan</td>
<td>0.7</td>
<td>0.7</td>
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* A measure of consumption = production + imports – stocks.
† Singapore, Malaysia and Thailand.
The EEC: The EEC is the only existing export market for Western Australian lupins and should remain the principal market, at least during the 1980s. Indeed, Unilever International, in July 1982, announced that it was prepared to use lupins in its feed mixes provided it could obtain 250,000 tonnes a year.

The EEC uses nearly 20 million tonnes of protein meal each year, of which about 70 per cent is soybean meal. It imports about 13Mt of meal, including slightly more than 8Mt of soybean meal. Its own soybean meal production of about 8.5Mt would be processed almost entirely from imported soybeans. Another increasingly important source of protein in the EEC in recent years has been corn gluten. In the four years to 1980/81, net imports of corn gluten averaged about 2.5Mt a year.

The sheer size of the EEC protein market indicates that the Western Australian lupin crop should be sold with little difficulty in the EEC. However, the degree of penetration of this market will depend on lupins being priced competitively with other protein meals, especially soybean meal — and their being accepted by compounders.

On a protein-equivalent basis, lupin prices can be compared reasonably directly with soybean meal prices. But we must allow for the possible need to add methionine and lysine to rations in which lupins wholly or mostly replace soybean meal. Moreover, lupins suffer some price disadvantage in that they are subject to a 5 per cent import duty while soybean meal can be imported duty free. However, these disadvantages are largely offset by the lower cost of preparing lupins for inclusion in a feed mix, as they do not need to be heat treated to breakdown trypsin inhibitors and other antinutritional chemicals such as haemagglutinins do soybean and other vegetable meals.

Also, as the oil content of narrow-leaved lupins — at 5 to 7 per cent — is too low for commercial extraction; its retention boosts the energy value of lupin seed meal when compared with other legume meals from which the oil has been extracted.

Apart from price, lupins’ acceptability will depend mainly on compounders’ becoming more familiar with lupins, and reliability of supplies. Some compounders in the EEC now are familiar enough with lupins to be confident that the sweet varieties being grown in Western Australia contain so little alkaloid as to have no adverse effects on animals and thus have a place as a protein source in their feed mixes. However, most EEC compounders are familiar only with the varieties available in Europe which are contaminated with bitter seeds, rather than with the pure low alkaloid cargoes available from Western Australia.

Lupins also will become more acceptable if they become available in big enough quantities to be used all year round by the compounders so that the costs of adjusting feed mixes are kept to a minimum. Availability of supplies has been a major obstacle to selling Western Australian lupins in the EEC in the past.

USSR and Eastern Europe: In view of its big livestock industry, the USSR is a large potential market for lupins in the long-term. Furthermore, being the world’s biggest lupin producing country, the USSR is familiar with lupins. However at present, livestock feeding in the USSR is based mainly on cereal grains. It uses about 5 to 6 million tonnes of protein meal a year, but it imports little. Moreover, currently
the USSR does not have the equivalent of Western Europe's high-
technology feed compounding industry.
If the USSR were to import lupins it would be unlikely to consider purchases of less than 100,000 tonnes. Because of its big total grain imports, the space required for segregation of less than 100,000 tonnes would not be worthwhile.

Eastern Europe is a more likely potential market in the medium-term. Eastern Europe uses about 6 to 7 Mt of protein meal a year. It imports 4 to 5 Mt a year of this. Also Poland, like Russia, is a major lupin producer and hence is familiar with lupins for livestock feed. In addition, the United States Department of Agriculture (USDA) has reported that the Eastern European region as a whole is suffering from a chronic livestock feed protein deficit, along with limited prospects for increasing its domestic protein meal production. However, two major constraints on sales to Eastern Europe in the medium-term will be the poor financial situation of most Eastern European countries and their physical handling capacity.

- **Middle East**: The high incomes of most Middle Eastern countries and the consequent growth in their sheepmeat consumption makes the Middle East another potential market for lupins. These countries do not have the sophisticated compounding operations of Europe. However, lupins could be fed whole to sheep either by broadcasting on the ground or in troughs as is done in Western Australia.

  The main Middle East sheep feed import is barley. Potential users in these countries will need to understand the lupin's role as a high protein complement for barley before they purchase any large quantities. A major problem at present is that one of the main potential markets, Saudi Arabia, subsidises grain, but not protein, imports.

  Nevertheless, the Grain Pool has received a very favourable response to its inquiries in the Middle East about the potential use of lupins.

- **South-East Asia**: The major potential markets for lupins in South-East Asia are likely to be Singapore, Malaysia, and Thailand. These countries have only small potential compared with the EEC. Nevertheless, together they represent a worthwhile medium term market, generally have a good standard of living for the region—especially Singapore and Malaysia—and are closer to Australia than Europe. In addition, all three countries have quite big intensive livestock industries... generally about 1 million pigs and 20 to 30 million chickens.

- **Japan and Taiwan**: Japan is a potential market for Western Australian lupins in the long-term. It has a big intensive livestock industry, a high standard of living, a large population, and only limited space to grow the ingredients necessary for livestock feeds. At present, it uses about 4 million tonnes of protein meals a year. Like the EEC it has a very sophisticated compounding industry and obtains a big portion of its requirements by importing whole seeds and processing them in Japan.

  However, at present the United States supplies virtually all of Japan's oilseed and oilseed meal imports. This situation is unlikely to change in the medium-term. Nevertheless, in the long-term, Japan could be a market for Western Australian lupins for use in livestock feeds.

  Taiwan is more likely to be a market for Western Australian lupins in the medium-term. It, too, has a big intensive livestock industry, a crowded population with limited space for growing ingredients for livestock feed, and a reasonable standard of living. Moreover Taiwan already has imported lupins from Western Australia for livestock feeding.

**Human food market**

A substantial potential market for Western Australian lupins in the long-term will be as a food product, or ingredient in products, used for human consumption in Asia. For example, some Japanese companies have shown interest in lupins to produce 'bean sprouts' if they are competitive enough with commodities such as mung beans normally used for this purpose. The biggest potential market for lupin grain will be as a substitute for soybeans and soybean meal in the many products in which they are used for human consumption.

Soybeans have been used for thousands of years in Asia—particularly North-Eastern Asia (Japan, Korea, Taiwan, China)—to produce 'soy protein' foods including soy sauce, fermented tofu products, and soya milk products such as tofu (soybean curd) and sufu (a cheese-like fermented tofu popular in China). Another product popular in both China and Japan is shiitake or miso—a fermented soy paste used in China as a base for sauces served with meat, seafood, poultry, or vegetable dishes, and in Japan mainly as a soup base.

Lupins eventually may be used as a substitute for soybeans in producing these foods but are unlikely to be accepted readily as such for some time because of traditional consumer taste preferences for soybeans, and again, lack of familiarity with lupins.

In the medium-term, lupins are more likely to be used to substitute for soybeans where soybeans are used in food products either to increase protein content, or as a meat or milk extender. Soybeans are being used in developing countries where the short protein content is balanced by the balance of payments problems and relatively low living standards, are unable to pay for the more expensive protein sources such as meat. In such countries, the fortification of wheat, corn, or cassava (tapioca) flour with soybean flour presents a rapidly growing market. Another means of boosting nutrition in many of these countries is to use soy grits and textured soy bits to fortify rice. A further possibility is to mix soy products such as flour, concentrate and isolate with milk to replace or extend milk supplies in developing countries where milk has become an important part of the diet.

In the more developed countries, lupins might also substitute for soybeans as a protein additive to flour, and as an extender for beef, poultry meats, and fish pastes (in Japan).
To penetrate some of these soybean markets in Asia would establish a premium-price market for at least part of the Western Australian crop—though mainly of the *L. albus* varieties. To gain a foothold in such Asian food markets, it would be necessary to have lupin grain accepted as a suitable substitute for the more familiar soybeans. This would require convincing evidence that lupins could substitute for soybean food products in terms of both consumer tastes and health requirements. For this reason the Grain Pool has commissioned a Korean study of the potential food uses for lupins. Their acceptability will depend also on continuity of supplies.

**Potential growth in markets**

The market prospects for Western Australian lupins in the next decade will depend mainly on the success of efforts to penetrate existing protein markets—both for livestock feed and for human food ingredients. Any growth in total demand for protein meals relative to supplies should allow easier penetration of these markets.

- In the medium term, the main market for lupins probably will continue to be the protein meal market for livestock feeds. The demand for protein meals is expected to continue to grow during the 1980s but at a slower rate than during the 1970s. The world recession and the possibility that oil prices could increase as the world comes out of recession probably will dampen the growth of demand and prices for meat, and consequently the demand for livestock feeds. Moreover, in many markets, livestock producers have largely closed the feed protein gap in livestock rations. As a result, meal consumption growth in these countries (including Japan and the EEC) is expected to ease during the 1980s in comparison with the 1970s.

Protein meal supplies also are likely to increase at a slower rate than in the 1970s. Available evidence indicates only limited scope for an increase in world production of protein meals. In the Northern Hemisphere, increased production is likely to depend mainly on the release of new higher-yielding varieties. Any expansion of the area of soybeans grown in the United States of America would be mostly at the expense of cereals. Moreover there is not likely to be any sizeable expansion in oilseed area in the EEC and the USSR, because of their big cereal requirements and limited land availability. In the Southern Hemisphere, the potential for an increase in oilseed production is not much better. Reportedly, additional land resources in South America are either limited or marginal, while no substantial increase in exports from Australia is likely in the medium-term.

Consequently, only sluggish growth in both demand and supply appears likely during the 1980s though demand growth could start to outstrip supply growth as the world moves out of the recession.

- In the longer-term, the human food market may become an important additional market for lupins. The protein market for human foods will continue to grow as the world, and more importantly for lupins, the South-East Asian, populations continue to increase. Moreover, vegetable proteins also may be used more widely to substitute for the more expensive animal proteins, especially in the developed countries. However, foreign exchange probably will continue to constrain increases in imports of protein products by developing countries to meet the demand of their growing populations.

**Price prospects**

Prices for lupins sold on both the domestic and export markets will reflect world market conditions for protein meals.

The price the Grain Pool obtains for local market sales will be affected by local conditions, but movements will mainly reflect changes in export prices. Moreover, if production increases, the proportion sold on export markets will increase.

Lupins must continue to compete with other protein sources, so their export prices will be determined mainly by trends in the world protein market and in turn by soybean meal prices.

**References**


5. Gladstones, J. S. "Recent Developments in the Understanding, Improvement, and Use of Lupins", in Advances in Legume Science by Sumnerfield and Bunting, 1980.


