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Cowpea, lablab and pigeon pea

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Clockwise from left: Pigeon pea in flower; cowpea crop on sandy soil; two of the authors, District Agronomist Col Mullen and Research Agronomist John Holland, at the release of Koala Lablab; lablab crop on heavy soil in flower

C MULLEN

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CONTENTS

DISCLAIMER

The information contained in this publication is based on knowledge and understanding at the time of writing (March 2003). However, because of advances in knowledge, users are reminded of the need to ensure that information upon which they rely is up to date and to check currency of the information with the appropriate officer of New South Wales Department of Agriculture or the user's independent adviser.

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INTRODUCTION

Cowpea (*Vigna unguiculata*), lablab (*Lablab purpureus*) and pigeon pea (*Cajanus cajan*) are summer-growing annual pulse crops. Cowpeas are a significant crop in NSW and can be grown as a grain-only crop or as a dual-purpose forage and grain crop. Lablab and pigeon pea are relatively minor grain crops at present, but both have the potential for expansion.

These pulse crops can be included in farming systems in northern NSW as a summer break crop to help manage cereal diseases and winter weeds as well as to add some nitrogen to the soil.

This Agfact outlines the agronomy of each crop for grain production.

Adaptation

Cowpeas, lablab and pigeon pea are well adapted to the slopes and plains of NSW where average annual rainfall exceeds 450 to 500 mm, or to irrigation areas. They are grown mainly in the northern half of NSW, where summer rainfall predominates. They are an alternative summer pulse crop to mungbeans and offer niche market opportunities for some growers.

These crops have good drought resistance, tolerate heat stress during vegetative growth stages, and are therefore well adapted to the warmer areas of NSW. They perform best under warm, humid conditions at temperatures between 20ºC and 30ºC. However, summer temperatures are often too low on the tablelands to give satisfactory growth. They do not tolerate frost.

All crops are adaptable to soil type, but pigeon pea does not tolerate waterlogging. Cowpea requires good drainage and is the best-adapted summer pulse for lighter textured soils. Lablab tolerates less well-drained paddocks.

Place in rotation

Apart from having value as grain cash crops, cowpea, lablab and pigeon pea are excellent rotation crops for building up soil nitrogen and breaking cereal weed and disease cycles. Well nodulated crops can provide 20 to 80 kg nitrogen/ha for following cereal crops in the rotation. The net amount of nitrogen fixed varies greatly and will depend on the initial soil nitrate level, how well the crop is nodulated, the crop dry matter production, and the grain yield harvested.

These crops should be followed by a winter or summer cereal or grass-type crop to minimise disease build-up and utilise soil nitrate. They can also be used as a main crop or double-cropped into cereal stubble when suitable conditions prevail. Lablab, pigeon pea and probably cowpea all aid the build-up of the VAM fungi in the soil for succeeding crops.

Cowpea is a host crop to the root lesion nematode (RLN) (*Pratylenchus thornei*) and should not be included in rotations on soils with this problem. Pigeon pea is resistant to RLN and is a good rotation crop where this problem exists.

Cowpea and lablab crops can also be turned under at mid-flowering as green manure crops. To assist decomposition, make sure that crops are green and sappy when you turn them under, and allow about a month for the nitrogen to be released before you re-crop.

When you are planning your crop rotations, be aware that lablab does possess a level of hard seededness, and some seeds may not germinate until the following summer. This could be a problem in some broadleaf crops such as cotton.

Inoculation

Cowpea, lablab and pigeon pea all need to be properly inoculated to ensure good nodulation of the plant roots and nitrogen fixation from the atmosphere.

Inoculation can be carried out by either applying a slurry to the seed before sowing, or by spray inoculation directly into the seed furrow. When you are slurry inoculating, use a methylcellulose glue slurry to increase the survival of the inoculant on the seed. Follow the directions on the inoculum packet. Inoculate seed the day before sowing and allow it to dry overnight. Store inoculated seed in a cool place out of sunlight, and sow as soon as possible.

Spray inoculation is very effective if you mix the inoculant with water and spray directly into the seed furrow at sowing. This is the preferred method if you are sowing large quantities of seed. Equipment can be readily set up on seeders and planters.

The net amount of soil nitrogen fixed varies widely and depends on:

- how well the crop is nodulated—the correct inoculum must be used (see individual crops)

- the initial soil nitrogen level—low soil nitrogen levels will encourage the legume to produce more nitrogen
- crop dry matter production—the greater the crop growth, the more dry matter and the more nitrogen produced. A rule of thumb is 20 kg N/t dry matter.
- the grain yield produced—higher grain yields remove more N.

Crops sometimes nodulate poorly when soil moisture is low and when soil temperature is increasing.

Seeding rate

When you are calculating the seeding rate for these crops it is important to ascertain the number of seeds per kilogram. Average numbers of seeds/kg are provided as a guide for each variety (see individual crops). This will enable you to calculate a sowing rate by using the following formula.

$$\text{Seeding rate} = \frac{\text{Plant population required}}{\text{Seeds/kg} \times \text{germination \%} \times \text{establishment \%}}$$

For example, the seeding rate to establish a plant population of 80 000 plants/ha for lablab would be as follows (germination 80% and establishment 80%).

$$\text{Seeding rate (kg/ha)} = \frac{80\,000 \times 100 \times 100}{5000 \times 80 \times 80} = 25 \text{ kg seed/ha.}$$

COWPEA

The plant

Cowpea is an annual summer-growing legume. It can be grown as a dual-purpose crop for grazing and/or grain production, or as a pulse crop only.

Production of cowpea has expanded because it is a valuable rotation crop for improving soil nitrogen fertility, especially for the cereal crops that are planted after it. Some varieties can also be used for grazing and grain production. Cowpea is an excellent fattening crop for sheep and cattle.

Much of the cowpea grain production in inland NSW is sold for seed, and increased grain marketing opportunities have become available overseas.

In NSW, cowpea is adapted to the slopes and plains where the average annual rainfall exceeds 500 mm, and to coastal or irrigation areas. It is grown mostly in the northern half of NSW, where summer rainfall predominates. On the coast, it is grown mainly for forage and as a green manure crop, although a few crops are grown for grain.

In NSW the total area sown to cowpea each year has fluctuated widely between 10 000 and 26 000 ha. Approximately half the area is harvested for grain each season, and the remainder is grazed by livestock. Average grain yields have varied from 0.4 to 0.8 t/ha.

Soils

Cowpea is well adapted to most soil types in NSW, from the light sandy acid soils to the heavier alkaline soils. However, soils must be well drained, as cowpea does not tolerate prolonged waterlogging, particularly in the presence of Phytophthora root rot. The varieties Red Caloona and Holstein offer good resistance to Phytophthora root rot.

Varieties

Poona and **Caloona** are the traditional varieties grown in NSW and are dual-purpose types used for both grazing and grain. These two varieties are both very similar and are late maturing. Both are susceptible to Phytophthora root rot (*Phytophthora vignae*), which causes stem and root rot. These varieties are smaller seeded varieties, with average seed size around 65 g/1000 seeds.

Cowpeas thrive on deep sandy soils, and on loams and heavier textured soils. They are a very useful cash crop and an excellent rotation crop for rebuilding soil nitrogen fertility. They can also provide high quality forage.

C MULLEN

Red Caloona, released by the Queensland Department of Primary Industries in 1975, is resistant to Phytophthora root rot. This variety should be sown in situations where Phytophthora is known to be present. This particularly applies on the north coast of NSW. Red Caloona is a quicker maturing small seeded variety with a distinct reddish seed (around 52 g /1000 seeds).

Cowpea is sometimes grown on the north coast of NSW as a green manure crop in rotation with sugar cane. The late maturing variety **Meringa** has been used for this purpose. However, soybean is also grown in this situation as a grain cash crop and for its rotational benefits.

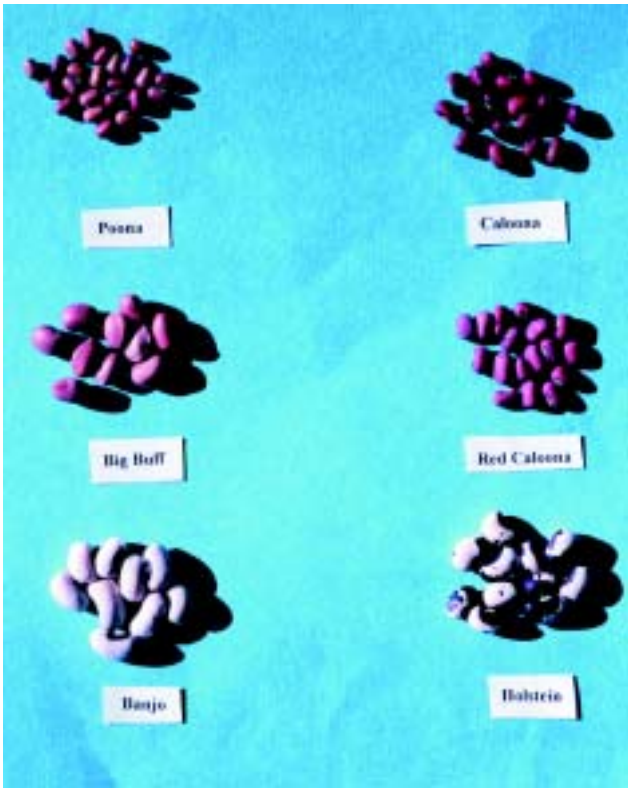
Banjo was released by NSW Agriculture in 1981. It is a quick-maturing grain cowpea with slightly superior grain yields to those of the older forage types. Banjo has a large whitish seed with a black hilum. It flowers in 50 to 55 days and matures within 90 days when sown between December and early January. Banjo should be grown under irrigation or under favourable dryland conditions. Average seed size is 215 g/1000 seeds.

Holstein is a grain-type cowpea released by CSIRO in 1992. It is similar in plant type, maturity and grain yield to Banjo. It is resistant to Phytophthora root rot. The seed is white and black, and average seed size is 190 g/1000 seeds. Flowers are pale yellow.

Big Buff is a grain-type cowpea that was released by CSIRO in 1992. Plants are determinate, and most pods are borne above the leaf canopy. Flowers are pale violet. Big Buff has similar flowering and maturity to Banjo when sown in December to early January. Grain yields are similar to those of Banjo. Big Buff has large buff-coloured seeds – much larger than those of Red Caloona. Average seed size is around 177 g/1000 seeds, compared with 52 g/1000 seeds for Red Caloona. Big Buff is resistant to powdery mildew but is susceptible to Phytophthora root rot.

Time of sowing

Cowpeas should be sown when soil temperatures at 10 cm depth are rising, and have reached at least 18ºC at sowing depth at 9.00 a.m. Eastern Standard Summer Time (ESST) on three consecutive days. December is the best month to sow all cowpeas for grain production, but crops can be sown from late November to early January in most districts. Yields are usually lower from crops planted earlier or later than this. With the Caloona and Poona types, earlier planting produces more plant growth for forage or green manure, but the plant usually lodges and can be difficult to harvest mechanically for grain. Pod set also tends to be much reduced. Banjo crops sown before December tend to be short in stature, and seed is much more prone to weather damage because it is set over a more prolonged period. Early desiccation when pods are physiologically mature can reduce this problem.



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There is a range of cowpea types, varying in size and colour.

For reliable grain production in inland dryland areas, subsoil moisture reserves to about 0.8 to 1 m depth must be present before sowing.

Rate of sowing

Caloona/Poona/Red Caloona types should be sown at 10 to 15 kg seed/ha, aiming for a plant population of 150 000 to 200 000 plants/ha (15 000 seeds/kg) in inland districts. On the coast, sowing rates vary between 20 and 40 kg/ha depending on sowing method and end use (grazing/grain/green manure). Banjo, Holstein and Big Buff seeds are much larger than those of Caloona and Poona, and should be sown at about 25 to 40 kg/ha in dryland paddocks so as to establish 100 000 to 150 000

J HOLLAND

A well established cowpea crop sown on wider rows.

plants/ha (4000 seeds/kg). Under irrigation, Banjo, Holstein and Big Buff seeding rates should be increased to 40 to 50 kg/ha.

Row spacing

The seed should be sown in rows 30 to 50 cm apart. Wider rows of 70 to 90 cm may be used where inter-row cultivation is needed to control weeds.

Sowing machinery

Most combines and air seeders are suitable for sowing cowpeas. However, with the Banjo variety and other large-seeded types, take extra care to avoid cracking the seed during sowing. Test sowing seed to ensure good germination, and handle it gently to avoid reducing its germination rate and vigour. You can use press wheels to improve emergence and seedling vigour; use a pressure of 1 to 2 kg per centimetre width of press wheel.

Inoculation

Inoculation of the seed with Group I inoculum is essential.

When correctly applied, inoculum will improve nodulation on the roots, improving nitrogen fixation from the atmosphere. An effectively nodulated crop does not need nitrogen fertiliser, even on infertile soil. Lime pelleting is not usually necessary, but should be used on problem acid soils.

Crops can sometimes nodulate poorly when soil moisture is low and when soil temperature is increasing.

Fertiliser

Cowpea requires adequate phosphorus. Add phosphorus to deficient soil at rates equal to or even slightly higher than those used for wheat. A common rate on many soils is 10 kg phosphorus/ha, which is equivalent to about 120 kg single superphosphate/ha. This rate also supplies around 12 kg sulfur/ha. Up to 40 kg phosphorus/ha is recommended on coastal soils low in phosphorus, particularly if super is broadcast before sowing. Cowpea may respond to molybdenum application on acid soils.

Zinc deficiency can be a problem on alkaline clay soils. Typical symptoms are yellowing between the veins of the leaves, which can be corrected by one or two foliar sprays of 1 per cent zinc sulfate heptahydrate; apply the first spray before the cowpeas are 15 cm high.

Cowpea can utilise VAM (Vesicular Arbuscular Mycorrhiza) by a symbiotic relationship that occurs between some soil fungi and plant roots to help gain access to phosphorus and zinc in the soil and fertiliser.

Weed control

Good weed control is essential for high-yielding cowpeas. Summer grasses, and in particular spiny burr grass on some sandy soils, can be controlled by selective herbicides. Select a paddock free of broadleaf weeds, such as Bathurst and Noogoora burrs and thornapples, as there are currently no chemicals registered for the control of these

Nodule formation on Banjo cowpea roots. A well nodulated cowpea crop can add significant amounts of nitrogen to the soil for the cereal crops that follow it.

C MULLEN

weeds. If you expect some broadleaf weeds, use wider row spacings and inter-row crop cultivation. For further information refer to NSW Agriculture's latest edition of *Weed Control in Summer Crops.*

Dual-purpose

When Poona/Caloona varieties are sown early (around mid-October to November), they can be lightly grazed and then shut up for a grain crop if seasonal conditions permit.

Crops can be grazed 10 to 12 weeks after sowing, depending on conditions. As a rule, crops are grazed between late December and early January. Cowpea is an excellent fattening feed for stock; it has crude protein levels of 16 to 20 per cent and good digestibility.

Make sure that you do not graze the crop too hard and that you leave the stems and the basic plant frame. Remove stock as soon as most of the leaves have been eaten.

Flowering of early-sown cowpeas usually occurs in about mid-February, and stock should be removed two or three weeks before this to allow regrowth to occur.

Grain yields from dual-purpose crops are extremely variable but can range up to 1 t/ha.

Cowpea is an ideal crop for rotating with cereals to minimise disease build-up, to control weeds, and to utilise soil nitrogen accumulation. In cereals, the improved nitrogen fertility will generally be reflected in higher grain yields and improved grain protein levels.

Cowpea stubble breaks down readily, and there is no problem with double-cropping cereals back into cowpea country after harvest in May/June/July using suitable recommended varieties, provided there is sufficient soil moisture available to establish the cereals.

Cowpeas are well adapted to no-till farming using narrow points and press wheels.

Insect pests

Cutworms can often damage newly sown stands of cowpeas, particularly in the spring and on lighter soil types. Grain crops are particularly susceptible to damage and downgrading by pests such as green vegetable bug, brown bean bug, heliothis, black cowpea aphid, thrips, mirids, lucerne seed web moth and etiella (on the North Coast). Watch crops carefully, particularly during flowering and pod filling. Cowpea is highly susceptible to mirids and thrips, and a spray at budding or early flowering is usually necessary. These pests can cause serious economic losses if they are not controlled. Although no definite threshold is available, indications are that an infestation rate of one or two thrips per flower or half to one mirid per square metre of crop warrants control.

C MULLEN

Good pod set in cowpea often depends on good control of insects such as myrids and thrips at budding and flowering.

In related crops (*Vigna* sp.), thresholds for green vegetable bug and brown bean bug have been set at one bug per 3 m^2 and one heliothis grub per 1 m^2. These thresholds have not been confirmed for cowpea, but can be used to assist in spray decisions. All threshold numbers have been determined by using a beat sheet. Apply a suitable correction factor if you are using other scouting methods. It is important to sample extensively throughout the field, as the distribution of bugs tends to be patchy.

Thrips can cause flower abortion and pod distortion. This photo shows grazing damage on pod tips and leaves caused by thrips.

C MULLEN

Etiella is a relatively new pest, and strategies that concentrate on controlling the adult moths are currently being developed. Etiella moths lay their eggs on the pods. The eggs then hatch and the larvae burrow into the pod. Once inside the pod, the grubs are inaccessible by sprays and can cause severe damage to the developing grain. NSW Agriculture's *Insect and Mite Control in Field Crops* contains further information.

Diseases

Phytophthora stem and root rot can be a serious disease and is aggravated by poor drainage conditions. The varieties Red Caloona and Holstein are resistant to this disease. Charcoal rot can occur spasmodically, and is accentuated by prolonged periods of moisture stress. Tan Spot (*Corynebacterium* sp.) also affects cowpea. There is no seed treatment for control, and seed should be selected from crops relatively free of the disease. Powdery mildew (*Oidium* sp.) can defoliate crops late in the season, but control is not justified. Basal stem rot (*Sclerotium rolfsii*) can cause yield reduction during pod fill. Sclerotinia root and stem rot can cause severe yield losses under conditions favouring the fungus.

Yields

From a December planting, Red Caloona, Poona and Caloona cowpeas are normally ready to harvest in 4 to 5 months. Dryland yields normally range from 0.5 to 1.25 t/ha, although yields of up to 2 t/ha have been recorded. Banjo can produce similar yields under good dryland conditions. With irrigated crops, yields of about 2 t/ha are possible, with average clean seed yields of 1.2 to 1.4 t/ha. Cowpea is moderately tolerant to waterlogging, but use an irrigation system with good slope and relatively short periods of watering to minimise any problems.

Harvesting

Cowpea should be harvested with as much care as possible to minimise seed damage. Harvest the grain as soon as it is mature, otherwise it may shell (especially Poona types). It is desirable to harvest grain at 12 to 14 per cent moisture content to minimise cracking and damage to seed. However, it is important to reduce seed moisture content to 12 per cent or below before storage. Grain usually stores well at this moisture content and does not require treatment.

Rain on a mature crop can cause weather damage and seed staining. Banjo cowpea is relatively tolerant of weather damage, being about as susceptible as azuki bean, Regur mungbean and pigeon pea. They are not as susceptible as Berken mungbean, although in some years brown staining can be a problem, resulting in downgrading of the peas.

In mild autumns, cowpea continues to flower and pod, and several good frosts or desiccation are required to dry the vines down for harvest. Desiccation allows the crop to ripen more evenly and to be harvested earlier, thus minimising its exposure to weather damage. Desiccated crops usually give a much cleaner grain sample, with less staining and trash. Desiccation can also overcome weed problems at harvest. The timing of desiccation is critical; spray the crop with a registered product when the seeds are mature, firm and beginning to change colour. A good guide is when you can cleanly peel the membrane away from most of the seeds, leaving little moisture. Harvest usually begins 5 to 8 days after desiccation, depending on weather conditions.

Adjust the header settings to minimise cracking. This usually requires a drum speed of no greater than 200 to 300 rpm. Both open- and closed-front headers are suitable. However, rotary drum headers are best for harvesting all pulse crops. Take extra care when harvesting Banjo, Holstein and Big Buff cowpeas because of their much larger seed size and susceptibility to cracking.

Marketing

Considerable amounts of cowpea seed are sold to inland growers for forage and grazing production. There is also some demand on the export market for cowpeas for the bean sprout trade. Red Caloona often commands a premium in this market over other cowpeas. There is also

A well podded crop of Banjo cowpeas beginning to dry down and nearing desiccation and harvest.

C MULLEN

Table 1. Minimum export standard for Australian machine-dressed Caloona/Poona cowpeas
Physical characteristics
The cowpeas shall have a good bright appearance of the specified type, i.e. buff coloured or red. Contaminants of either are to be reported as percentage by weight.
Nil tolerance
The cowpeas shall be free from animal excreta, rodents, live insects and any chemical not registered for use on stored cowpeas or in excess of legal tolerances. There shall be nil tolerances on pickling compounds/seed dressings or any fungicide added to the pulse as a seed dressing and any tainting agents and or other contaminants imparting an odour not normally associated with cowpeas, including caked, bin burnt and/or mouldy Cowpeas which are a result of product storage.
There shall be nil acceptance on Toxic and/or Noxious weed seeds which are prohibited by State laws against inclusion in stockfeeds.
Purity
The sample shall contain a minimum of 99 per cent by weight of cowpea seed material.
The sample will contain not more than 2 per cent by weight of defective cowpea and not more than 1 per cent poor colour cowpeas.
The foreign material shall not exceed 1% by weight, of which no more than 0.1% shall be unmillable material.
Moisture: 12% maximum.
Definitions
Cowpea Seed Material: made up of whole cowpea, defective cowpea, cowpeas other than the specified type.
Foreign Material: includes unmillable material and all vegetable matter other than cowpea seed material. Mungbeans are to be reported as a separate percentage.
Defective Cowpeas: include cowpeas which are broken, damaged and split, grub eaten, sprouted, affected by field mould.
Unmillable Material: includes soil, stones, metals and non-vegetable matter. Soil to be noted as percentage by weight.
Poor Colour Cowpeas: cowpeas whose seed coat or cotyledons are distinctly off colour from the characteristic colour of the predominating class of the specified type.
Other Cowpeas: cowpeas other than the specified type are to be reported as a separate percentage.

a demand for the Poona type or buff-coloured cowpeas as whole beans in the culinary trade. 'Blackeye' types such as Banjo have a good export demand and command a price premium, but exports are limited.

Cowpeas for export are usually sold graded and bagged (dressed). Grading losses are usually around 15 to 20 per cent. The export trade prefers A grade cowpeas. Lower grades are severely discounted and may be classified as suitable for stockfeed only.

Minimum export standards for machine-dressed cowpeas are shown in Table 1.

There is potential for cowpeas to be used as a source of protein, both domestically and overseas. Crude protein levels are usually around 23 to 25 per cent. Cowpeas have low levels of alkaloids, lectins, tannins and inhibitors and can usually be consumed untreated for human consumption (whole or as sprouts) or by livestock.

As prices may fluctuate widely both between seasons and within seasons, consider taking out a contract for a portion of your crop.

LABLAB

Koala lablab (*Lablab purpureus*) is currently the only variety suitable for grain production in NSW. It is a quick-maturing annual summer pulse crop. It has white to cream seeds and is adapted for grain production in northern NSW. It is the first grain lablab adapted to most of this area and is a vast improvement on the forage varieties Highworth and Rongai, which fail to produce grain in most seasons in northern NSW. Koala was released by NSW Agriculture in 1995.

The plant

Koala is an erect plant with flowers and pods held well above the main canopy. Flowers are pale mauve. Pods are 3 to 6 cm long and generally contain two to five seeds.

Koala generally reaches the 50 per cent flowering stage in 50 to 70 days from a December planting. Its habit is indeterminate, and flowering can take place over an extended period if soil moisture conditions are good. Koala usually matures 110 to 160 days after sowing.

The yield potential of Koala is in excess of 2.5 t/ha when grown under favourable conditions. Commercial dryland yields of up to 2 t/ha have been achieved. In drier years, yields of Koala lablab can be lower than mungbeans, whereas under good conditions the yield potential of Koala is around 25 per cent greater than mungbeans.

Soils

Koala lablab is adapted to a wide range of soils, from sandy loams to heavier textured, well drained clay loam soils. It is particularly well adapted to the heavier textured self-mulching clay loam soils, provided that they are not prone to waterlogging.

Planting

For reliable dryland production, subsoil moisture reserves of at least 0.8 to 1 m should be available at sowing.

Soil temperature at sowing depth needs to be at least 18ºC on three consecutive days at 9 a.m. ESST and rising before planting.

Time of sowing

Ideally, for grain production lablab should be planted in December to early January in northern NSW.

These sowing times should allow the maximum concentration of pod set and give the least exposure to weather damage on ripe pods. Planting earlier than this will result in excess vegetative growth, vining growth habit, and flowering over a longer period.

When sown for forage or dual purpose, lablab can be sown from mid October to November, when the danger of frosts is over and soil temperatures are above 18ºC.

Sowing rates

Koala lablab should be sown at around 20 to 25 kg seed/ha, depending on seed size, to give a plant population of around 60 000 to 100 000 plants/ha or 6 to 10 plants/m^2. Seed size varies from 4000 to 6000 seeds/kg. Germination percentage usually varies between 75 and 85 per cent.

Row spacing

Row spacings from 30 to 100 cm are suitable for lablab. Narrower rows will help the crop to compete with weeds. Press wheels will help establishment.

Planting seed

Koala lablab is registered under Plant Breeders Rights (PBR). Mt Tyson Seeds holds the commercialisation rights. Planting seed can be obtained by contacting Mt Tyson Seeds at Mt Tyson, Queensland.

Inoculation

Seed must be inoculated with Group J inoculant to ensure good nodulation of lablab plants and good nitrogen fixation.

Nutrition

The main nutrients required by lablab are phosphorus and zinc. Lablab can utilise high VAM situations to help access phosphorus and zinc.

Phosphorus

Lablab requires adequate phosphorus to be applied with the seed. Soils with low to medium levels of phosphate require 10–15 kg phosphorus/ha. On highly fertile self-mulching clay soils and alluvial soils high in phosphorus, no phosphorus fertiliser is required.

Zinc

Zinc deficiency can occur on alkaline soils with high phosphorus levels. Symptoms of zinc deficiency are stunting of plants and yellowing between the veins of the leaves. Zinc deficiency can be remedied by a soil application of zinc or by one or two foliar sprays of 1 per cent zinc

sulfate heptahydrate, the first when plants are less than 15 cm high.

Weed control

A high standard of weed control is essential if you want to obtain high-yielding lablab. Broadleaf weeds, in particular, should be controlled in the years before you grow lablab. There is only a limited range of herbicides available for use in lablab. Consult the latest edition of NSW Agriculture's guide *Weed Control in Summer Crops* for further information. If you expect a broadleaf weed problem, use wider row spacings and inter-row cultivation.

If you have used sulfonylurea herbicides in previous cereal crops, make sure that you stick strictly to plant-back periods when you plant the lablab.

Lablab is also highly sensitive to the phenoxy herbicides such as 2,4-D, MCPA, dicamba and 2,4-DB, and any drift can result in severe damage to crops.

Diseases

Lablab is relatively free of diseases such as root rots and foliar diseases. Sclerotinia stem rot (*Sclerotinia sclerotiorum*) has been recorded under wet and humid conditions. Ascochyta leaf spot (*Ascochyta phaseolarum*) has also been recorded but is not normally serious. Charcoal rot can affect crops under dry conditions but is usually not serious.

Insect pests

Lablab crops can be damaged by cutworms and wireworms during establishment. The black cowpea aphid can also affect lablab but is not generally a problem.

Heliothis is a major pest of lablab when the crop is flowering and podding. Egg laying usually coincides with the start of flowering, and crops should be monitored from that stage through podding.

The indeterminate growth habit of lablab in many situations will mean that the crop may need protection over a period of up to 6 to 8 weeks. Crops may require one or two sprays for heliothis control. Spray when the numbers of larvae exceed two per square metre.

Green vegetable bug and brown bean bug can also attack lablab during the pod filling stage, and the crop should be sprayed when numbers exceed one per square metre.

Mirids may need controlling during flowering and pod fill where numbers exceed two or three per square metre.

Thrips also need to be monitored in budding and flowering crops, but lablab is not as sensitive to damage as cowpeas and mungbeans.

Lablab is usually planted on wider row spacings, up to 1 m.

J HOLLAND

Dual-purpose

Koala lablab can be used as a dual-purpose crop suitable for either grain production or grazing. It will usually produce around 70 per cent of the dry matter forage of the longer season variety Highworth.

Koala lablab is normally grown as a grain crop. However, failed grain crops provide excellent grazing for stock. After harvest, regrowth can provide very useful grazing for fattening stock. Feed value is generally equivalent to that of lucerne, with crude protein levels around 18 per cent and digestible dry matter levels of about 60 per cent.

Lablab will continue to grow into the autumn (much more than cowpeas) until halted by frost or lack of soil moisture.

When sown early (mid October to November), Koala can be grazed lightly and then closed up for grain recovery in early February, if seasonal conditions permit. Do not graze the crop too hard, and leave the basic plant frame intact for maximum recovery. Grain yields from dual-purpose crops are extremely variable.

Irrigation

Koala lablab has a limited role as a fully irrigated crop. It is not as profitable as other fully irrigated crops such as soybean, as it tends to lodge when very favourable moisture conditions produce excess vegetative growth and high yield potential. The crop is much better adapted to a supplementary irrigation regime in which one or

two strategic irrigations are applied. Yield potential under these conditions is 2.5 to 3.0 t/ha.

Harvest

Koala has an upright growth habit, reaching a height of between 0.4 and 1 m at maturity. The pods are borne above the top of the canopy, resulting in few problems at harvest. Pods thresh easily and shattering is not usually a problem.

Lodging is seldom a problem, except when the crop has made excessive vegetative growth and has high yield potential, such as under irrigation.

Koala lablab generally has good weathering tolerance, but the crop should be harvested as soon as possible after the beans mature to avoid weather exposure and to minimise cracking and damage to the seed. Grain should be harvested at 12 to 14 per cent moisture content.

Koala lablab will continue to flower and pod into autumn until lack of moisture or heavy frosts dry the crop out. In many cases desiccation will allow the crop to ripen more evenly and to be harvested earlier, thus minimising its exposure to weather damage. High water volumes are essential for consistent results with desiccants.

Desiccated crops usually give a much cleaner sample of beans, with less staining and trash. The timing of desiccation is critical, and crops should be sprayed when seeds are mature, firm and beginning to change colour. A good guide is when the membrane around the majority of seeds peels away cleanly, leaving little moisture.

Headers should be adjusted to minimise cracking when harvesting Koala lablab because of its larger seed size. Rotary drum headers are preferred for harvesting, and drum speed should be set at no more than 200 to 300 rpm.

Koala lablab pods

L HUEKE

Grain moisture content

When beans are held in long-term storage they should have a moisture content of less than 12 per cent.

If lablab is being transported directly from the paddock to the grading shed, receivals will be accepted up to 14 per cent moisture content with prior arrangement.

Beans above 13 per cent moisture that are being held on-farm should either be dried down to the required moisture or put into aerated storages.

Yields

Koala lablab has a yield potential in excess of 2.5 t/ha when grown under favourable conditions. Commercial dryland yields have ranged from 0.5 to 2 t/ha. In more favourable seasons Koala lablab has yielded up to 25 per cent higher than mungbean. In below-average seasons where yields are less than 1 t/ha, the yield of Koala lablab is usually no better than that of mungbean, and is occasionally lower.

Grain volume weight is usually in the range of 80 to 85 kg/hectolitre.

Markets

Market research indicates that there is a demand for Koala lablab in the Indian subcontinent and Indian communities throughout the world, as well as in Asia. The beans can be sprouted, used whole, or split into dhal. They can be used as a substitute for traditional chickpeas in dhal.

The appearance of the bean is extremely important. Koala lablab is normally traded as a whole bean for human consumption. Grain discolouration by staining or weather damage could significantly reduce grower returns. Discolouration of the white seed coat with dirt should be carefully monitored during harvest. This problem appears to be worse when harvest occurs after rain, or when the crop is being harvested too soon after a heavy morning dew. Staining of the bean can also occur if the crop has not been desiccated and there is green material present at harvest.

Although pods can look badly weather damaged, the beans inside are usually unaffected, provided that insects such as heliothis have been controlled.

Occasionally grain samples of Koala lablab have been found to have a small percentage of split seed coats before harvest. In the 1991–92 and 1992–93 seasons, split seed percentages ranged from 0 to 3 per cent. However, in 1993–94 the range was generally 0 to 15 per cent, with one sample as high as 27 per cent. The damage ranges from a small tear in the seed coat to a split that traverses the whole seed. There is usually a brown discolouration of the seed coat adjacent to the split. The cause of this is not clear, but it is thought to be related to early moisture stress followed by critical rainfall periods during pod fill.

The effect of this splitting on the marketability of the crop is uncertain. However, traders believe it should not affect the quality of dhal produced from such a sample, as the seed coat is removed during processing.

In common with many pulse crops, lablab contains toxic principles such as lectin in the seed. Traditional cooking in Indian cuisine removes these, but take care if you are considering feeding the unprocessed grain to livestock. It may suppress appetite, cause scouring and reduce growth unless it is heat-treated.

Receival standards

Receival standards are generally based on a tolerance of a maximum of 5 per cent defective beans (weather damaged, stained, insect damaged, split or broken) and the sample having a good, bright, creamy appearance. If the rate of occurrence of defective beans exceeds 5 per cent, then dockages may apply as per the guidelines used in the chickpea industry.

Lablab is usually sold graded and bagged (dressed). Grading losses are usually around 5 to 10 per cent, but could be as high as 15 to 20 per cent in weather-damaged crops.

Grain protein

The grain protein content of Koala lablab grown over five sites in 1992–93 varied from 19.6 to 28.3 per cent (dry grain basis) and averaged 24 per cent.

PIGEON PEA

Pigeon pea is a short-lived summer-growing perennial pulse crop that is grown widely throughout the tropics and subtropical regions. In Australia, it is grown as an annual crop. In NSW pigeon peas are suited to areas of the northern slopes and plains where grain sorghum is grown. The grain is used for human consumption and is prized by people in India, Africa and southeast Asia. In India, the largest consumer, it is usually eaten as dhal, or split-pea. Currently the pigeon pea industry in Australia is small. Extensive market research and development needs to be undertaken for what appears to be basically an export commodity.

Currently the use of the crop is expanding as a heliothis trap crop in cotton production.

Varieties

The University of Queensland has released the grain-type pigeon pea varieties Hunt, Quantum and Quest. These cultivars do not respond to day length and flower 60 to 80 days after emergence.

The variety **Hunt** grows to 1 m high and flowers in 65 to 80 days.

Quantum matures marginally faster than Hunt and yields 18 per cent higher than Hunt in northern NSW.

Quest is the latest release and is the main variety recommended at the present time. It has similar maturity to Quantum (flowers in 65 to 80 days after emergence) but has larger, light-coloured seeds, which are more acceptable in the market place. Maturity occurs approximately 50 to 75 days after flowering.

Pigeon pea outcrosses when two or more varieties are grown in close proximity. Although the factors responsible are not well understood, it is suggested that to maintain pure seed, seed crops of different varieties should be separated by at least 3 km and preferably by 5 km.

Climate

Pigeon pea has a reputation for drought resistance. Although the plant can survive in very dry conditions, experience indicates that seed yield is minimal under these conditions.

Flowering is delayed under periods of extreme moisture stress. However, rainfall to alleviate such a stress will stimulate further flowering.

The principles of summer crop agronomy developed for sunflowers and sorghum are relevant to pigeon pea production. On the north-west plains, 0.75 to 1.0 m of wet soil is a prerequisite for planting.

Pigeon peas are sensitive to frost, which will defoliate the plant.

Soils

The crop can be grown on a wide range of soil types from lighter loams to the clay soils of the plains. Good surface and internal drainage is essential, as short periods of waterlogging will kill the plant, especially in the younger stages.

Because of the susceptibility of the crop to waterlogging, furrow irrigation during growth is not currently recommended, except in very well drained situations A furrow irrigation program would normally involve pre-irrigating and planting into a full profile of soil moisture.

Spray irrigation on well drained soils is feasible.

Planting times

The limitation to early planting appears to be a requirement for a minimum soil temperature of 18ºC at sowing depth at 9 a.m. ESST. Pigeon pea characteristically grows slowly and competes poorly with weeds, and low soil temperatures will lengthen the establishment phase.

The recommended planting time is from late November to early January. December is considered the best month to plant in normal seasons. This is especially the case on the slopes, where crops could be frosted before maturity if planted in January. As a guide, the crop takes about 65 to 80 days to flower and a further 50 to 75 days for the pods to mature.

Plant populations and row spacings

Under dryland conditions in north-west NSW, populations of 100 000 to 200 000 established plants/ha are preferred. The higher population would be desirable in better rainfall areas and with at least 1 m of subsoil moisture. In drier areas, and with less than 1 m of stored moisture, the desired plant population is lower. Seed size of well filled seed of the variety Quest is about 12 to 15 g/100 seeds, although seed grown under harsh conditions may be lighter.

Wide row spacings of 70 cm to 1 m are suitable for this crop under dryland conditions, enabling inter-row cultivation when necessary. However, under irrigation, at least 300 000 plants/ha should be established in rows less than 40 cm apart. Growers have described pigeon peas as easier to establish than sunflowers. Sowing depths of up to 5 cm have proven satisfactory. The use of press wheels with light pressure has improved emergence.

Inoculum

Pigeon peas require inoculation with the Group J inoculant. Nodules can be difficult to find in high nitrogen soils, but the plant should nodulate quite freely in low nitrogen soils. Nodulation can be erratic on alkaline black clay soils.

Fertiliser

On phosphorus-deficient soils, apply phosphate fertiliser at the rates recommended for sunflowers.

Zinc deficiency may occur on alkaline clay soils. Application of foliar zinc in this situation will result in a quick response. Soil applications can overcome zinc deficiency for 5 years and longer.

Pigeon pea hosts VAM fungi, allowing the crop to gain access to phosphorus and zinc in the soil and fertiliser.

Weed control

As mentioned previously, pigeon pea grows slowly as a seedling, and as such is a poor competitor with weeds.

There are a number of herbicides available for grass and broadleaf weed control. Refer to NSW Agriculture's *Weed Control in Summer Crops*. Inter-row cultivation can be used successfully when the crop is sown in wide rows.

Insects

Heliothis is the major pest of pigeon pea, and can completely devastate a crop if not correctly managed. Regular crop checking should begin as soon as the first flowers appear. Checking should be carried out two or three times a week during flowering. Eggs are laid in and around flowers, so you should time the spraying to control the hatching larvae.

A well grown crop of dryland pigeon pea (2 t/ha), grown on undulating black soil near Tamworth, NSW

J HOLLAND

The importance of adequate checking and insect control cannot be overstated for two reasons:

- The crop is attractive to heliothis, which can substantially decrease yields.
- The strategy to overcome the insecticide resistance problem in the summer-cropping belt of northern NSW depends on the astute and responsible use of the insecticides now available. Compliance with the strategy restrictions on the use of pyrethroids and the proper timing of applications of other chemicals is essential to maintain the efficacy of these compounds.

Other insect pests that can cause problems are cutworms at the establishment stage and grass blue butterfly during the vegetative stage (first 4 weeks), particularly when crops are moisture stressed. Thrips, mirids, green vegetable bug and pod sucking bug can also damage crops during flowering and podding.

Pigeon pea is resistant to root lesion nematode, and aids the build-up of beneficial VAM fungi in the soil.

Harvesting

The perennial nature of pigeon pea results in green leaves and often flowers being present on the plant when the older pods have matured and dried. Frosts will cause leaf drop and make harvesting easier. Grading may be required to remove residual green leaf material. Crops planted in December to January will generally be ready for harvest in May–June.

Crops can be desiccated with defoliants, which will reduce the amount of green material that has to pass through the header. Crops will be ready for harvest some 10 to 12 days after application.

The flowering and configuration of the plant mean that seed is well presented for harvest. Conventional open-front headers will successfully harvest the crop, although (as with most grain legumes) rotary harvesters are preferred.

Slow drum speeds of 350 to 400 rpm are required to minimise seed cracking. The use of low-speed bat reels appears to cause less shattering, as the crop is swept back from the cutter bar. Separator sieve and wind settings should be similar to those used for soybean harvesting.

L HEUKE

Pigeon pea in flower

Mature pods are quite tolerant of weather damage.

Yields

Yields of up to 3 t/ha have been recorded under very favourable seasonal conditions. Yields under normal conditions should be between about 0.5 and 2 t/ha.

Marketing

India is the main destination for pigeon peas, although smaller markets exist where Indians have settled in other countries. Seed is usually sold as the dry split pea (dhal) for human consumption. The marketing of pigeon pea will probably follow the pattern set by the chickpea industry, which has an entirely free market. Some growers choose to grow at least part of their crops under contract, whereas others wait until harvest to find an outlet for their product. Minimum export standards for machine-dressed pigeon peas are given in Table 2.

Pigeon peas contain tannin and trypsin inhibitors in the seed. Heat treatment by cooking removes the trypsins, but you should take care if you intend to feed unprocessed pigeon peas to livestock. Pigeon pea protein levels are usually around 20 per cent.

Table 2. Minimum export standard for machine-dressed pigeon peas
Physical characteristics
The pigeon peas shall be sound, dry, fresh and light to medium brown in colour. A greenish tinge is allowable.
Nil acceptance
The pigeon peas shall be free from animal excreta, rodents, live insects pests and any chemical not registered for use on stored pigeon peas or in excess of legal tolerances. There shall be nil tolerances on pickling compounds/seed dressings or any fungicide added to the pulse as a seed dressing and any tainting agents and or other contaminants imparting an odour not normally associated with pigeon peas, including caked, bin burnt and/or mouldy pigeon peas which are a result of product storage.
There shall be nil acceptance on Toxic and Noxious weed seeds prohibited by State laws against inclusion in stockfeeds.
Purity
The sample shall contain a minimum of 99% by weight of pigeon pea seed material. The sample will contain not more than 2% by weight of defective pigeon peas and not more than 1% poor colour pigeon peas.
The foreign material shall not exceed 2% by weight, of which no more than 1% shall be unmillable material.
Moisture: 13% maximum.
Foreign seeds: See NACMA Commodity Standards Manual, Appendix 1
Definitions
Pigeon Pea Seed Material: made up of whole pigeon peas, defective pigeon peas, seed coats
Foreign Material: includes unmillable material and all vegetable matter other than pigeon pea seed material.
Defective Peas: include pigeon peas not of the specified type and pigeon peas that are broken, damaged and split, grub eaten, sprouted, affected by field mould.
Unmillable Material: includes soil, stones, metals and non-vegetable matter.
Poor Colour Peas: pigeon peas whose seed coat or cotyledons are distinctly off colour from the characteristic colour of the predominating class.

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