Crop investigation into Grain / Legume crops suitable for incorporation into a Cane Rotation

ISIS CANE SUPPLY AREA

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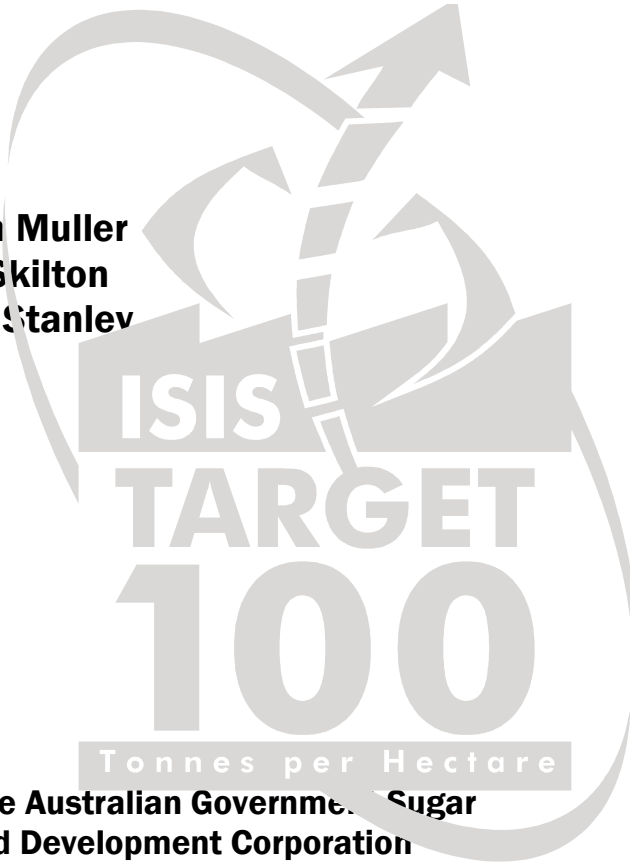


Australian Government
Sugar Research and Development Corporation

Funded by the Australian Government Sugar Research and Development Corporation

INTRODUCTION

Funding was obtained from the Australian Government Sugar Research and Development Corporation (SRDC) to undertake a feasibility study into opportunities for grain and legume crop industries in the coastal sugar cane cropping regime of the Isis Cane Supply Area.

The purpose of the study was to undertake a literature review of potential crops that could be produced as part of a cane rotation in the Isis Area. The importance of this study was that it was a cost effective solution to assessing potential break crops, without incurring the expense of numerous field trials, in addition to presenting an opportunity to explore a number of novel crops that may not have previously been considered for production by growers.

The study was instigated as a result of the current downturn of the Queensland Sugar industry and the identified need to implement an additional, low risk income stream for growers, in addition to adopting some of the findings of the Sugar Yield Decline Joint Venture, particularly the benefits of a grain legume rotational crop.

One of the primary difficulties encountered by growers in developing grain/legume crops beyond a break crop, are the number of challenges including marketing, agronomics and logistics. What this study was designed to do, is to minimise the risk to growers in venturing into break crops by identifying opportunities and threats of these various crops.

The other objective that resulted in the development of this project was the concern that growers may become too reliant on the one crop. Soybeans have been produced in the Isis Cane Supply Area for the past two seasons with significant success, but the danger of relying too heavily on the one crop is evident, and there is a direct need to explore alternative, beneficial crops available for production in the Isis area.

The key attachment to this desktop study is the overview of alternative crop field trials in the Isis Region 2004 - 2006. This information is complementary to this report and provides it with a practical context. In addition, as a product of both reports, presentations have been provided to growers as an important component of the Isis Target 100 and Maryborough productivity initiatives. These presentations are also attached for the reference of SRDC and other interested parties.

THE STUDY

A literature review was undertaken to examine the prospects of a host of various legume, grain and other crops, to be grown in rotation with a cane crop in the Isis Cane Supply Area.

First, a number of crops were identified from various sources, including consultation with industry bodies and literature searches. From these identified crops, information was obtained in relation to particular attributes of these crops with respect to their growing conditions, field requirements, pest and diseases resilience/impact and marketability. This data was compiled in order to assess the suitability of the crop based on a number of selection criteria, including:

- Climatic suitability of the crop to be grown in the Isis Cane Supply Area
- Opportunity for crop to be integrated into a cane rotation (seasonality suitability)
- Potential benefits crop delivers for subsequent cane crop
- Market prospects of crop in regards to delivering a financial return

Each individual crop was examined to compile together a detailed list of the growing requirements and market prospects of that crop. This information was used as a guide to conclude the suitability of the particular crop for production in the Isis Supply Area. The crops as presented in this study were assessed as follows:

✓ Indicates given current understanding, the crop is suitable for production in the Isis Cane Supply Area.

✗ Indicates given current understanding, the crop is inappropriate for production in the Isis Cane Supply Area.

Indicates that literature review suggests the crop may be suitable, but further investigation of field trials or the exploration of other elements of the crop needs to occur to ensure the appropriateness of the crop for the Isis Cane Supply Area.

The following study presents the available information for the individual crops investigated. This information is presented in a manner to indicate the recommendation of the study for the individual crop, followed by the investigation. As is evident, there are a number of crops that are listed as requiring further investigation, this does not suggest the inadequacy of this study, rather the importance of the development of on ground field trials.

SUMMARY OF RECOMMENDATIONS

The results of this study have indicated that there are a number of potential and likely crops that can be used to be investigated for use as a rotational crop within a cane cropping regime in the Isis Cane Supply Area. The study also confirmed the previous knowledge of the industry as to which crops are and are not suitable for production in the area.

From this point, it is important to develop and evaluate the crops that have been identified as being potentially able to be produced in the area, and also those crops that require further investigation. One of the biggest issues identified in this study was the importance of securing a market and solid financial return for the crops investigated. Regardless of the climatic suitability, nutritional benefits achieved through rotation or opportunity for the crop to be integrated into a cane rotation, the ultimate decision for growers in the selection of a break crop, is adequate financial return given the current price path of sugar.

Another specific item that was identified in this study that should be given due consideration is the handling and storage of rotational crops. Given volatile markets and market supply, most crops required on-farm storage facilities to ensure the best dollar return available for growers. At this stage, the concept of on farm storage is not practical, however, at a district level, there is potential.

The results of this study should give conclusive evidence that the current sugar industry does not have to be reliant on the one break crop, rather that there are many opportunities available at the present and many with considerable potential. These cropping options offer growers the chance to achieve substantial dollar returns, whilst still retaining their identity as a cane grower. The benefits of these crops in rotation with the cane cycle also promise to deliver many benefits to subsequent cane crops. This system suggests that the integration of a break crop within the cane cycle should become a standard practice amongst all growers in the Isis Cane Supply Area.

CROP SUITABILITY FOR THE ISIS DISTRICT

Study Crop	***Study Assessment***		
Adzuki Bean	✓		
Barley			✕
Canary			✕
Canola			✕
Chickpea		▲	
Cotton			✕
Cowpea		▲	
Faba Bean			✕
Fenugreek			✕
Field Peas		▲	
Guar		▲	
Industrial Hemp			✕
Kenaf		▲	
LabLab – Grain		▲	
Lentils			✕
Lima Beans		▲	
Linola, Linseed and Flax			✕
Lupins			✕
Maize (inc. Popcorn)		▲	
Millet and Panicum			✕
Mungbean (including Blackgram)	✓		
Navy Bean	✓		
Oats			✕
Peanuts	✓		
Pigeon Pea		▲	
Safflower		▲	
Sesame		▲	
Sorghum – Grain		▲	
Soybean	✓		
Sunflower		▲	
Triticale			✕
Vetch		▲	
Wheat			✕

CROP CONTENTS

Study Crop:

ADZUKI BEAN

Recommendation: ✓

While acknowledging that a trial of adzuki beans was undertaken in the Isis Cane Supply Area in 2004/05 and produced unfavourable results, the significant potential for the further development of this crop in Australia, have warranted it to be identified as being a possible break crop for the Isis cane industry.

The outcomes of the previous trials with this crop indicated that insect management and control was the significant factor in the success of this trial. Taking this knowledge into consideration, the potential marketing opportunity, gross margins, nutritional benefits and production timeline make adzuki bean an idealistic crop for rotation with cane in the Isis Cane Supply area as it delivers triple bottom line benefits. Although necessary investigation will need to be undertaken with respect to insect management and quality control.

Description:

Adzuki bean are a summer grain legume, highly sought after in eastern Asia. Adzuki bean have the potential to develop into a profitable cropping option for growers who are prepared to employ stringent crop management practices required to deliver high yields, and in particular, high quality. Export is the principle market for the adzuki bean, particularly as the Australian crop has an advantage over northern hemisphere products in terms of seasonality, as freshness is a considerable quality factor.

Uses:

The red seed coat of the bean is significant as red is linked to many cultural festive occasions (although other colours of adzuki bean are available). The most common use of the processed dry seed is as a highly sweetened bean paste, which is prepared in numerous ways with different flavours and textures in sweet soups and desserts.

Market:

While Australian adzuki beans are highly regarded in Japan, the market can be extremely volatile as there are strict import quotas and supplier restrictions. The major price determinant for good quality adzuki bean is the success of the Japanese crop, which is harvested in September/October. As Australia plants after the Japanese harvest, this gives a good price indication for the upcoming season.

Grower considering planting significant areas are advised to talk to potential buyers prior to planting to seek minimum price contracts to reduce the risk of price fluctuations. Potential growers also need to be aware of the lack of markets for second grade adzuki bean, particularly in low price years.

Several Japanese and Australian companies are interested in processing adzuki bean into paste in Australia with some small scale trials already completed. The establishment of a paste manufacturing plant will stabilise prices, as the price will not be related so closely to import quotas into Japan, as adzuki paste is currently exempt from the import quotas.

Soil Requirements:

Adzuki bean are best grown on light, deep, well drained soils. Heavy clay soils should be avoided, particularly where waterlogging may occur.

Varieties:

Erimo is the principle variety grown in Australia and has the greatest market potential. A small, niche market exists for the larger Dainagon type, but growers should ensure they have a market for this variety before planting.

Row Spacing:

Row spacing should be between 60 to 75 cm with 75 cm the maximum as row closure is needed and narrower plant spacings should be avoided to reduce susceptibility to sclerontinia.

Seeding Rates:

Erimo should be planted at 50 kg/ha as seed size ranges between 7000 to 9000 seeds/kg.

Planting Depth:

Adzuki bean seeds should be planted to a depth of about 30 – 50 mm into moisture and will emerge in around five to seven days. It is less risky to plant the seeds into moisture than to plant dry and water up.

Inoculation:

Adzuki bean should be inoculated with a Group I cowpea inoculant.

Fertiliser Requirements:

Adzuki bean plants should be dug up 14 days after emergence to check for nodulation, if there are no nodules, nitrogen should be applied. Soils should be monitored for deficiencies, and appropriate action taken, particularly in relation to soils deficient in phosphorus, potassium, magnesium, sulphur, zinc, molybdenum and iron.

All fertiliser application and rates should be sought through an agronomist, and soil testing prior to planting will give the most accurate guide to fertiliser application rates and need.

Irrigation:

In order to achieve a high yield and good quality seed, good irrigation management is extremely critical. The crop needs to be treated like a horticultural crop and will require at least two watering at about 2 mL/ha at pre-flower and pod fill. Adzuki bean water usage is about half to two-thirds that of navy beans.

Weed Control:

As adzuki bean are slow growing in the first few weeks, sound weed control practices are vital to reduce competition and to ensure a clean harvest free of both contamination and staining. There are a number of registered herbicides that control most grasses and broadleaf weeds in adzuki crops and growers should consult their agronomist for advice regarding weed management.

Diseases:

Sclerotinia may potentially be a problem, but can be managed by planting in wider rows, avoiding the crop ripening in autumn and not trying to grow a huge, lush bush. Isolated instances of powdery mildew and a condition known as 'gummy pod' (sticky exudates from ripening pods) have been reported. However, 'gummy pod' is thought to be a symptom of hot conditions during flowering and can be overcome by planting at the correct time.

Insects:

Insect pest control is essential to maintain high quality in adzuki bean grain as well as to protect yield. Adzuki bean are more attractive to heliothis than most other summer grain legumes, and crops will need to be monitored regularly. Growers should budget for at least two insecticide applications.

Harvest:

Provided good crop management practices have been followed and the weather has not been too rough, adzuki bean crops should be ready to harvest about 90 days from planting and should mature evenly, with leaves yellowing, dropping and pods drying down. However, defoliation may be required. The quality of the adzuki bean is very important, so it is vital to avoid unnecessary mechanical damage such as splitting and cracking of the grain and seed contamination with volunteers.

Potential Yields:

Adzuki bean yields range from between 1.5 to 3.0 t/ha.

Price Indication:

The price range for adzuki beans can fluctuate between an average of $750 to $1,500.

Study Crop:

BARLEY

Recommendation: ✗

While barley has the potential to deliver some favourable returns for growers, its timing of production is not coherent for it to be grown in rotation with a cane crop in the Isis Supply Area. The required area of production and equipment also make in an unsuitable crop for rotational purposes.

Uses:

Barley has three key end users:

Feed Grain	· Barley is the preferred grain for most feedlots and stockfeed manufacturers. The majority of the Queensland crop is classified as feed and used by the intensive livestock industry, namely beef, pigs, dairy and poultry. Most buyers use the NACMA standards for the purchase of the crop, with some applying bonuses or discounts for grain size, hectolitre weight and protein. A significant amount of feed barley is also exported.
Malt Barley	· Malt Barley is used for the production of beer and other foodstuffs, with approximately 25% of the Queensland barley crop of malting standard. Malting barley attracts a premium price, but has very specific requirements for variety, germination, protein, hectolitre weights and grain size. The Queensland domestic malting industry has a requirement for approximately 50,000 million tonne of malting barley and an export market needs to be accessed for the premium to remain once this tonnage is reached.
Forage – for grazing, hay or silage	· Barley makes high quality silage, which is a preferred winter grazing crop for many producers. Local feedlots and milk producers often pay good prices for barley silage. Vigorous early growth also makes it a popular grazing crop. Barley produces more straw than wheat, and as such is a valuable commodity for producers as it can be baled and sold to feedlots/abattoirs.

Market:

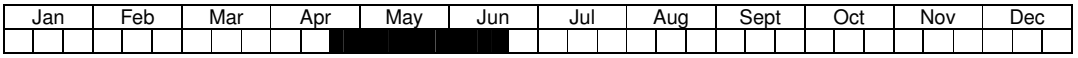
Barley is the second most widely grown crop in Australia, behind wheat, yet Australian production of barley only occupies 3% of the world market. Although Australian malting barley trade accounts for 30% of the world malting barley trade, with our major competitors being Canada and the European Union. The deregulation of the domestic barley market in Queensland has led to a wide range of marketing options for growers, one option for feed barley growers is direct contracting grain to feedlots or other end users.

Varieties:

Malting Varieties Only varieties accredited for malting can be sold onto the malt market.	
Grimmett	· Called the 'workhorse' of the Queensland and Northern New South Wales malting industry · Slightly quicker maturity than Tallon · Excellent grain size and moderate level of disease resistance · Grimmett is a popular choice in more marginal areas · Accepted by both domestic maltsters and suitable for export
Tallon	· Considered to be the standard variety for Southern Queensland · Tallon combines high yield with moderate levels of disease protection, this results in a high reliable high performing variety · Popular choice through most of Queensland and is an excellent choice for silage or grain · Is accepted by one domestic maltster and has had limited exposure to export markets
Lindwall (PBR)	· Medium to slow maturing variety · Has high yield potential in favourable growing conditions · Has been prone to powdery mildew infection · High quality malting variety, sought after by one maltster – but still gaining acceptance on export market, which is dependent on a consistent and reliable supply. · PBR variety marketed by Grainco Australia Seeds.
Gairdner (PBR)	· High yielding variety released from WA – performance has been good in northern regions, but grain size can be affected in a hot or dry finish · Showed higher than expected infection of powdery mildew · Preferred for higher rainfall areas as a dry finish can result in high levels of small grain which will not make malt standards · Has an established export market · Some acceptance in local domestic malt industry for evaluation · Segregation may be a problem for malt quality · PBR variety marketed by SGB
Feed Grain Varieties Malt accredited varieties can also be sold into the feed market	
Kaputar	· Quick maturing variety with short stature and usually stands well · Severe lodging associated with brittle straw has been observed in some very high yielding crops · Performs well in all areas – Outstanding in Central Queensland – good choice for late planting in most areas
Gilbert	· Slower maturing variety with high yield potential · Not suited to late planting · Less likely to lodge than Tallon, but very susceptible to net blotch
CK85 (PBR)	· New high yielding, medium maturity variety suited to all growing areas. · Large plump grain and equal or better disease resistance than Tallon with significantly higher yields · Sure to set new standards for the Queensland Barley crop · PBR to Grainco Australia Seeds
Binalong (PBR)	· Short compact variety of medium slow maturity with excellent yield potential and stand ability · Outclasses current varieties

	▪ Cross between Skiff, Blenheim and O'Connor ▪ Combines yield with good levels of disease resistance for most major foliar diseases
Skiff	▪ Medium maturity semi-dwarf variety with large grain size and good resistance to lodging
Corvette	▪ Quick maturing variety with good yield and large, blue aleurone grain ▪ Poor lodging resistance
Dash (PBR)	▪ Medium slow maturing variety ▪ High yield potential and excellent straw strength ▪ Very erect growth habit ▪ Good levels of disease resistance ▪ Good variety to chase yield on an early plant
Schooner	▪ Considered a standard in many parts of the malting industry ▪ Not suitable for production in Queensland as is highly susceptible to sprouting in the head.
Grazing Varieties Grazing barley is popular as it provides good quality feed early in the season. Most varieties can be grazed, but a few varieties have been selected specifically for grazing	
Malebo	▪ 6 row barley ▪ soft, leafy early growth
Dictator (PBR)	▪ hooded (awnless) variety with black grain ▪ quick early growth

Planting Time:



The planting time for barley is very versatile. Early plantings will generally produce higher yields, larger grain size and lower protein levels which is more likely to achieve malt quality. Early crops are also more likely to get frosted and growers need to assess the frost risk, although barley can tolerate a 1% lower frost than wheat. Late plantings will often mature into hot, dry weather that can reduce grain size, yield and malting quality.

Row Spacing:

Rows wider than 36 cms have caused minor yield reduction and are also predisposed to lodging.

Seeding Rates:

Barley can produce a large number of tillers and the best yields and the best yields are achieved with an established plant stand of 800,000 to 1,000,000 plants/ha. Barley can tolerate high plant populations without significant yield reduction, but if the plant population falls below 80 plants/metre square, yield can be reduced. Lower plant populations can also encourage late tillering, which results in a less even crop and delays harvest. Late tillers often have smaller seed, which also affects the quality of the crop.

Planting Depth:

Barley should ideally be planted at a depth of between 50 – 75 mm. Plant emergence may be reduced if seed is sown deeper than 75 mm. Seed should be planted into moisture at the minimum depth possible. For successful establishment, the root must continue to grow into wet soil. Press wheels can improve the contact between seed and wet soil and reduce the rate of drying of soil above the seed. Particular care should be taken with planting depth if using seed with fungicidal dressing. Some seed treatments may shorten the coleoptile length and make establishment from depth more difficult.

Nutrition:

Nitrogen	· Management of nitrogen availability is vital to achieve optimal yields and quality · The level of nitrogen available will impact strongly on both yield and protein, which have a significant impact on crop return. · A large percentage of Queensland's barley crop is classified as feed as protein levels are above 12% · Soils are generally still relatively fertile and nitrogen is not limiting · Older cultivation or double crop situations can produce malting grade barley – especially in a good season – however, skill is required to balance the requirement for nitrogen to maximise yield without over fertilising and increasing the protein level. · Rule of thumb used by some in growing malting barley is 0.4kg of nitrogen is required for every mm of available soil moisture.
Phosphorus	· Phosphorus deficiency is widespread with over 60% of soils being responsive to phosphorus fertilisers · Low phosphorus levels in a high nitrogen situation can result in delayed flowering which affects the yield potential and grain filling time of the crop · For optimum performance – it is recommended to use a starter fertiliser with phosphorus unless levels are very high.
Other Nutrients	· Zinc deficiency has occurred on some of the alkaline brigalow soils and some of the heavy, alkaline flooded clay soils along rivers systems. · As zinc plays an important role in the efficient uptake of Nitrogen for protein, its significance should not be ignored and any suspected deficiencies should be addressed. · Zinc deficiency can be corrected by applying a zinc fertiliser with the seed at planting – or incorporating zinc sulphate monohydrate into the soil 2-3 months prior to planting. Zinc seed treatments are also available · Copper deficiency has occurred in some areas. · Sulphur can be a problem in areas with a long history of cultivation · If sulphur deficiency is suspected, use a test strip to indicate potential response · This is more likely to occur after short fallow or double crop situations, where soil sulphur levels have been depleted by the previous crop.

Irrigation:

Barley has a high water use efficiency rating and can extract moisture from below 0.8 metres, and given a good starting moisture profile, high yielding crops can be grown on limited irrigation. Requirements for water will depend on winter rainfall and irrigation systems, but one of the crucial times to apply water for achieving malt quality is grain fill. Adequate moisture during tillering and early jointing is important for maximising potential yield.

Weed Control:

Barley is a vigorous early growing plant, which tillers profusely. This means that it quickly gains a high leaf area and has a much higher weed smothering ability. Barley growers generally find they can get better weed control with less chemical use. Effective weed control is vital for ensuring good water use efficiency, maximising crop yields and meeting quality standards at harvest. Crop weeds can be managed most effectively by integrating chemical and non-chemical control.

Diseases:

Leaf Rust & Stem Rust	· Traditionally the major air-borne diseases of barley in Queensland and is more likely to occur in wetter years or higher rainfall areas · Both can cause significant yield loss and quality downgrading · Grain yield can be reduced by up to 50% by stem rust and around 30% by leaf rust. · Best protection is to plant resistant varieties and avoid planting very early or very late in the season. · Timely application of fungicides can also be effective
Net Blotch	· The most significant disease of barley and is likely to be a problem in wetter years and in stubble retained situations, as the pathogen may be seed borne. · Occurs in two forms – net form of net blotch and spot form of net blotch · Net form produces dark brown to black strips on leaves and leaf sheaths of older plants & gives a characteristic netting pattern in juvenile leaves · Spot form produces dark brown, round to elliptical spots on leaves and leaf sheaths that are often surrounded by yellowing · High levels of either disease will kill leaves prematurely which may cause yield losses in excess of 30% · Growers are advised to avoid planting barley on barley where stubble is retained, as stubble borne spores are the main source of infection for the new crop
Spot Blotch	· Favoured by warm wet conditions & is promoted by stubble retention · Can be seed borne · Leaf symptoms are almost identical to the spot form of net blotch, yet spot blotch may also cause discolouration of grains · The disease is more likely to be a problem in sub-coastal areas – popular varieties are susceptible.

Powdery mildew	· Often present in susceptible varieties, but generally causes only relatively small yield loss · Some seed treatments can give good early season control of powdery mildew – but these may shorten coleoptile length and cause emergence problems · Resistant varieties are the best means of control · Some plants with moderate levels of resistance appear to be susceptible at the seedling stage, but display adult plant resistance.
Crown Rot	· Common in winter cereals · Soil borne and can be carried over from one season to the next on barley stubble · Yield losses of as much as 28% have been recorded · Rotation with chickpeas or summer crops is currently the best method of control as there are no resistant varieties
Common Root Rot	· Soil borne · Wide spread in barley crops and can cause yield loss of up to 15% · No variety resistance, so rotational cropping is best method of control
Covered smut	· Seed borne with a life cycle similar to bunt of wheat · Can be easily controlled with seed dressing and seed should be treated for smut every year · Grain contaminated with covered smut is not accepted by end users, unless heavily discounted
Root Lesion Nematode	· Barley is tolerant to root lesion nematode infection · Nematode numbers in the soil may still increase under barley cropping

Insects:

Aphids	· Minor pest · Sap sucking feeding rarely causes damage and control measures are usually unnecessary
Armyworms	· Feed on the leaves · Can tolerate considerable feeding from moderate numbers of armyworms · Control is seldom warranted, unless of numbers of armyworms are well distributed through the crop · The most serious armyworm damage occurs in barley when the older larvae start feeding on the green stem, just below the head as the crop matures, this results in the ripening heads being severed from the stem and has the potential to cause significant yield loss if left uncontrolled. · Control is warranted if the armyworm population distributed throughout the crop is likely to cause the loss of 7-15 heads/m^2
Blue Oat Mite	· If pale green or greyish irregular patches appear in the crop, check for the presence of blue oat mite at the leaf base · Adults are about 2mm long having distinctive red legs and move very quickly when disturbed · Damage is most likely during dry seasons where the mite is in large numbers making moisture stress worse, control may be warranted in this situation.
Brown wheat mite	· Small brown mite half a pinhead in size · Damage, like the blue oat mite, is only severe in dry season · Feeding causes a fine mottling of the leaves and the damage gives the appearance of drought effects · Heavily infested crops have a bronzed or yellowish appearance
Cutworms	· Soil inhabiting pest · Normally attack seeling plants by cutting through their stems near ground level and also feed on the foliage of older plants · Most damage done between germination and tillering · Chemical control may be warranted at levels exceeding 1 larvae/4 square metres in emerging crops

Harvest:

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
									■	■	

Barley is generally harvested between October and late November. The crop tends to dry down well, and desiccation is not necessary unless late weed growth needs control. Mature barley does not stand weather damage well and it is important not to delay the harvest as a result. Lodging can also be a problem, and patches of unripe crop near headlands and low lying areas should be avoided as they can contaminate the sample. When barley is ripe, it is relatively easy to thresh and harvest and can begin at moisture levels as high as 20%, although generally very little is harvested above 18% moisture.

Gross Margins:

While the cost of producing a crop of barley will vary for each individual situation, as an indicative guide only, a gross margin, based on a minimum till operation for feed barley, has been reproduced.

INCOME					
Yield (t/ha)					2.80
Price (on farm) of Barley-Feed ($/tonne)					$150.00
Income/Ha					$420.00
Variable Costs	**Qty**	**Rate**	**Unit Cost**	**Ha Cost**	**Total**
Operations					$75.00
Ground Rig	4	1	$5.00	$20.00	
Planting – air seeder	1	1	$23.00	$23.00	
Harvest	1	1	$32.00	$32.00	
Fallow Herbicides					$28.63
Glyphosate	3	1.5	$5.25	$23.63	
Surpass	1	1	$5.00	$5.00	
Seed					$16.00
Barley Seed	1	40	$0.40	$16.00	
Fertiliser					$37.50
Starter Z	1	30	$0.55	$16.50	
Urea	1	60	$0.35	$21.00	
InCrop herbicides					$4.50
MCPA LVE	1	0.5	$9.00	$4.50	
Fungicides					$-
Insecticides					$-
Total Variable Costs/Ha					$161.63
Gross Margin/Ha					$258.38
Break Even Price					$57.72 per tonne
Break Even Yield					1.08 tonnes per ha

Additional information of interest:

Barley is more susceptible to insect damage than most other grain, therefore when storing, particularly malting barley, it is important to be aware of the issues to ensure the grain maintains its qualities.

Study Crop:

CANARY

Recommendation: ✗

Given the restricted market opportunities and production season, canary is deemed to be an inappropriate crop for use as a rotational crop with sugar cane. The requirement of on farm storage also inhibits the prospects of this crop for production in this area.

Uses:

Canary is used exclusively as birdseed.

Market:

Australian requirements of canary are small, and as such, the majority of the crop is exported which leads the market open to price fluctuations according to overseas demand. The world market is approximately 300,000 tonnes, of which over 250,000 is supplied by Canada, and as such can be easily oversupplied leading to volatile prices. 80% of Queensland canary is produced on the Darling Downs.

Soil Requirements:

Canary is produced on similar soils to wheat.

Varieties:

Moroccan Standard, a very small seeded canary variety is presently the only variety grown.

Planting Conditions:

Canary should be planted when the soil profile is full of water. Good rains in late winter and a wet spring are conducive to heavy yields. Once established, canary is a hardy plant and fairly tolerant, but yield will suffer if dry weather interferes with the grain filling process. Canary is sensitive to trifulralin residue.

Planting Time:

May to June appears to be the preferred planting time for the upland areas of the eastern and northern Darling Downs, although up till late July planting may be suited if irrigation is available. Canary is sensitive to floret blasting and tipping-out if very hot conditions are experienced during flowering.

Row Spacing:

Row spacings of between 18-25cm are recommended.

Seeding Rates:

There are approximately 143,000 seeds/kg and a planting rate of between 10 – 15 kg/ha is recommended.

Planting Depth:

Optimum planting depth is between 50 to a maximum of 75mm.

Nutrition:

Canary is prescribed to have similar nutritional requirements to wheat.

Weed Control:

As canary shows little early vigour, it has difficulty competing with weeds. No herbicides are registered for grass or wild oat control, although preliminary research trials show that Matavan appears to be promising. Broadleaf weed control options include Tordon 75D and Tordon 242.

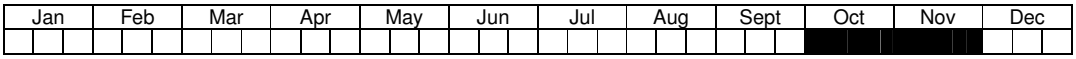
Diseases:

Crown Rot	· Canary is susceptible to crown rot · Rotting of the crown and stem tissue occurs and results in empty or incompletely filled heads · Where disease is prevalent, growers should avoid planting canary after wheat or barley
Powdery mildew	· Greyish white powdery patches appear over the surface of lower leaves & progress up the plant · Usually uneconomical to control

Insects:

Canary seed can usually be produced without too much trouble from insect attack. Ants, cutworms and armyworms sometimes may require control as they can damage the crop during establishment and armyworms may damage older plants by eating the flag leaf or cutting through stems below the seed head. Control methods are similar to that in wheat or barley.

Harvest:



Canary can be harvested between October and November. As canary does not readily shatter, harvest can be delayed until the crop is fully mature. Combine cylinder or rotor speed, should be set at between 500 – 750 rpm and there is a need to check for unthreshed seeds in seed heads over the back of the header. De-hulling seeds should be avoided as export specifications are a maximum of 4% and for protection, dust masks should be worn when handling the crop as tiny hairs at the base of the seed make canary seed dust very irritating to the skin during harvest & handling, and has been linked to respiratory health problems. Grain moisture can be at up to 13% with a grain weight of 70kg/hl.

Potential Yields:

Average yields for dryland blocks are documented at between 1 - 1.5 t/ha while yields of up to 2 - 3 t/ha are recorded as an average for irrigated blocks.

Price Indication:

Price fluctuates between $350-$700/tonne

Special Equipment Requirements:

Essential to have on-farm storage facilities as the market is often over supplied.

Additional information of interest:

Stored canary seed is not subject to grain insect damage.

Study Crop:

CANOLA

Recommendation: ✗

While canola as a crop does have a number of prospects, its production timing does not make it suitable to be grown in rotation with cane. Given that the closest receival depot is in Newcastle, transport costs are also deemed to be too exuberant to warrant the production of canola.

Market:

75% of the Australian canola crop is exported, with the closest receival depot in NSW. Although some grain merchants in Queensland may purchase a small amount of canola as animal feed. There are a number of buyers for larger quantities that pay with an oil bonus/penalty system. The standard is 40% with a 1.5% bonus or penalty for every 1% oil over or below standard.

Soil Requirements:

Canola is not suited to corse or crusting soils due to establishment problems and requires high fertility.

Climatic Conditions:

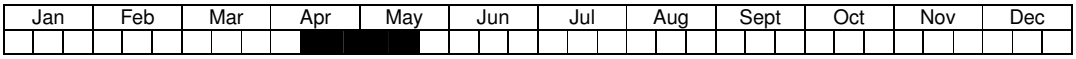
It is difficult for canola to produce an oil content greater than 40% when mean daily temperatures between flowering and maturity are greater than 18^{o}C. For each 1.5 degree increase in mean daily temperature oil content at harvest will be reduced by 1%. Maximum temperatures in the high 20's will usually cause flowering to cease.

Varieties:

Available information details early maturating varieties are suited to the Darling Downs region because of the hot dry conditions between October and November. Although there are different variety groupings determined by herbicide resistance.

Regular Varieties	· Mainly open pollinated lines so most varieties fall in this category
Triazine tolerant (TT)	· Resistant to atrazine and simazine, which allow the flexibility to plant into paddocks that have broadleaf weed problems · Have a 15-20% yield and oil content penalty attached · Are not GMO and come from naturally occurring selections
Imidazolinone tolerant (IT)	· Marketed under the Clearfield logo · Provide an alternative source of herbicide tolerance to the triazines · Tolerant to Group B herbicide 'On-duty' · Unlike TT lines – no oil or yield penalty · Not GMO and come from naturally occurring selections.

Planting Time:



For frost risk reasons, mid and mid-early lines are best suited to be planted before mid-May, while early cultivatars are best planted after this date so that high temperatures during maturity do not unduly affect oil quality and yield. From the early to mid part of May, yield will decline with delayed sowing at a rate of 4% per week.

Row Spacing:

Rows wider than 40cm are not recommended, and planting closer is encouraged to ensure the crop smothers weeds.

Seeding Rates:

There are between 250,000 – 400,000 seeds/kg and a sowing rate of 3 – 5 kg/ha should be aimed for. A plant population of between 200,000 to 600,000 plants/ha should be aimed to be achieved as uneven stands cause problems with weeds and maturity.

Planting Depth:

Seeds should be planted at a depth of between 2 to 6 cm. Because of the small seed size, constant shallow planting depth is critical in order to achieve an even plant stand. Deeper planting will result in poor emergence, especially in heavy textured or crusting soils. Rolling or press wheels are essential for soil/seed contract and even germination. Surface broadcasting or scattering seed and then harrowing is unreliable as it depends on follow up rainfall.

Nutrition:

Nitrogen	· Rates should be 20% higher than that used for wheat · Require from 40-45 kg N/tonne of seed produced · With high rates of N application, a small reduction (0.5 – 1%) in oil content can be expected · Due to seeling burn, no more than 20 kg N/ha should be used when planting.
Phosphorus	· Canola is extremely responsive to P application · Soils with Bicarb P phosphorus test of 15 – 20 mg/kg give a response to P application · Oil content tends to respond positively to P application
Sulphur	· Very high requirement for sulphur · Where sulphur deficiency is likely to occur (less than 10mg/kg S) apply sulphur at a rate of 10kg/ha in a sulphate form

Irrigation:

Irrigation in canola is listed as being similar to that of wheat.

Weed Control:

Various strategies for weed control in canola start with block selection of a clean block with minimal broadleaf weed problems. Good even emergence & narrow row spacing enable an early canopy cover to smother weeds and TT lines enabling the additional benefit of the use of atrazine and simazine. Because of row spacings, inter-row cultivation is seldom an option of control.

Diseases:

Canola is listed as being susceptible to scleroinia stem rot and blackleg.

Insects:

Aphids, Rutherglen bug and Heliothis all prey on canola.

Harvest:

Reglone is registered as a desiccant at 1.5 to 3.0 L/ha and should be applied when 70 – 80% of seeds have changed colour. Depending on weather conditions, dry down could take between 5 to 10 days. It is important to harvest with a moisture content of 8% or less, as seed is difficult to dry once in the silo due to small seed size. Moist grain will damage oil quality and can combust.

Potential Yields:

Indications suggest that yields in the vicinity of 2.5 t/ha could be achieved.

Price Indication:

Prices vary between $280 - $410 /tonne delivered to Newcastle.

Gross Margins:

For reference purposes only, the following gross margin has been supplied to give an indication of the cost of production involved with canola.

INCOME	
Expected Price ($/t)	400
Expected Yield (t/ha)	1.2
Expected Income ($/ha)	480
VARIABLE COSTS	
Operations	
Spray-ground rig x 1	$5.00/ha
Chisel plough x 1	$4.70/ha
Scarify-apply fert x 1	$3.80/ha
Spray-ground rig x 1	$5.00/ha
Planting x 1	$4.00/ha
Aerial Spray x 1	$15.00/ha
Harvest x 1	$32.00/ha
Fallow Spray	
Trifulralin @ 1.5 L/ha ($7.50/L)	$11.25
Glyphosate @ 1L/ha ($6.00/L)	$6.00
Seed	
@ 4kg/ha ($3.50 kg)	$14.00
Feriliser	
40 kg/ha MAP	$23.00
80 kg/ha Urea	$46.00
Insecticide	
Aphids Pirimor WG @ 0.5kg/ha $47/kg	$23.00
Freight	
to Newcastle from Roma	$50.00
Total Variable Costs ($/ha)	**$242.75**
GROSS MARGIN ($/ha)	**237.25**

Additional information of interest:

Canola should not be planted as a double crop immediately after sorghum or mungbeans because of toxins in stubble. Canola is not a recommended winter crop option for Central Queensland.

Study Crop:

CHICKPEA

Recommendation:

The production of chickpeas in rotation with cane requires further investigation, particularly in respect to planting opportunities. Based on information available for the development of a chickpea industry in this area, the planting timeframe for the crop is understood to be early May. This does not suit for rotational purposes with cane. Having said this, there have been grower trials of chickpeas in the area, and yield results based on locality and planting time will need to be examined to evaluate whether there is potential for the crop to be grown as a rotation.

The reason for the further investigation required into chickpeas is the potential of this crop. Chickpeas have a versatile market and a variety of end users to ensure a respectable return for potential growers. The cited gross margins also suggest that it is a favourable crop to grow and there is a range of available management practices to control pests and diseases.

Market:

There are a range of buyers supplying different needs of the chickpea market including bulk, machine dressed in containers, processed into splits and dhal, and specialty types such as larger sizes and lighter colour. Therefore there are also various contracting options available from the major buyers and growers are encouraged to begin their market research well before harvest.

The value of chickpea is likely to remain firm due to the continuing shortage on world markets and with well managed crops, growers have an excellent opportunity to capitalise on the situation.

Kabuli chickpea are another option and are grown for both the export and domestic market, with only a small percent of the Australian crop presently produced in the northern regions. The specifications are very strict for Kabuli peas with large (8-9mm), bright and unblemished grain bringing the premium prices. Although there is still an attractive market for the small sized peas. Kabuli crops in the Northern region require more intense management and do not regularly meet specifications but the potential rewards can be worth the risk for experienced chickpea growers. Seeds need to be graded, sized and bagged (at the growers' expense) prior to marketing.

Varieties:

There are two distinct varieties of chickpea – Desi and Kabuli.

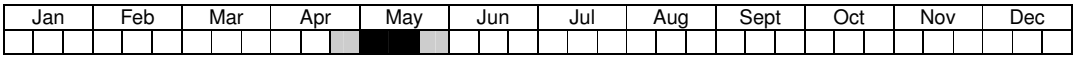
Desi is a relatively small, light brown angular seed that is used for split pea (dhal) or flour after hulls are removed. The main market for Desi types is the Indian sub continent or Indian migrants in other parts of the world including Britain and Western Canada. Desi is the most common variety in Queensland.

Kabuli types of chickpea are creamy white in colour and are much larger in size. They are usually sold whole, so seed size and appearance are very important and should be larger than 8mm in diameter. Kabuli chickpeas flower at a similar time to the Desi types, but as they have a significantly longer grain filling period, this renders them more susceptible to both moisture stress and heliothis damage, particularly as they are relatively more attractive to heliothis than the Desi types.

Planting Conditions:

Growers need to source high quality seed (based on both germination and vigour) and treat the seed with P-Pickel T. Untreated, low vigour seed is the main cause of uneven, poor plant stands and low yields.

Planting Time:



Chickpea yields show a marked response to the time of planting, and earlier or later sown crops often suffer from reduced yields. Early crops are susceptible to frost damage during flowering and pod set and can result in excessive vegetable growth under favourable conditions, which predisposes the crop to lodging. Late planted crops can suffer from moisture stress during grain filling and are prone to heliothis attacks. They can also be difficult to harvest because of lack of height. The optimal planting time suggested is the 1st and 2nd week of May, with marginal opportunities either side of these weeks.

Row Spacing:

Chickpeas have been successfully grown using a wide range of planting equipment and row spacings, ranging from 18 cm to one metre. Recent trends in chickpea production in Queensland have involved the use of wide rows of between 0.5 – 1 metre and controlled traffic layouts with a modified "broadacre" configuration.

When deciding planting configurations, growers need to be conscious of the fact that profitable chickpea production boils down to how effectively they control ascochyta and heliothis in the crop, as spray application techniques and timing have a major bearing on the effectiveness of both these operations.

Seeding Rates:

Chickpea yields are relatively stable within the range of 20-40 plants/square metre, with populations of 30 plants/square metre optimising yields in northern regions. Higher populations are justified for late planting's, while lower populations of around 20 plants/square metre are often recommended for crops grown on wide row spacings (1 metre). High populations planted on wide rows often result in thin main stems and a higher risk of lodging.

Planting Depth:

Ideally, chickpea seed should be planted 5-8cm deep into a good moisture profile as this will reduce the risk of damage from pre-emergent residual herbicides and promotes the early formation of lateral roots in the top soil. This also enhances inoculum survival in moist soil, and can improve nodulation and eliminates a significant proportion of ascochyta infected seeds.

Press wheels can significantly improve the establishment of chickpeas by as much as 50%, although heavy pressures should be avoided. V shaped press-wheels will leave a furrow down the planting line, which can lead to concentration of residual herbicides in the furrow after rainfall and result in subsequent crop damage.

Inoculation:

Chickpeas require a highly specific strain of rhizobia, Group N – CC1192, and inoculation is essential for effective nodulation. Chickpea have a high demand for nitrogen, with a typical 1.5t/ha crop requiring approximately 120kg N/ha to achieve this yield. Therefore the $1 - $1.50/ha spent on inoculation is the most cost-effective means of meeting the crop's nitrogen requirements.

Fungicide seed dressing:

The use of P-Pikel T is recommended for the treatment of al plantings throughout Queensland. This product is considered superior to all other seed dressings in minimising the risk associated with the spread of ascochyta infection on seed, which is seen as the most significant threat to the Queensland chickpea industry.

Nutrition:

Phosphorus	· Chickpeas are considered to have a moderately high requirement for P, although economically, fertiliser responses to P are uncommon.
Sulphur	· Certain soil types are prone to sulphur deficiency, eg. some basaltic black earths · Where soil phosphate levels are inadequate, low rates of gypsum is the most cost effective long term method of correcting sulphur deficiency.
Zinc	· Chickpeas are considered to be very responsive to zinc, and recommendations are currently based on likely responses in other broadacre crops. · VAM is extremely important to the zinc nutrition in chickpeas, and significant response can be expected in situations where VAM levels have become depleted due to long fallows. · A range of pre-plant treatments are available for zinc deficiencies including application of zinc sulphate monohydrate to the soil, seed treatments and foliar sprays.
Iron	· Iron deficiency has been observed occasionally on alkaline, high pH soils. · It is usually associated with waterlogging following irrigation or heavy rain and attributed to the interference with iron absorption and translocation to the foliage. · Symptoms include a general yellowing of young leaves, which can develop in severe cases to distortion, necrosis and shedding of terminal leaflets.
Potassium	· Responses to K are unlikely on most black earths and grey clays · K fertilisers may be warranted on red earths, but should be based on soil analysis.
Nitrogen	· Chickpeas should not normally require nitrogen fertiliser, provided that they have been effectively nodulated. Some situations where this may be warranted though is when they have not been inoculated properly or in late plant situations where the crop has rapid early growth and additional nitrogen is critical in achieving adequate height.

Weed Control:

Chickpeas are slow to emerge, make slow early growth and are notoriously poor competitors with weeds. Even moderate weed infestation can result in severe yield losses and harvesting problems. Several options are available for broadleaf weed control, although most relate only to use as a pre-emergent and will require the grower to make a decision prior to planting on the weed status of the block and whether control will be required.

Diseases:

Phytophthora Root Rot	· Root rot disease has the potential to cause serious losses · Most prevalent under cool, wet conditions and waterlogged soils · Water spreading over the soil surface spreads the disease · The disease is usually observed late in the season, although it may affect young plants if wet conditions are experienced after sowing.
Botrytis Grey Mould	· Is a serious disease of chickpeas and can cause total crop failure · Losses are worst in wet seasons, particularly when crops develop very dense canopies during the winter months. · Early symptoms include flower abortion and failure to set pods · Often goes undetected unless the crop is closely monitored. · Affected areas on the stem and leaf develop a soft rot and become covered in a fluffy grey mould · P-Pickel T is registered for the treatment of grey mould infected seed.
Viral Diseases	· A number of aphid-borne viral diseases can attack chickpeas, and can cause substantial crop losses · Symptoms include a reddening and/or yellowing of the foliage, a reduction in leaf size and twisting of shoots and tips · These diseases tend to be very sporadic in Queensland and largely influenced by seasonal conditions. · Problems tend to be associated with high levels of aphid activity. · These diseases tend to be difficult to diagnose and are often confused with nutrient deficiencies, herbicide damage, physiological disorders and waterlogging
Ascochyta Blight	· A very serious fungal disease that can devastate crops under mild, wet conditions · Even under 'average' rainfall conditions, it can have a major impact on both yield and marketability of the crop · The disease spreads on infected seed, and infected chickpea stubble · Symptoms include pale brown-fawn coloured lesions on the stem, leaves and pods. · All growth above stem lesions usually die back
Physiological Reddening	· Occurs where the crop has been subjected to severe heat and moisture stress and then receives rain close to physiological maturity. · Crops affected by this reddening often drop their leaves faster than is normally the case.
Physiological Leaf Spot	· Leaf symptom occurs regularly in most regions, and in most years. The spotting always appears on the upper leaf surface, and is brownish in colour. No disease pathogens have been linked to this condition, which appears to be associated more with stress conditions on the crop

Insects:

Heliothis are the main economic insect pest of chickpeas, with both species attacking the crop. Heliothis tend to do the most damage during the green pod stage of growth and reduce both grain yield and quality. Prices are discounted if the level of insect damaged and defective chickpeas exceed 6%.

Harvest:

The receival standards for chickpeas have been revised, with the maximum moisture now increased to 14% for grower receival, as harvesting grain at 13 – 15% moisture content will help minimise cracking.

Chickpeas thresh easily, but are prone to cracking, and removing alternate wires and lank-off plates from the concave will help reduce cracking. Air fronts also help to reduce shattering losses, and minimise the amount of soil and other debris in the final sample. In conditions where soil contamination is likely to be a problem, fitting perforated screens to replace the feeder house floor, elevator doors and clean grain cross augers should be considered. Sap from green stalks and weeds can also build up on the platform, and may need to be cleaned off. Truck wash is quick and effective in removing any sap build-up.

Potential Yields:

It is cited that chickpea yields average approximately 70% of wheat yields when planted in an identical situation.

Price Indication:

The price for chickpeas varies regarding the type and quality of the product. As an indicative guide only, a budget price for normal chickpeas would be in the vicinity of $400/tonne. However for Kabuli chickpeas, this price would be around $1000/tonne for 9mm peas, graded and bagged.

Gross Margins:

As an indicative guide, following is a gross margin that has been documented form a medium risk ascochyta area in southern Queensland. This gross margin has been provided to illustrate some of the production costs with chickpeas.

INCOME			
Yield (t/ha)			1.5
Price ($/tonne)			$400.00
Gross Income ($/ha)			$600.00
COSTS	**No. Operations**	**Cost/unit**	**Cost/ha**
Glyphosate fallow spray	3 x 1.2L/ha	$5.50/L	$19.80
Planting	1	$4.50/ha	4.50
Groundrig (own equipment)	8	$2.00/ha	$16.00
Harvesting (own equipment)	1	$10.00/ha	$10.00
Transport (100km contract)	1 x 1.5t/ha	$10.00/tonne	$15.00
Labour cost	1	$10.00/ha	$10.00
Planting seed (treated)	45kg/ha	$1.20/kg	$54.00
Inoculum	1	$3.00/100kg seed	$1.35
Simazine (PSPE)	1.5L/ha	$6.00/L	$9.00
Dithane DF fungicide	2x1kg/ha	$7.50/kg	$15.00
NPV insecticide + Aminofeed	1x375ml/ha	$70.00/L	$27.00
Desiccation (glphosate + Ally)	1.2L + 5g/ha	$9.60/ha	$9.60
Agronomist	1	$4.00/ha	$4.00
Total Variable Costs			$196.00
GROSS MARGIN ($/ha)			**$400.00**

Study Crop:

COTTON

Recommendation: ✗

Cotton is not considered to be a viable break crop option for the Isis Cane Supply area. While the planting and harvesting schedule of the crop would fit perfectly into a cane rotation, there are compounding factors against the introduction of the crop to the Isis area. Primarily, the biggest drawcard with cotton is the high management demand of the crop. Cotton is an intensive crop, which is quite demanding on growers as it requires high input and management.

Although the gross margins indicate the potential attraction of cotton as a crop, the equipment requirements and management practices in addition to broad scale farming practices indicate the crop is not suitable for production in this area.

Description:

Cotton demands a higher level of management than other field crops. There is a much higher level of risk in growing cotton, given the high insect pressure, disease and climatic conditions during the growing season that can affect yield and quality. Given the variability of production and control methods between irrigated and dryland farming, this study is only examining the farming practices in relation to an irrigated cotton farm.

Market:

Cotton is marketed by a number of merchants through a range of strategies. The price of cotton is export driven, with large fluctuations resulting from changes in the Australian dollar and changes in world supply and demand. Processing (cotton ginning) is carried out by several organisations with Gins located across Queensland.

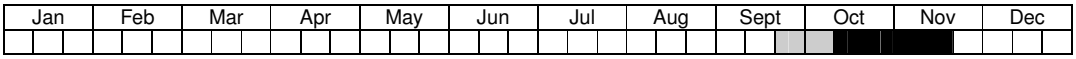
Varieties:

Seed companies continue to release improved cotton varieties for the Australian industry from the breeding programs which develop new varieties with improved tolerance to disease and insect attack. For information and descriptions of recommended commercially available varieties, growers are encouraged to look at the Variety Guides which are produced annually by the seed companies.

Planting Conditions:

A minimum soil temperature of 17^{o}C at 7.00am for 3 consecutive days prior to planting is required as this ensures rapid germination and good seedling growth.

Planting Time:



The planting time for cotton in the Isis area would appear to be in the timeframe of early October to mid-November, although this window of opportunity could potentially be extended to late September – as long as the soil temperature maintained its required temperature. Yield potential and quality are decreased by later plantings. Early plantings under cool and/or wet conditions are more susceptible to seedling diseases and sucking insect attack.

Row Spacing:

The conventional row spacings of cotton is a solid plant with 100 cm row spacings. Although considerable research is being explored in cropping practices of Ultra Narrow Rows which are planted at between 18-35cm apart. This management practices has been trialled extensively in the short season irrigated cotton growing regions of Southern NSW and offers some advantages including compatibility of planting and cultivating gear with other row crops, faster canopy coverage, earliness and possibly improved yield. Although the disadvantages do include prominent drainage problems with the shallow furrows, shoulder compaction and picking difficulties. Research continues to be examined in this field, and ultimately the row spacing configurations need to be a judgement made by the grower based on their equipment spacings and confidence to trial new production methods.

Seeding Rates:

The recommended planting rate for cotton in this area is likely to be between 90,000 to 120,000 plants/ha or an equivalent of 9-12 plants/metre of row, with seeds per kilogram ranging from 9,000 to 13,000 seeds.

Planting Depth:

Cotton seed should be placed into soil with good seed soil contact at a depth of approximately 50-75mm.

Planting Machinery

Best results for cotton planting are achieved with row crop unit planters and press wheels, although combines give satisfactory results with 87-105cm row spacings. Soft centred and low pressure press wheels are highly recommended.

Seed Germination:

The minimum prescribed germination for cotton is 70%.

Nutrition:

Regular soil testing program for both nutrients and moisture to a depth of 60-100cm profile is considered essential for managing sustainable cropping practise. All fertiliser requirements should be based on a soil test, block history and petiole testing. Fertilisers can be applied in one shot mixes or in several applications of various fertilisers.

Nitrogen	· Nitrogen fertiliser rates vary from between 70-180 kg/ha, depending on soil type and nutriment status. · Split applications are becoming increasingly popular to reduce nitrogen losses. · Applications can be split between pre and post planting with approximately 70% applied during the fallow. · Post plant applications can be side dressed during cultivation or water run as urea or anhydrous. · A lack of nitrogen reduces yields and quality, while excessive rates increase rank growth, causes poor fruiting, delays maturity and complicates defoliation.
Phosphorous	· Colonisation of roots by VAM is an important step in the uptake of soil phosphorus (and zinc).
Potassium	· Only if soil tests indicating less than 150mg/kg of potassium, should pre-plant fertiliser be applied.
Zinc	· Zinc is commonly applied mixed with other fertilisers and is also applied as a foliar spray to pre-flowering cotton.

Irrigation:

Minimum irrigation water requirement is 4-7 mL/ha, depending on production region.

Weed Control:

Development of a stringent herbicide regime is required to control problem weeds and growers should take the approach of an integrated weed management strategy, which includes the use of pre and post emergent herbicides, inter-row cultivation and chipping.

Diseases:

Disease management guidelines have recently been developed for the cotton industry. The purpose of the guidelines are to assist cotton growers minimise the impact of disease on the profitability of their operation. Very few cotton diseases can be completely eliminated, but the application of an effective Integrated Disease Management Strategy can produce some desirable outcomes to support the prevention of diseases that don't currently exist on farm, a reduction in the rate of build-up of a disease that has been introduced to the farm, eliminating a disease that is affecting profitability and minimise the impacts of disease on crop growth and productivity.

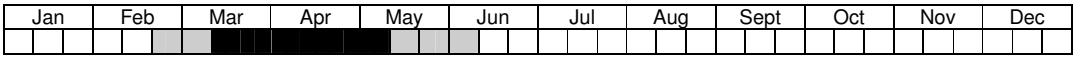
Insects:

The management of insect pests in cotton is very intensive and calls for highly skilled management. Insecticide inputs constitute one of the major costs associated with cotton production. The employment of a professional consultant to monitor insect numbers and to provide agronomic advice is essential. When control is warranted, the consultant will suggest the best insecticide to use and assist growers in implementing strategic insect management practices. The cotton industry presently has a number of innovative strategies and programs to assist growers in addressing issues in relation to insect management practices.

Desiccation

Desiccation of cotton is required and cotton defoliates much easier with a good boll load and with all available nitrogen all used up. Desiccation usually commences when unopened bolls are quite firm and when 60-80% of bolls are opened. Two defoliations are usually required, 7-14 days apart with harvest about 10 days later.

Harvest:



There is no confirmation of the likely harvest period in this area, although this window of opportunity may extend between late February to early June. Picking of cotton starts when at least 80% of bolls are open if two picks are desired, although one pick harvest may be more economical during most seasons.

Cotton is harvested with either a spindle picker or stripper harvester. Although the yield of irrigated crops and the need for leaf free plants, favours the use of spindle pickers. Moisture content in the cotton determines the initial start of picking, the length of the picking day, and the uninterrupted continuation of picking until completion. Excessive moisture, greater than 12%, causes spindle wrap which leads to lower out-turns, lower quality and quality of cotton ginned.

Temperature and consequent day degrees affects the actual time the plant takes to move through the various growth stages. Peak flowering usually occurs during December to early January.

Potential Yields:

Yield calculations are based on bales of raw cotton which are called lint. As an indication, one bale equals 227 kg lint. Cotton seed usually contains 36-40% lint. Expected yields in the area are likely to be an average of 8.5 bales/ha.

Gross Margins:

As an indicative guide only, gross margins for cotton produced on the Darling Downs during the 2002/03 year are provided below.

ITEM			DRYLAND FALLOW SOLID PLANT		DRYLAND FALLOW DOUBLE	FALLOW SKIP	IRRIGATED CROP	
INCOME				/ha		/ha		/ha
Expected Price ($/b quoted)			$430/bale	$1634	$430/bale	$1376	$450/bale	$3,600
+seed value (at 37% GTO)	$160.00	/tonne		$224		$192		$480
-ginning cost	$65.00	/bale		$247		$208		$520
-ACF & research levies	$3.75	/bale		$14.25		$12		$30
Expected Yield (bales/ha)				3.8		3.2		8.0
EXPECTED INCOME ($/ha)				$1,594.75		$1,348		$3,530
VARIABLE COSTS	**COST**	**$/unit**	**rate/ha**	**$/ha**	**rate/ha**	**$/ha**	**rate/ha**	**$/ha**
Operations ($/ha)								
Primary till	5.66	/ha	1	5.66	1	5.66	1	5.66
Secondary till	4.93	/ha	1	4.93	1	4.93	1	4.93
Inter row	6.30	/ha	1	6.3	1	6.3	1	6.3
Boom spray	2.95	/ha	5	14.75	7	20.65	4	11.80
Aerial spray	12.50	/ha	5	62.25	3	37.20	12	150.00
Plant	6.20	/ha	1	6.20	1	6.20	1	6.20
Harvest/module building	95.00	/ha	1	95.00	1	47.50	1	95.00
Eliminator	4.90	/ha	1	4.90	1	4.90	1	4.90
Seed (kg)	2.80	/kg	6	16.80	6	16.80	12	33.60
Fertiliser (kg product)								
Nitrogen	0.47	/kg N	50	23.50	50	23.50	160	75.20
Starter Z	0.55	/kg	40	22.00	40	22.00	60	33.00
Herbicide (L product)								
Glyphosate x 2 sprays	5.40	/L	1.2	12.96	1.2	12.96	1.2	12.96
Trifuralin	7.50	/L	2.8	21.00	2.8	21.00	2.8	21.00
Cotogard	12.80	/L 30cm	4.5	17.28	4.5	8.64	4.5	17.28
Dual	17.25	/L 30cm					2	10.35
Diuron	7.35	/L 30cm	3	6.62	3	3.31	3	6.62
Insecticide (L product)								
Dimethoate	7.00	/L 50cm	1.3L x 0.5	1.05	0.3Lx0.5	0.53	0.3Lx1	2.10

EXPECTED INCOME ($/ha) (continued)				$1,594.75		$1,348		$3,530
Endosulfan EC	11.00	/L 50cm	2.1Lx2	46.20	2.1Lx2	23.10	2.1Kx1	23.10
Tracer	345	/ha	0.15Lx1	51.75	0.15Lx1	51.75	0.15Lx1	51.75
Methomyl	14.70	/L 50cm	0.5Lx1	7.35	0.5Lx1	3.68	0.5Lx1	7.35
Thiodicarb	26.65	/L	2.0Lx1	53.30	2.0Lx1	53.30	2.0Lx1	53.30
Amitraz	14.30	/L	2.0Lx2	57.20	2.0Lx2	57.20	2.0Lx3	85.80
Bt	11.75	/L	1.5Lx1	17.63	1.5Lx1	17.63	1.5Lx2	35.26
Pyrethroid	25.00	/ha	3	75.00	3	75.00	3	75.00
Predator	9.85	/ha					5.0Lx1	49.23
Profenofos	13.56/L						2.5Lx1	33.90
Talstar	62.70	/L	0.8Lx1	50.16	0.8Lx2	100.32	0.8Lx2	100.32
Conditioners								
Pix	38.00	/L			0.3Lx1	2.85	0.65Lx1	24.70
Dropp	140	/L	0.1Lx1	14.00	0.1Lx1	14.00	0.1Lx1	14.00
Prep	23.00	/L	2.0Lx1	46.00	2.0Lx1	46.00	2.0Lx1	46.00
Irrigation (ML/ha)	40.00	/ML					4.5	180.00
Crop consultant	45	/ha		36.00		45.00		45.00
Field Handling/Cartage	10.60	/bale		40.28		33.92		84.80
Insurance	40.00	/ha		40.00		40.00		40.00
Casual Labour	80.00	/ha		80.00		80.00		80.00
Chipping		/ha		23.00		23.00		42.00
Interest on crop credit	7% inputs	/ha		39.79		38.75		56.83
Tarps, ropes etc.	2.50	/bale		9.50		8.00		20.00
TOTAL VARIABLE COSTS				$1008.36		$955.58		$1,701.24
GROSS MARGIN ($/ha)				**$586.39**		**$392.42**		**$1,828.76**
BREAK-EVEN YIELD (bales/ha)				2.34		2.22		4.06
BREAK-EVEN PRICE ($/bale)				$265		$298		$212

Study Crop:

COWPEA

Recommendation:

While strictly not a profitable crop, the nitrogen benefits of a cowpea crop may ensure it is of benefit for production in the Isis Cane Supply Area. The production timing, is suitable for rotation with a cane crop and the inputs and management practices appear to be reasonable. Further investigation may be explored in varietal choice for use of grain for export consumption or for seed production, alternatively as a green manure crop, cowpea has the potential to offer significant benefits to subsequent cane crops.

Uses:

Cowpea is an annual legume, grown for either fodder or grain.

Market:

There is a market for the Big Buff variety cowpeas in Middle Eastern countries where growers have achieved approximately $500 to $600/tonne for the graded product. Grading is necessary and price is based on a clean seed basis.

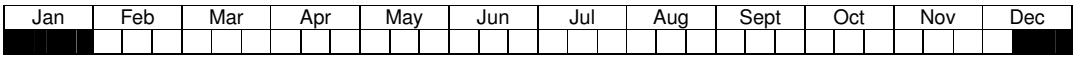
Soil Requirements:

Cowpea is adaptable to a wide range of soils, although blocks prone to water logging and have poor drainage should be avoided.

Varieties:

The small red seeded varieties were the main types grown for forage, although plantings have dropped in recent years due to competition from other forage legumes such as lablab. The release of a white seeded variety, Banjo, in 1986 created new interest, as it was suitable for the culinary trade and had the potential to attract high prices. The variety Big Buff is also providing opportunities in the culinary bean trade.

Planting Time:



Cowpea as a grain crop is best planted between mid-December and late January. This period of time will produce more uniform flowering and shift harvest out of the main summer wet period.

Row Spacing:

Row spacings of between 30-50cm are generally preferred, although wider 70-90cm rows can be used where inter-row cultivation is required for weed control.

Planting Depth:

Cowpea seeds should be placed 30-50mm into moisture on medium to heavy clay soils. Growers shouldn't press directly over the row, unless they are using a low pressure wheel.

Inoculation:

Cowpea needs to be inoculated with Group I Cowpea inoculum.

Seed Germination:

Cowpea have an establishment rate of approximately 60-80% under normal conditions.

Nutrition:

Nitrogen	· Nitrogen fertiliser is not normally recommended, provided the crop is properly inoculated.
Phosphorus	· Cowpea has the same phosphorus requirements as for other pulse crops. · Deficiencies are likely where soil bicarbonate P levels are low or VAM levels are depleted because of long fallows.
Sulphur	· Using single superphosphate to apply the above phosphorus rates will alleviate any potential sulphur deficiencies. · Sulphur deficiency is most likely to occur in double crop situations after a high yielding winter cereal.
Zinc	· Cowpea should be treated the same as other pulse crops in relation to zinc.

Weed Control:

Block selection is the most appropriate weed management method, as there are no registered products for broadleaf weed control in-crop. Wide row spacings are also an alternative so that inter-row cultivation can be used.

Diseases:

Phytophthora stem rot	· Phytophthora stem rot causes plants to yellow off and begin to die back in patches. · When removed from the soil, a light brown area may be seen completely girdling the base of the stem. · In moist conditions, the upper part of the plant may be attacked directly causing a withering and collapse of the stem. · The disease causes under wet and water logged conditions · This is the premier disease of cowpea and has the capacity to devastate susceptible varieties · It causes dark brown lesions to develop on the surface of the lower stem followed by wilting and eventual death of the plant.
Wilt	· Root disease prevalent after prolonged rain and water logged conditions. · Causes an internal rotting and brown discolouration of the vascular tissue inside the stem, followed by the collapse of the plant. · Symptoms differ from phytophthora stem rot in that there are no external stem lesions – no chemical control is available. · This disease is managed through crop rotation.
Powdery Mildew	· Powdery Mildew is often more prevalent under dry conditions or with late planted crops. · It resembles a white powdery film scattered over the surface of the foliage and when plants are moisture stressed, it can cause premature leaf drop. · Does not appear to affect yield where it occurs late in the crop · Control is not warranted, unless the disease occurs in flowering crops.
Charcoal Rot	· Tends to be most severe in crops weakened by drought, mechanical injury or stress. · Severely infested plants will often die-off prematurely
Cowpea Mosaic Virus	· Usually a minor disease · Diseased plants develop a severe yellow mottling of the leaves. · It is seed borne.
Tan Spot	· Symptoms consist of broad irregular yellow areas, starting from the leaf margin and extending inwards, followed by a tan discolouration. · The disease appears to be more severe in stressed crops, and can often go undetected in crops grown in good conditions. · As it is a seed borne disease, growers should only use clean seed.

Insects:

Cowpea is very susceptible to insect damage and heliothis, aphids, mirids, green vegetable bug, bean fly, flower thrip and lucerne seed web moth should be closely monitored during flowering and pod fill.

Cow pea is highly susceptible to flower thrip during budding and early flowering, when they can cause flower abortion and pod distortion. Flower thrip damage in cowpeas starts at preflowering when nymphs and adults attack the terminal leaf buds. However, the main attack is on the flower buds and flowers. Infested buds appear dried and brown and may eventually abort leaving dark red scars.

Harvest:

Maturity is very dependent on both the variety and soil condition – the average time period for maturity following planting is between 80 – 110 days. Most varieties though have a tendency to put on new growth under favourable moisture conditions. Where this occurs growers will need to decide on whether to delay harvest until after the first frost, or use a desiccant to finish the crop.

The timing of desiccation in cowpeas is critical, as the majority of seeds should be mature, firm and beginning to change colour. A handy guide is when the membrane around the majority of seeds peels away cleanly.

A moisture content of 12-14% at harvest will minimise cracking and damage to the seed. Although grain needs to be below 13% moisture for safe storage.

Harvest of the culinary types of cowpea intended for human consumption should not be delayed, as they can be badly weather damaged if exposed to wet, humid conditions.

Potential Yields:

Growers can expect to achieved yields in the vicinity of 0.5 to 1.5 t/ha in dryland cropped situations, and 1.0 – 2.0 t/ha in irrigated.

Study Crop:

FABA BEAN

Recommendation: ✗

Based on available information in relation to the production of Faba Beans as a rotational crop with cane, they are not considered to be a viable option. Principally, the factors impinging of the examination of Faba Beans as a viable break crop is the production period, which would interfere with the normal cane cycle and the sensitivity of the crop to high temperatures. Given that the flowers of the plant abort when day temperatures exceed 22^{o}C, this crop is not considered to be suitable to the climatic conditions of the Isis Cane Supply area, even if grown as a winter crop.

Uses:

There are two primary uses for faba beans dependent on quality, human consumption and stockfeed.

Market:

The human consumption market demands a large seed with a bright, unblemished seed coat. This standard can be difficult to achieve and as such, early harvesting and drying is recommended to achieve this quality. The major markets for human grade include Asia, Egypt, Saudi Arabia and the United Arab Emirates. The premium markets in the Middle East are volatile and growers should discuss with agents prior to planting to ensure a market. There is also a range of buyers in the protein stockfeed market for faba beans.

Soil Requirements:

While not relevant in the examination of a new crop, faba beans should not be planted within 500 metres of the last seasons stubble, and of relevancy to the cane cycle, should not be planted into a block more than once in a four year period. If possible, faba beans should be planted into standing cereal stubble to reduce the attractiveness of the crop to aphids.

Climatic Conditions:

Faba beans have a reasonable tolerance to cold conditions, but are sensitive to high temperatures and hot dying winds at flowering. Day temperatures above 22^{o}C will often cause flowers to abort.

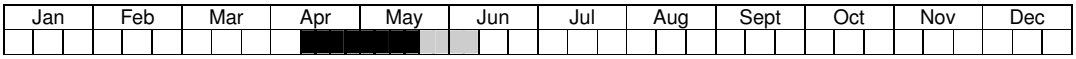
Varieties:

Aquadulce	· Broad bean with a very large seed size and late maturity, not suitable for Queensland.
Ascot	· Fiord selection released under PBR. · Not yielding as well as Fiord, but good resistance to ascochyta · More suited to southern Australia conditions than Queensland.
Barkool	· Fiord selection that branches and sets more pods/node. · Yields similar to Fiord, although may perform better in drier seasons.
Fiesta VF	· New variety released under PBR in 1998 · Similar yield potential to Fiord and can attract $20 - $40 premiums if seed quality is good · Tall variety that can lodge if planted early or planted on 1 metre wide rows
Fiord	· Original variety released in Australia and main commercial variety grown · Good yield potential, but is susceptible to rust and chocolate spot
Icarus	· New chocolate spot resistant line, which flowers later than Fiord. Not yielding well in trials · Very large seed that can be difficult to sow through some planting · Not recommended for Qld because of its late maturity
Manafest	· Large seeded late maturity variety suited to southern Australia conditions · Not under PBR, but marketed under a closed-loop system by the AWB

Planting Conditions:

Faba beans should be planted into a good moisture profile, the use of minimum till practices is recommended to conserve moisture and support the high biomass crop. Paddocks with low populations of broadleaf weeds are recommended as control options are limited. Previous herbicide applications will need to be considered as to ensure residual herbicides will not affect the crop.

Planting Time:



Faba beans have a relatively narrow planting window and planting time for the Western Downs/Maranoa is mid April to mid May and for the Darling Downs, early May to early June. Very early planting can lead to excessive vegetative growth which can predispose the crop to lodging. Late planted crops often yield poorly because flowering ceases at higher temperatures.

Row Spacing:

Rows can be extended out to 1 metre, although configurations of between 50 – 75 cm appear to be the standard. Wide rows appear to reduce foliar disease pressure and offer the additional benefit of the option of band spraying fungicides, insecticides and herbicides. If planting on 75 – 100 cm row spacings, growers should avoid varieties susceptible to lodging, reduce target population and avoid very early plantings as a measure of minimising the risk of lodging.

Seeding Rates:

Growers should aim to establish at least 20 – 30 plants/square metre. There is considerable variation in seed size between different varieties and growers are advised to calculate there planting rate based on the number of seeds/kg and recommended germination percentage. Seed testing for germination and vigour is also highly recommended.

Planting Depth:

Faba beans should be sown at about 5 – 8 cm, although seedlings are capable of emerging from as deep as 10 cm. Shallow sown faba beans tend to be damaged by herbicides and produce few lateral roots and are more prone to lodging. If moisture seeking, growers should aim for a depth of 6 – 10cm to ensure good moisture conditions before germination and to protect the inoculum from high temperatures near the soil surface.

Inoculation:

Group F inoculum containing strain WSM 1274.

Nutrition:

Faba beans have a high requirement for phosphorus and zinc. Crops will continue to respond to VAM even at high soil P levels. Faba beans should not require additional nitrogen, provided they have been inoculated properly.

Irrigation:

Faba beans can be successfully grown under irrigation as the crop has some tolerance of waterlogged conditions. In situations where water is limited, growers should plant on a full profile and irrigate just prior to the commencement of flowering, although if required, faba beans are a relatively safe crop to plant dry and add water up on beds or furrows.

Weed Control:

There is a range of herbicides registered for use in faba beans.

Diseases:

Rust	· Most prevalent disease in faba beans, and in severe cases can result in complete crop failure · Infection can develop as early as June-July in Queensland due to our warmer dry temperatures. · Infection can occur between 1°C and 30°C, although it does take longer at either end of this broad scale. · Rust does not require extended periods of rain for infection, unlike Chocolate spot · Moisture provided by morning dews are sufficient · The time lag between infection and appearance of disease symptoms is quite long · Rust epidemics are dependent on both the level of initial inoculum and the time of the initial disease infection · The application of a preventative mancozeb spray, such as Dithane before the onset of pustule development can provide season long effects
Chocolate Spot	· Other main fungal disease that can infect the crop · Symptoms of this disease can be found at low levels early in the season in most crops – usually only develops into epidemics under prolonged wet conditions. · Spreads most aggressively under humid, mild conditions at flowering time · If day temperatures are between 15 and 20°C and humidity is over 70%, crop inspections will need to be made every three days
Viruses	· There are a range of viruses that can affect faba beans including bean leaf roll virus, sub clover red leaf virus and bean yellow mosaic virus. · Most important one for this region appears to be the Bean Leaf Roll, which has the capacity to dramatically reduce yield · Viruses are always present, although severity varies from season to season · Control recommendations include sowing faba beans into standing cereal stubble. The reluctance of the cereal stubble reduces the attractiveness of the paddock to aphid flights.

Insects:

A number of insects can reduce the value of a faba bean crop through yield loss, or holes in pods predisposing the crop to weather damage. The main insects of concern during the flowering and podding stages are heliothis, thrips and GVB. Crop monitoring for insects should be carried out periodically and increased in frequency from the onset of flowering and early pod set.

Harvest:

Early harvest management techniques will maximise grain yield and quality, as the longer mature grain is in the paddock, the more likely it will loose its bright colour, which is essential If the grain is to meet human consumption standards. Harvesting at higher moistures, above 13% is highly recommended, provided drying or aeration facilities are available and staining of the grain does not occur during harvest.

Price Indication:

Budget prices for human grade faba beans are $220/tonne and $170/tonne as for beans for stockfeed.

Additional information of interest:

Faba beans are considered to be a viable alternative to chickpeas in Queensland on:

- Heavier soils prone to waterlogging
- Situations where phytophthora root rot is a high risk in chickpeas
- Situations where there is a high risk of ascochyta in chickpeas
- Wet seasons
- Sodic layers occur in the top 0-90cm of soil

Although, in most situations, chickpeas will outperform faba beans in terms of profitability. As while chickpea yields are slightly lower, commodity prices for chickpeas are often 50-100% higher than faba beans.

No major insect problems are encountered during storage. Faba bean yields can be increased by up to 25% by using bees to pollinate the crop. If there is less than one bee per 10 square metres then growers should consider introducing hives.

Study Crop:

FENUGREEK

Recommendation: ✗

Given the limited market opportunities and the production period of Fenugreek, this crop is not considered to be suitable for rotation with cane in the Isis.

Description:

Fenugreek is an annual herb belonging to the legume family.

Market:

The fenugreek market is limited and cannot absorb large tonnages, world trade is only 10,000 to 15,000 annually, and as such the market can be easily oversupplied. India and Morocco are the major export countries, and growers should secure a minimum price/hectare contract before planting.

Soil Requirements:

Fenugreek is reasonably well adapted to grey clays and black earths, provided they are well drained.

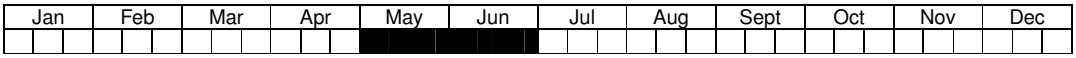
Climatic Conditions:

Fenugreek can tolerate high spring temperatures better than most other winter legume crops.

Varieties:

No named varieties are available, and considerable variation exists amongst different seed lines. Therefore seeds should only be secured from a reputable source. Based on projected indications, new and improved varieties will be available in the coming years, but will only be available in a closed-loop marketing system.

Planting Time:



Planting time is between May and June, depending on locality.

Row Spacing:

Row spacings of less than 30cm are usually preferred, although spacings of up to 70cm have been used in row crop situations. Wide rows would be expected to result in reduced yield prospects and risk lodging.

Seeding Rates:

Fenugreek should be planted at between 15 to 20 kg/ha with an aim to establish 80 – 120 plants/sq metre. Seed size ranges from 50,000 – 100,000 seeds/kg and seeding rates need to be adjusted accordingly.

Planting Depth:

Fenugreek should be planted at a depth of about 2 - 4 cm deep and the seedbed should be consolidated with either rollers or presswheels. Deep planting and crusting soils should be avoided.

Inoculation:

Strain SU277 – Trigonella strain of inoculum

Nutrition:

There should be no need to fertiliser the crop with nitrogen as it has been inoculated. Phosphorus and zinc are recommended to be applied at the same rate as a wheat crop in similar country.

Weed Control:

Fenugreek competes poorly with weeds and should be planted in clean country. No herbicides are registered for the crop at the present, although a number of products appear to be reasonably promising in trials.

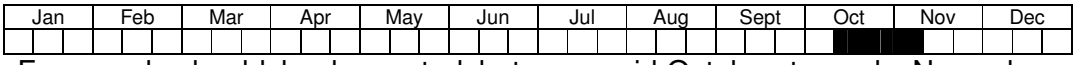
Diseases:

There have been no obvious disease problems to date. Powdery mildew has been observed in experimental plantings. Cercospora traversiaona has also been recorded as causing leaf and pod spots and shrunken dark seeds, although planting healthy clean seeds should control this seed borne disease.

Insects:

Aphids are the most common insect pest and can devastate the crop if left untreated. Thrips, pod-borers and heliothis should also be carefully monitored.

Harvest:



Fenugreek should be harvested between mid-October to early November. The long pods borne at the top of the plant are relatively easy to harvest and the crop matures fairly evenly and shattering is not a problem. Fenugreek should be harvested when the upper-most few pods are not fully mature and some moisture is in the stem. This practice will ensure maximum seed recovery and minimise damage to the seed. Grain should be even and bright golden in colour when harvested and have a 99% purity and be free of winter cereal grain and noxious weeds.

Potential Yields:

Commercial yields of between 1.0 and 1.5 tonne/ha are achievable under reasonable growing conditions.

Price Indication:

Because of highly volatile market, prices fluctuate between $300 to $500/tonne.

Study Crop:

FIELD PEAS

Recommendation:

Field Peas have the potential to offer a number of benefits if grown as a rotational crop with cane, but there are still a number of unknown variables that need to be considered, and as such further investigative trial work is required on this crop. The development of a substantial field pea market in Southern Australia indicate there are prospects for the development of this crop with reasonable dollar returns to growers. However, further investigation needs to be pursued on the extent of the impact of powdery mildew on the crop grown under Queensland conditions.

Uses:

Field peas can be used for both human consumption and stockfeed purposes.

Market:

Very few field peas are currently grown in Queensland, despite the development of a relatively mature and stable industry in southern Australia. Field peas compete with other protein and energy sources, with imported soybean meal setting the ceiling for domestic field pea prices, an example of this arrangement is with least cost ration formulations in the poultry industry, peas are worth around $220/tonne when soybean meal is priced at $450/tonne. Presently approximately 400,000 tonnes of field peas are produced in Australia, about 40% is used domestically for stockfeed with the remaining 60% exported for human consumption primarily to India and for stockfeed to mainly Europe.

Soil Requirements:

Field peas are relatively more tolerant of saline and sodic soil conditions.

Climatic Conditions:

With Queensland conditions, field peas are conducive to the rapid build-up of powdery mildew on the foliage, which can devastate the crop during spring.

Varieties:

Field Pea varieties grown in Australia can be divided into 4 basic categories:

Dun Type Varieties	· Used mainly for the stockfeed industry · Glenroy is a tall, semi-leafless pea specifically released for its powdery mildew resistance · It's late maturity means it is unreliable for grain production in Queensland and is the preferred variety for fodder or green manure crops
White Pea Varieties	· Used for human consumption · Varieties include Kiley, Mukta, Bonzer, Laura, Dinkum, Wirrega,
Blue Boiler Varieties	· Seeds are green inside, and are grown for the premium canning market · Varieties include Soupa, Excell, Bluey and Jupiter · Jupiter is the most erect pea variety available, although it appears that it would lodge badly under our conditions.
Maple Pea Varieties	· Have speckled seed coats · The main variety is Collegian

Planting Time:

Field peas are quick maturing and are advised to be planted at a similar time as to Hartog wheat in our area. Peas are more sensitive to frost during the flowering and pod filing stage than most other winter legumes and low lying, frost prone areas should be avoided.

Row Spacing:

Field Peas tend to be planted on narrow row spacings.

Seeding Rates:

The aim when planting is to establish around 25 plants per square metre. This often means a seed rate of around 70 – 80kg/ha, but this varies considerably with varieties. It has been suggested that growers assume an 80% germination rate and 80% emergence under normal field conditions. Populations as high as 35 plants/sq metre may be warranted in favourable environments.

Planting Depth:

Seeds should be planted to a depth of between 5 to 8 cm into moisture.

Inoculation:

Group E pea inoculum

Nutrition:

Phosphorous should be applied the same as for a wheat crop and Nitrogen is not required on inoculated crops.

Weed Control:

Field peas have a relatively good selection of herbicides available for use, but growers should seek advice from their agronomist.

Diseases:

The major diseases in field peas in the south have not been as significant problems in Queensland, including black spot, downy mildew, ascochyta and bacterial blight. The most damaging disease under our conditions is powdery mildew, which can cause yield losses of up to 50%. Powdery mildew is most common in late winter and spring when warm days and cool nights lead to dew formation and spread of the disease, under these favourable conditions, the disease can spread through the entire crop in five to six days.

Only part powdery mildew resistant varieties are available under Queensland conditions including Mukta and Kiely of the White pea varieties and Glenroy in the Dun type.

Insects:

Growers will need to monitor for heliothis during the flowering and pod filling stages. Insecticide rates are similar to those used in chickpea and seedling crops should be checked for blue oat mites.

Harvest:

Peas will flower in approximately 80 to 100 days when planted in early June. They have a strong tendency to collapse on the ground at maturity and specialised harvest equipment is usually required. Early harvest and desiccation can help minimise harvest difficulties.

Potential Yields:

Average field pea yield range between 1.0 and 2.0 tonne/ha.

Study Crop:

GUAR

Recommendation:

Guar appears to be a crop with a lot of potential. Agronomically, the crop is suited to production in the Isis Supply area, being tolerant of the climate and field conditions. However, the draw card with guar is the lack of certainty over the marketability of the crop. Given the formation of a Guar Industry Development Association and the current export as a whole grain, it is definitely considered to be a crop to keep a close eye on with respect to industry development. The crop has the potential to be trialled in the District as a green manure crop, to ensure it can successfully be produced in the Isis.

Description:

Guar is a summer growing grain legume, adapted to well-drained soils and hot, dry climates.

Uses:

Guar has a number of uses and market opportunities. In some areas of the world it is produced as a vegetable for human consumption. It is a useful fodder crop and crop residue has been used as a valuable, high protein animal feed source. The crop can also be used to produce high quality hay.

Guar grain is milled for the endosperm (referred to as 'splits'), from the remainder of the seed. Splits commonly comprise approximately 30% of the total seed weight, and are further processed to yield guar gum and guar flour. Guar gum has a number of useful properties, including its high viscosity, which has developed a number of industrial and food processing products.

Market:

The majority of the world's guar production is based in India and Pakistan, with smaller areas produced in the USA. There are also a limited number of companies worldwide with the capacity to process guar, and presently no processing facilities exist for guar in Australia and the entire crop is exported as whole grain. As such, given the limited market, it is essential that a market is sourced prior to planting. A Guar Industry Development Association has recently been established to foster the development of the Australian guar industry.

Soil Requirements:

As guar will perform poorly on soils with drainage limitations, paddock selection is vital. Guar is susceptible to root diseases that proliferate in waterlogged conditions so soils with poor drainage that are susceptible to waterlogging, either at the surface or in sub-soils, should be avoided. Deep, well drained, sandy loams or sands are preferred, although some well drained alluvial clays and clay loams have also produced favourable results.

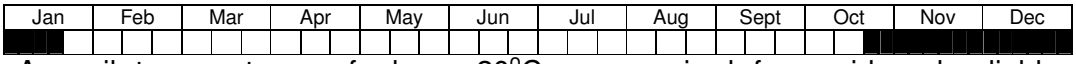
Climatic Conditions:

Guar is tolerant of hot, dry conditions.

Varieties:

There is presently only one variety of guar available commercially, CP1777. This is an erect, minimal branching, long season variety although current seed supplies appear to be contaminated with some off types, so some variation in plant type will be observed. A research program is currently underway to evaluate a wide range of guar varieties.

Planting Time:



As soil temperatures of above 20^{o}C are required for rapid and reliable germination and establishment, planting generally cannot commence prior to mid October. Planting after mid-January is likely to result in flowering commencing soon after emergence, which will set pods close to the ground and lead to unfavourable harvesting conditions.

Row Spacing:

Good results have been achieved in row spacings between 30 – 100cm. Wider rows allow for inter-row cultivation and application of in crop pesticides. If growers chose wider row spacings (>75cm), they should consider using planting rates at the lower end of the range. In irrigated situations, row spacings of between 30 and 50cm are recommended to achieve optimum yields, although wider spacings will result in better aeration, which may help reduce the incidence of leaf and pod diseases under humid conditions.

Seeding Rates:

Established plant populations of 150,000 to 200,000 plants/ha are satisfactory in dryland cropping situations, with seed size approximately 30,00 seeds per kilogram. Based on assuming 70% establishment, this equates to planting rates of 7 – 10 kg/ha.

Inoculation:

As guar is a legume, it requires to be inoculated with the Rhizobium strain CB3035. Good inoculation techniques should be used to maximise the chances of high levels of nodulation and nitrogen fixation.

Seed Germination:

The germination of any seed purchased should be checked and the planting rates adjusted accordingly.

Nutrition:

Nitrogen	· If inoculated correctly, guar will produce its own supply of nitrogen, so N fertilisers are generally not required. · Yellowing of the crop in the absence of waterlogging, may indicate nitrogen deficiency, which could be the result of ineffective inoculation or extremely low soil nitrogen levels. · In conditions of extremely low soil nitrogen, low nitrogen application rates in starter fertiliser may assist early growth. · It is also important to remember that legumes are lazy, and will use nitrogen available in the soil over fixing their own. To gain the maximum benefits to the cropping system, guar should be grown in blocks of low soil nitrogen.
Phosphorus	· Guar has a very high phosphorus requirement, and in all but very high phosphorus soils, a starter phosphorus fertiliser should be applied with the seed at plant. P fertiliser will also be required if VAM levels in the soil are low.

Irrigation:

Although guar is tolerant of hot, dry conditions, it needs adequate moisture, from rainfall or stored soil moisture, to produce acceptable yields. As summer rainfall can often be erratic, planting on soils with high levels of stored soil moisture will increase the chances of producing a profitable crop.

Weed Control:

To current knowledge, no herbicides are registered for use in guar in Australia, and as such, block selection is the best practice for weed management, although guar is relatively uncompetitive with weeds in its early stages of growth.

Diseases:

Guar tends to be sensitive to a range of root pathogens induced by waterlogging. The only control of this condition is to avoid potential waterlogged conditions, including soils with poor internal drainage. A number of foliar diseases have been reported in guar worldwide, none appear to be of economic significance in Australia in dryland crops to date. Although foliar diseases have been observed in irrigated crops, but reasonable control can be achieved by using wide row spacings to encourage aeration.

Insects:

Guar appears to be relatively free of insect pest problems under most conditions. Although tentative evidence suggests that there may be a slight impact in this area from mirids and pod sucking bugs such as green vegetable bugs. To current knowledge, no insecticides are registered for use in guar in Australia.

Harvest:

The current commercial guar variety is relatively compliant in nature, given that it will continue to grow, flower and produce pods until it is stopped by moisture, nutrient or temperature stress (ie. frost). This characteristic of the crop can present a challenge to harvesting, especially with early-planted crops and where end of season moisture conditions are good. The plant is very indeterminate, and can have immature, ripe and over-ripe pods on the plant all at the one time.

Fortunately, guar pods hold their seeds well and shattering losses are generally low. Guar pods are relatively resistant to weather damage, although prolonged wet conditions can lead to seed discolouration a subsequent reduction in commercial value. The use of herbicides as desiccants to accelerate ripening is currently being evaluated, however at present, no products are registered for this purpose.

Guar can be relatively easy to harvest with conventional headers. Drum speeds should be slowed and concave clearance set at about 19mm to minimise seed damage. As the seed is relatively dense, high fan speeds can be used. Row crop fronts and air reels have been used successfully to minimise seed and pod losses.

Potential Yields:

Yields of around 1 t/ha dryland farmed and 3t/ha irrigated can be achieved from well managed crops.

Price Indication:

Recent price indications for guar have achieved up to $300/t (on farm) for good quality grain.

Potential Benefits:

Guar is a useful fodder crop and as a legume, will contribute nitrogen to the cropping system if grown as a green manure crop.

Study Crop:

INDUSTRIAL HEMP

Recommendation: ✗

While Industrial Hemp is considered to be a real 'flavour' crop with the Queensland Government, given the legislation changes in 2002, there is still too much uncertainty and inconclusive results to warrant investigation into the suitability of this crop in the Isis Cane Supply Area. While literature suggests that there are a huge number of potential markets for this crop, in the three years of promoting the benefits of Industrial Hemp, none of these markets have eventuated. There is also considerable reluctance to recommend this crop, given the high on-going costs of the production of Industrial Hemp, given the licensing arrangements and continual visits from inspectors to ensure compliance. While the crop does appear to be suitable to the growing conditions and rotation of cane produced in the Isis Cane Supply area, given the perceived 'hassles' in the production of the crop, the return does not justify the effort required by the grower.

Description:

Industrial hemp a.k.a Indian hemp, cannabis or hemp, is a plant with a long history that has been used for its bast fibre in the stem, multi-purpose fixed oil in the seeds and an intoxicating resin secreted by the epidermal glands. While the crop has had a tarnished reputation as it is widely referred to as a drug, there has been a resurgence of interest in the crop since the late 1980s for the use of its fibre products, arguably driven by the green movement.

Uses:

Items manufactured from Industrial Hemp include food, textiles, paper, rope, fuel, oil, stockfeed, medicine, and spiritual and recreational products.

Legislation Changes:

The legislation regarding growing industrial hemp in some Australian states has changed in recent years, reflecting the government and general communities ideology that industrial hemp may make a useful contribution to the economy as an alternative agricultural crop and that it can be grown under conditions that do not compromise law and order. Here in Queensland, amendments to the Drugs Misuse Act 1986 were proclaimed in 2002 to facilitate the commercial production of fibre and seed from industrial hemp crops.

Market:

Market opportunities for industrial hemp fibre may exist in areas including reinforcing fibre for paper, fibre reinforced plastics, polycomposites, fibreboards, geotextiles, textile fabrics, animal bedding, kitty litter, industrial absorbent products and insulation. Market opportunities for oil and seed have also been developed or are under investigation, including, animal stockfeed, soap, oil, paint, varnish and cosmetics.

Industrial hemp products have found a place in niche markets in the developed world. There is speculation of more opportunities in the future, with some industry proponents estimating the international market for bast fibre to increase from 100,000 tonnes in 1999 to over 20 million tonnes by 2050. However, the prediction of market size has been fraught with difficulty in the past, with a dramatic over-estimation of market potential by Canada in the late 1990's. The degree to which industrial hemp will meet market demand will depend on demonstrable proof that is products are of equal or superior quality to its competitors at equal or reduced costs.

It has been estimated that approximately half of the world market for industrial hemp oil is currently for human food and food supplements. The comparatively higher profitability of producing seed and oil for this market than producing plant products for other markets has been suggested. Although, current prohibition in Australia of industrial hemp seed and oil in novel food denies access to this potentially lucrative market.

Soil Requirements:

Industrial hemp plants grow well on a fertile, neutral to slightly alkaline, well drained clay loam or silt loam soil. The requirement for a well drained site is necessary as industrial hemp plants are particularly sensitive to wet, flooded, or waterlogged soil.

Varieties:

While there are over 2,000 hemp varieties, only a small number of these varieties have low concentrations of THC (Tetrahydrocannabinol – the active 'drug' constituent of cannabis). As such, finding varieties with a low TCH concentration and that are suited to a Queensland condition, is an important step in the development of a successful industry.

Planting Conditions:

A well-prepared seedbed that is fine, level and firm is best for uniform gemination. Analysis of the soil prior to planting is recommended to assist in determining the rates of fertiliser application. Seeds are usually planted at a depth of 10 to 20 mm with a recommended seeding rate of 40 to 150 kilograms seed/ha. The use of a roller at planting may assist in germination by facilitating good contact between the seed and the soil.

Row Spacing:

Seeds are normally planted in rows spaced from 70 to 200mm apart.

Irrigation:

Until germination has occurred, usually three days after planting, it is recommended that irrigation be applied to keep the surface soil moist. Industrial hemp is sensitive to drought and needs ample water, especially during the first six weeks of its growth. A crop may require 2 to 6 ML of irrigation water/hectare.

Pests and Diseases:

Industrial hemp has a reputation for being resistant to pests and diseases, although the degree of resistance has been greatly exaggerated with the crop playing host to several insects and fungal pathogens.

Grey mould is one of the most significant diseases associated with industrial hemp. Green vegetable bug, heliothis and monolepta beetles have been found in crops of industrial hemp grown for fibre in Queensland, but have not appeared to have had a significant impact on yield. However, damage to the terminal buds of plants, particularly from heliothis moth, may require strategic pest control intervention.

Harvest:

For fibre production, industrial hemp plants are usually cut in the early flowering stage or while pollen is being shed, well before seeds are set. Consideration of mechanical harvesting technology suitable for industrial hemp has only recently begun to take place in developed countries, such as Australia.

Potential Yields:

Yields from trials to date have ranged from 8 to 11 tonnes/hectare.

Gross Margins:

Based on a study by the Australian Hemp Resource and Manufacture, now called Ecofibre Industries Limited, estimated that gross margins for industrial hemp in this area could be in the vicinity of $1,164 to $3,354/hectare. However, these figures tend to be quite extreme when compared to government department research that estimates, based on current market opportunities, returns from -$60/hectare to $452/hectare. Most gross margins analyses for industrial hemp also tend to give little consideration for the cost of necessary monitoring and inspection by regulatory staff, which, in Queensland, can exceed $1,000 per crop annually.

Based on current information, it appears that to achieve a viable gross margin, the production of industrial hemp in Australia will need to be undertaken on a broadacre basis. If this assumption is correct, the size of industrial hemp farming operations would need to be comparable with other broadacre crops such as cotton, wheat or barley. Furthermore, planting, cultivation and harvesting equipment would need to be of sufficient capacity to handle large scale operations.

Special Licence Requirements:

Amendments to the Drugs Misuse Act 1986 specify that to deal with industrial hemp a person must be in possession of a researcher licence and/or a grower licence or be an authorised person. Only licensed or authorised persons are able to deal with industrial hemp without committing an offence under the Act in relation to trafficking in, supplying, producing, publishing or possessing instructions for producing and possessing Industrial Hemp. Industrial hemp inspectors are appointed under the Act to monitor the compliance of licensees with their licence, and inspectors have wide powers of entry (with or without consent) and general powers.

In order to hold a licence, an applicant must not have been convicted of a serious offence in the past 10 years. As set by regulation, an application fee must also accompany an application for a licence. Applicants are also required to pay the cost of criminal history checks for themselves and associates.

Study Crop:

KENAF

Recommendation:

With its summer growth habit, Kenaf would fit well in the sugar farming system as an income producing fallow crop, provided the prospects of market development could be substantiated. On paper, Kenaf appears to be the crop that is 'too good to be true', it appears to be designed as a rotational crop with cane offering a number of benefits. The primary reluctance with endorsing kenaf as a break crop is the limited development of a market for the fibre and seeds. While the potential is there for this market to flourish, the risk associated with developing such a market is not justified for the production of the crop, at the present, in the Isis Supply Area.

Description:

Kenaf is an annual fibre crop that originated in central Africa. It is a member of the hibiscus family and is closely related to okra and cotton. Cultivated forms of kenaf are erect, herbaceous annuals that can grow to a height of 5 metres in a 120-150 day growing season. Plants will branch when widely spaced but they are generally grown very close together and this results in plants with straight slender stems.

Kenaf is a relatively new crop in Australia, and local knowledge and experience is limited, although the experience to date has suggested that it is relatively easy to grow crop.

While kenaf has been investigated as a potential crop in the past, interest in this crop has dramatically renewed given the pressure to produce non-timber renewable fibre and the push to find a complementary crop to improve the economic viability of the Queensland sugar industry.

Uses:

Shredded whole stalks are used to make a variety of products such as newsprint. Long bast fibres can also be used for rope, canvas, carpet backing and fishing nets.

When the kenaf stems are cut into smaller pieces, the core and bast fibres can be separated with a mechanical fibre separator. The separation of the two fibres allows for independent processing and provides raw materials for a growing number of products including paper, particleboard, animal bedding, biroremediation aids, interior car parts, bio-plastics and soil-less potting mixes.

Kenaf seed also contains about 20% oil, which can be used of cooking and lubricants. The oil can also be used in the manufacturing of soap, linoleum, paints and varnishes. Cattle feed in the form of a seedcake can be made

from the residue after oil extraction. Kenaf leaves have medicinal properties and at this stage, the product potential for using kenaf seems unlimited.

Market:

Kenaf is richer in cellulose than wood, with the whole stalk having two fibrous components – bast (bark) and core portions.

Anticipated demand for 100,000 tonnes of fibre within the next few years for use in the chemical, building and car industries.

As a potential market indication, the Japanese paper industry produces 14 million tonnes of paper and paper products annually. This means that they use about 40 million tonnes of raw product. In 1996 they were using 10,000 tonnes of non-wood fibre, including kenaf, and by 2002 this had grown to 40,000 tonnes.

Varieties:

The two common varieties currently planted are Everglades and Guatemala 4. Both varieties have performed well on the tropical Queensland coast in sugar producing areas.

Planting Conditions:

Good plant establishment is a basic prerequisite if maximum crop yields are to be obtained. It is absolutely essential to have adequate soil moisture to germinate the seed. If establishment is suboptimal, there is little the grower can do to improve the stand and the investment made is at serious risk.

Trials with kenaf in the Burdekin suggest that a very fine seedbed is not required for planting as good results have been achieved with direct drilling into cane trash and/or strategic tillage of the stool area only.

Row Spacing:

Row spacings of 28 to 75cm have been found to have little effect on stem yield. The wider rows allow easier access for inter-row cultivation or in-crop spraying if required.

Seeding Rates:

Kenaf is planted with a row crop planter and trials to date suggest that the optimum plant population is in the range of 250 000 to 400 000 plants per hectare. Lower populations result in branching and an increase in stem thickness, which may cause harvesting difficulties. Populations higher than 400 000 can lead to a reduction of stem diameter and this in turn may cause lodging of the crop. Sowing rates of 15kg/ha has given reasonable stands with a population of between 380 000 and 450 000 plants/hectare.

Seed Germination:

Germination is between 85 and 90% and under favourable temperature and moisture, seedlings will emerge in 3 to 5 days and attain heights of 30 to 40cm in three weeks.

Nutrition:

As kenaf is a highly productive crop it therefore takes up considerable quantities of nutrients from the soil. The crop has high requirements for nitrogen, potassium, calcium and magnesium. Soil testing is important to determine nutrient status of the soil and determine fertiliser inputs.

In rotation with cane, if lime is required for the subsequent cane crop, it should be applied prior to planting the kenaf.

Little work has been done on nutrient recommendations, but sugarcane rates of 150 kg nitrogen/ hectare, 20 kg of phosphorus/ha and 50 kg potassium/hectare are a good starting point. If a soil test shows a trace element to be low it should be applied prior to planting.

In cane rotation, an application of mill mud will provide the majority of the nutritional requirements with approximately 100 kg/ha of additional nitrogen being required.

Irrigation:

The production of fast growing, high yielding crops such as kenaf, not only require large inputs of fertiliser, but also water. Kenaf grown during the summer months in the wet tropics is unlikely to suffer from lack of water, but where regular rainfall is not common, irrigation will be required, as would be the case in the Isis area.

Weed Control:

Although kenaf can generally outgrow most weeds, they have the potential to cause a problem in the early stages of growth. There are no herbicides currently registered for kenaf in Australia, but trials indicate that pre-emergent herbicides are effectively controlling grasses without harming the crop.

Broadleaf weed control is likely to be a bigger problem, as commonly available broadleaf herbicides will kill the kenaf. Low growing weeds will be shaded out, but climbing vines are a potential problem.

Wider rows of 75 cm will enable the use of both inter-row cultivation and Irvin legs for inter-row spraying with a contact herbicide while the crop is low enough to travel through.

Diseases:

Diseases have not proved a serious problem in experimental plantings of kenaf in the Burdekin area. There appears to be considerable variation between kenaf varieties in their susceptibility to disease. Good crop management as well as crop rotations play an important role in the incidence and severity of many diseases affecting kenaf.

Insects:

Although kenaf is attractive to a lot of insects, only a few are classified as pests. This is largely because kenaf is harvested for its vegetative structures, which are less prone to damage than reproductive structures. Product quality does not suffer from insects as harvested kenaf stems are broken down during the pulping process.

The main pests of concern are those which defoliate plants and so reduce growth rates and stem yields. At this stage it is not known what levels of defoliation kenaf can tolerate before yields are significantly affected. The main insects causing defoliation of kenaf are the red-shouldered leaf beetle and a number of looper caterpillar species.

A number of insects can cause problem if plants are grown for seed. These include Heliothis, Green Vege Bugs and Harlequin bugs. Chemical control of all these pests will be needed to ensure production of good quality seed. Soil insects such as cutworms and false wireworms can cause problems with establishment.

Root-knot nematodes have been known to cause galling on kenaf roots and this restricts water and nutrient uptake. Unfortunately, sugarcane also hosts root-knot nematodes, which poses a potential problem. Although the degree of infestation will largely depend on the nematode density at planting, susceptibility of the cultivar grown, and the standard of management. Subsequently while a kenaf rotation will support root-knot nematode populations, it is not considered to be a serious problem as long as adequate management measures are taken.

Harvest:

The highest quality fibre is obtained when plants are harvested at the onset of the flowering period. Kenaf has a large window for harvest (6 to 8 weeks) in which time there is little change in the quality or quantity of the harvestable material.

Hand cutting is practiced only where labour is cheap and plentiful. There are three main options for the mechanical harvesting of kenaf:

1. Windrow the crop, leave it to dry and then pick it up from the windrow. Problems result when soil is picked up with stems and contaminate the sample
2. Direct harvesting of the green standing crop
3. Direct harvesting of the dry standing crop

At this stage, windrowing appears to be the preferred method and crops grown for seed have had the fibre residue baled for further use.

Potential Yields:

While little information is available on the achievable yields, based on trials conducted, yields of 25 t/ha have been achieved, with a break even yield of 17.6/tha required for current farming practices.

Price Indication:

Until the kenaf market is further developed, there is little indication as to potential price for this market, although as a rough guide, $95/tonne is suggested.

Gross Margins:

The following Gross Margin is an indicative guide only, based on DPI trials in the wet tropics. Consideration would need to be applied for the production of Kenaf in the Isis area and access to potential markets:

Income					
Yield (t DM/ha)	25				
Price ($/t)	$95.00				
Total Income					**$2,375.00**
Variable costs					
Machinery		**No. of operations**	**Cost ($/ha)**	**Total**	**Cost/ha**
Land preparation	Rotary	2	$22.00	$44.00	
Cultivating	Ripper	1	$8.00	$8.00	
	Discing	3	$6.50	$19.50	
	Inter-row	2	$4.50	$9.00	
Fertilising		2	$13.00	$26.00	
Planting kenaf		1	$12.00	$12.00	
Spraying		3	$5.00	$15.00	$133.50
Seed	Nature Trust Australia supply seed to contracted growers free of charge				
Fertiliser		**Rate (kg/ha)**	**Cost ($/kg)**	**Total**	**Cost/ha**
	Urea	325	$0.39	$126.75	
	MOP	100	$0.60	$60.00	$156.75
Insecticide	**Carbaryl**	2.2	$20.00	$44.00	$44.00
Herbicide	Stop	3	$11.00	$33.00	
	Basta	1	$20.00	$20.00	$53.00
Harvesting/Transport		**$/hour**	**t/hour**	**Total**	
Harvesting		30	25	$750.00	
Delivery ($20/t)		20	25	$500.00	$1,250.00
Total variable costs					**$1,667.25**
Gross Margin					**$707.75**

Special Equipment Requirements:

To present knowledge, there is no processing facility in Australia, and this is a major obstacle to industry development.

Study Crop:

LABLAB – GRAIN

Recommendation:

LabLab Grain has some potential as a break crop in the Isis Cane Supply Area. A number of growers are already familiar with the soil nutritional benefits of a green manure LabLab break crop, but the additional prospects of a dollar return may have some potential in this area. Storage may be a critical issue, but further discussions should occur with Mt Tyson seeds to investigate the prospects of establishing a grain LabLab industry in the Isis.

Varieties:

The only commercially available grain LabLab variety is Koala, which is registered to Mt Tyson Seeds under PBR. Koala is a short season, early maturing lablab, suitable for both fodder and grain production. Koala has a white-cream coloured grain, which is suitable for the culinary pulse markets in India, North America, Europe and Asia.

Planting Time:

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
■											■

The planting time for grain lablab crops is mid-December to mid-January where flowering would be likely to commence in approximately 45 days. Early plantings have a tendency to grow tall and rank, and often develop a vining growth habit and uneven maturity.

Row Spacing:

Narrow row spacings of 50cm or less tend to be preferred, and solid plantings will help to smother weed seedlings. Wide row spacings have similar yield potential, but prolong flowering and make heliothis management more difficult.

Seeding Rates:

Seeding rates average about 15-20 kg/ha, but should be increased to 20-25 kg/ha for late plantings. Seed size varies from 4,200 – 5,000 seeds/kg. A plant population of 8-10 plants/m^2 is ideal, and this will help to smother weed seedlings, as lablab is fairly vigorous.

Planting Depth:

Seeds should be planted to a depth of 30-60mm into moist soil.

Inoculation:

Group J inoculum (lablab) is required to be used.

Nutrition:

Particular attention should be paid to zinc and phosphorus nutrition.

Weed Control:

Wide row spacings and inter-row cultivation if an option for weed control, although there are a number of chemicals registered for use.

Diseases:

Lablab appears relatively free of problems associated with root rots and foliar diseases. Sclerotnia is the one exception, and can attack the crop when it is grown under humid, wet conditions in paddocks that have been intensively farmed with broadleaf crops.

Insects:

Heliothis are strongly attracted to lablab and can devastate grain crops if they are unchecked. Egg laying usually coincides with the start of flower, and crops should be scouted regularly from this stage onwards. Due to the growth habits of the crop, it may need protection for an extended period of up to six to eight weeks. Even well managed crops may require two sprays of insecticide for heliothis control. Larval numbers should not be allowed to exceed two per square metre.

Maturity

Flowering in lablab starts around 45 days from a December planting, but the final harvest maturity can vary from 120-160 days. Maturity is largely influenced by the amount of moisture available to the crop during the grain filling period. Koala can have a very indeterminate growth habit, and will continue to flower and pod-up while rainfall or subsoil moisture is available to the crop.

Chemical defoliation may be warranted where the crop continues to flower and growers are not prepared to wait for a frost to finish the crop.

Harvest:

Koala has an upright growth habit, reaching a height of between 0.4 and 0.8 metres at maturity. The pods are borne in the top canopy and the crop usually presents few problems at harvest. Lodging is seldom a problem, except where the crop has made excessive vegetative growth and has high yield potential. Pods thresh easily and shattering is not usually a problem.

As koala is normally traded as a whole bean in the pulse market for human consumption, appearance is extremely important. Grain discoloured by staining or weather damage can significantly reduce grower returns. Discolouration of the white seed coat with dirt should be carefully monitored. It appears to be worse when the harvest occurs after rain, or when the crop is being harvested too soon after a heavy morning dew.

Potential Yields:

Yields of between 0.5 – 2.0t/ha can be expected under dryland conditions and 1.5 – 2.5 t/ha in irrigated.

Price Indication:

Lablab grain is traded in the same markets as chickpea, and as a consequence, both demand and commodity prices will follow similar trends for chickpea on the world market. Opportunities exist for export into the high priced markets of Europe, North America and the Indian sub-continent. Prices over the last season have been around $350-$400/tonne on a clean seed basis.

Study Crop:

LENTILS

Recommendation: ✗

Given the unconvincing results of lentil varieties grown in Queensland and the production period of this crop interfering with the cane cycle, this study does not feel the development of a Lentil industry in the Isis is justified and beneficial to growers.

Description:

There are two basic types of lentils grown in Australia; either red or green lentil, which is based on the colour of the seed coat.

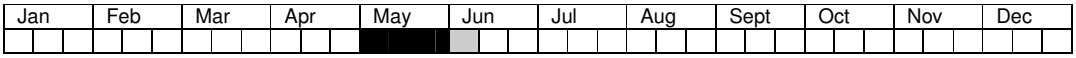
Market:

Lentil seed is sold for human consumption. The world trade varies from between 600,000 to 950,000 tonnes, of which 80% sold is red lentil. The major exporter of red lentils is Turkey, while the big players in the green lentil export trade are Canada, USA and New Zealand, which concentrate on the higher quality, premium market.

Varieties:

Green Lentils	· Used as a whole pea for cooking · Seed coat is green to brown, and the internal colour of the seed is yellow. · Seed size varies from 6-8mm · Matilda is an Australian variety that is approximately 15-20 days quicker in flowering than the Canadian varieties that are unsuitable to Australia because of their late maturity. Matilda is considered to be the most suitable green lentil for Queensland conditions and can only be grown under contract with The Lentil Company, based in Victoria.
Red Lentils	· Sold split for cooking · Red internal seed colour is exposed when the seedcoat is removed and the seed split during processing · External seed coat of red lentils can vary from light grey, through black to brown or red · Cumra and Cassab have been the best performing red lentils under Queensland conditions.

Planting Time:



Lentils appears to be suitable to be planted to the Isis conditions in May and the planting period would need to be extended to frost risk areas until early June. Early plantings run the risk of being frosted, or growing excessively rank and prone to infection with Botrytis grey mould. Late planted crops are very short and difficult to harvest. Crops will commence flowering in approximately 100 to 120 days from planting and will flower profusely over a prolonged period. Because of their indeterminate growth habit, it is not uncommon to find flowers, green pods and mature pods on the plant at the same time.

Row Spacing:

Narrow row spacings are preferred as wide rows will reduce yields and can accentuate the lodging problem.

Planting Depth:

Growers should aim to plant 4-6cm into moisture and rolling is advisable because of the crop's short harvest height.

Inoculation:

Group E pea inoculum

Nutrition:

Lentil phosphorus and zinc requirements are similar to that of other grain legumes. Lentils are extremely sensitive to iron deficiency and as a result, foliar sprays may be required.

Irrigation:

Lentils do not tolerate waterlogging.

Weed Control:

Lentils only make slow early growth and compete poorly with weeds, paddocks with severe broadleaf weed problems should be avoided.

Diseases:

Lentils are prone to a number of diseases which have the potential to devastate the crop if not properly controlled. Botrytis grey mould can be very damaging in early sown crops that become vegetative and rank. Lentil rust is the same rust species that attacks faba beans and has the capacity to cause serious losses in lentils under Queensland conditions. Cucumber mosaic virus and alfalfa mosaic virus have both demonstrated damaging results in lentils in northern NSW and Queensland. These two viral diseases are believed to be seed borne, as well as being distributed by aphids.

Insects:

Heliothis should be monitored during flowering and pod-filling.

Harvest:

Lentils are considered to be at an optimum stage for desiccation or harvest when 90% of the pods are golden-brown. Timing is critical as the crop is predisposed to shattering and lodging. Crops are usually very short (15-40cm) with the pods born throughout the plant and this usually requires the crop to be cut very close to the ground. As a result, floating cutter bars and flat, level paddocks are considered essential if considering growing lentils and all but the shortest crops will lodge at maturity, and crop lifters will usually be required. Windrowing may be worth considering, as it ensures more even crop maturity and minimises grain loss from lodging and shattering. Careful adjustment of the header is required to avoid cracked grain. Moisture should be at a maximum of 14%. Because of the Queensland growing conditions, the short crop height achieved, indeterminate flowering, and weak stems prone to lodging all contribute to major problems at harvest. There is also a very high risk of incurring harvest losses in our area, where there is a high probability of experiencing heavy storm rainfall in October-November.

Potential Yields:

Yields of between 0.5 to 1.5 t/ha can be anticipated.

Additional information of interest:

The varieties that have been bred in southern Australia appear to not be successfully adaptable to ensure the development of a stable, viable industry in northern Australia. Release of a number of new varieties has created considerable interest in the south, and trials to date in Queensland indicate that most of these new varieties still have only moderate yield potential, as well as some serious production problems in the Queensland environment.

Study Crop:

LIMA BEANS

Recommendation:

All indications suggest that Lima Beans have considerable potential as a rotational crop in the Isis. They appear to be easier to produce then navy beans and have the potential for greater economic return. While a commonly marketed bean in Australia, there is no current commercial production of Lima Beans. This is what limits the further development of the crop in the Isis Supply Area. For the establishment of a Lima Bean industry in the area, there would need to be reassurance that yields could be sold on the Australian market, to eliminate the importation of beans from the USA. There is also a potential market for the beans in Japan if quality standards are met.

Description:

Lima beans are in the same plant genus as common or navy beans and are emerging as an attractive alternative to navy beans.

Uses:

In Australia, lima beans are principally used as green baby lima beans canned in brine either along or as a component of a bean mix. They are also retailed direct to consumers as raw beans in small packages.

Market:

Currently, up to 1000 tonne of lima beans are imported each year, with no commercially produced crop in Australia, despite several years of research demonstrating the feasibility of such production. Lima beans are imported as raw beans from the USA, where they are the by product of harvesting immature 'wet' green beans which need to be immediately canned. Given the scale of demand in Australia, such a specialised industry is argued not to be feasible here. However, produced for dry grain, lima beans have yields comparable with navy beans and are more drought tolerant under rainfed growing conditions. Australian production of lima beans has the potential to target the Japanese market for high quality exports.

The principal domestic markets include Simplot Edgells and Masterfoods canneries, health food shops and other retailers for raw beans.

Soil Requirements:

Lima beans are best suited to light, well drained soils with deep profiles. Yields can be very constrained on some heavy black mulching clays.

Climatic Conditions:

Lima beans are best suited to a day temperature range of between 20 to 35^{o}C. The growth rate of lima beans is very temperature sensitive, and maturity will be delayed as the minimum temperature falls below 20^{o}C.

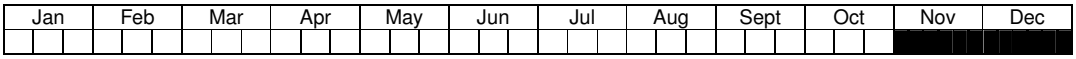
Varieties:

The emerging varieties suited to production in this area and with acceptable canning quality include the 'Green baby' series, 'Improved Kingston' and 'Mendoza bush'.

Planting Conditions:

Lima beans can be planted either into conventionally tilled seed beds or directly into minimum till stubble using either row crop or conventional seed drills.

Planting Time:



Lima beans have a narrowly defined optimum sowing period between November – December.

Fertiliser Requirements:

To achieve optimal yields, the potential crop nutrient requirement must be supplied as fertiliser with up to 80 kg/ha of nitrogen required for crops of up to 2 t/ha irrigated.

Irrigation:

Lima beans could suitably be grown in southern Queensland in the 600 –1000 mm rainfall zone and with irrigation, couple be a summer crop grown from central NSW to central Queensland as it requires 300 – 400 mm of irrigation.

Weed Control:

There are a number of chemicals registered for use in lima beans including pre and post emergent herbicides.

Diseases:

Diseases of lima beans are minor, with insignificant damage due to a bacterial 'chocolate spot' and to root rot fungi.

Insects:

Damage can be sustained in lima beans from myrids, thrips and Heliothis. Myrids are very difficult to detect, since most of their life cycle is spent inside developing seed pods. Control will require targeting of adults with preventative insecticides before they lay their eggs. Thrips and heliothis can be controlled, as for navy beans, with a range of insecticides available.

Harvest:

Due to indeterminacy in growth habit, the plants leaves often remain green and functional while pods mature, especially if moisture and temperature are favourable. The interval from planting to first ripe pod is in the range of 80 – 100 days.

Although lima beans have seed pods with thick hard shells, they tend to split open along the inner structure, exposing seed to the weather and, at fully maturity, tend to dehisce. Due to uneven ripening of pods over a 2-3 week period and the indeterminate flowering and partially developed pods, timing of harvest is problematic.

Harvest trials with desiccants and different timings are in progress.

Price Indication:

The current price for beans landed in Australia are based on world parity and associated fluctuations. Current market trends indicate a return in the vicinity of $1400/t.

Gross Margins:

Gross margins under rainfed conditions are likely to be at least 20% better for lima than for navy beans. Input costs for the two crops are similar, but yields and prices are considered higher for lima beans.

Study Crop:

LINOLA, LINSEED AND FLAX

Recommendation: ✗

Principally, while the Linum usitatissimum plant has a lot of versatility with respect to its end products, it is not considered to be a viable option in rotation with cane in this area given its production time that does not fit well as a rotational crop with cane.

Description:

Linseed, Linola and Flax refer to the same plant – *Linum usitatissimum*, of which, a range of cultivars have been developed aimed at various markets. Linseed refers to the brown seeded varieties, containing 35-45% oil and 18-26% protein. Linola is a high quality oilseed crop that differs from linseed as it is has a yellow seed. The flax fibre is obtained by stripping the bark of 'bast fibres' from the stem of the linseed plant. Along with specialist flax lines, dual purpose cultivars also exist making it possible to harvest both the grain and process the straw to obtain flax fibre.

Uses:

In the 1950's-60's, Linseed was extensively planted as a winter oil seed crop on the Darling Downs. The quality industrial oil extracted was in strong demand for a number of uses including its major use in oil based paints. It's popularity declined when paint manufacturers changed to synthetic bases. Current uses of linseed include specialty products such as multigrain breads, biscuits, linseed oil and meal, birdseed and the organic human consumption market. Linola produces a vegetable oil with a lower level of linolenic fatty acid and higher proportion of linoleic fatty acid. This oil produced is polyunsaturated edible oil suited to a range of food uses.

Market:

These days, there is a much smaller volume of linseed in demand, so it is critical to arrange contracts with buyers prior to planting. Rights for seed supply and marketing of the linola crop in Australia are now assigned to the grain division of Elders. This means that linola can only be grown under a contract to Primac Elders. As an upside, there is some renewed interest in flax for fibre production. Use of flax for production of linen and high quality paper has a long history. Current trends indicate a move towards use as a substitute for fibreglass and as a fibre for the components in the automotive industry.

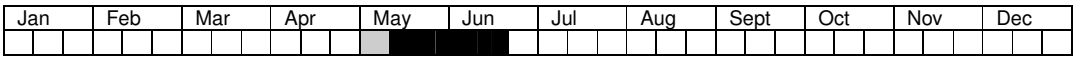
Soil Requirements:

Linseed can be grown on a wide range of soils, but tends to do best on light to medium textured clays and loams. As the crop is highly dependent on the beneficial soil VAM fungus for growth, planting following a VAM host crop and on a short fallow will assist in the VAM activity. This in turn will boost the linseed's ability to access soil nutrients, including zinc and phosphorus. Crusting soils should be avoided because of low seeling vigour.

Varieties:

LINSEED	· Preferred variety and is the standard by which other linseed varieties are measured against for yield performance · Has white flowers, brown seed and an early maturity · Is only short to medium in height, and usually stand reasonably well, although can lodge under fertile/high yield situations · Resistant to rust and has some tolerance to pasmo disease
Glenelg	
LINOLA	· Has blue flowers · Superseded the two original linola cultivars · Is resistant to Fusarium wilt and less prone to pasmo infection · CSIRO are continuing to develop new cultivars
Argyle	

Planting Time:



Planting time is between May to Mid-June. Linseed is frost sensitive during two stages: as a young seedling during the first few days of emergence and during flowering and pod development. As a result, planting in high frost risk areas such as Wallaville, should be delayed until June. Yield drops away quickly when planting is extended past mid-June due to an increased risk of moisture stress and heliothis damage.

Row Spacing:

Normal winter cereal row spacing is suitable for linseed, such as 18 cm.

Seeding Rates:

For dryland situations, seeding rates of 20kg/ha should be aimed for and up to 20-40 kg/ha under irrigation. The plant population aim should be around 300-400 plants/square metre under irrigation or high yielding environments. There are approximately 150,000 seeds per kilogram.

Planting Depth:

Because of its small seed size, linseed requires a fine firm seed bed. Growers should aim to plant into moisture, but avoid sowing any deeper than 50mm. A light rolling is often an advantage.

Seed Germination:

Growers should ensure planting seed has a germination of at least 80%.

Nutrition:

Nitrogen	· Rates similar to that required for wheat · If soil tests indicate that N is low, application rates of 30-40 kg/ha for dryland crops and 50-60 kg/ha for irrigated crops · Excessive levels of nitrogen should be avoided to reduce the risk of crop lodging. · Linseed is sensitive to fertiliser burn if nitrogen fertiliser is put in close contact with the planted seed. · Emergence has been shown to be reduced by 50% by applying 23 kgN/ha as Urea with the seed.
Phosphorus and Zinc	· Linseed is extremely sensitive to long fallow disorder, where extended periods of fallow have reduced VAM (mycorrhiza) levels. · With low VAM levels in the soil, the availability of zinc and phosphorus to the crop is reduced · Applying zinc and phosphorus fertilisers will not fully compensate for inadequate VAM · Banding these elements with the seed will assist · Zinc deficiency can also show up in short fallow crops, so a pre-plant soil test is recommended as a guide to fertiliser requirements. · Zinc can be applied either pre-plant, or as a foliar application two weeks after emergence. · Zinc seed dressings are also available and are the most cost-effective method of avoiding zinc deficiency · Do not delay until symptoms appear in the crop.

Weed Control:

Weed control is critical as the crop's slow early growth and upright canopy make it a poor competitor with weeds. Ground selection of blocks with low weed problems as a preventative measure is the best control method.

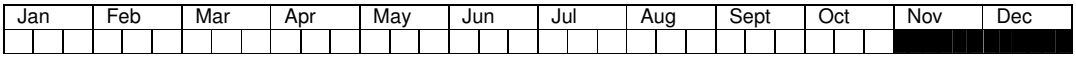
Diseases:

Pasmo	· Appears as a dark brown spot on the stem and leaf · Fungal disease which is carried on and in the seed and is also wind-borne · Wet conditions in spring encourage the spread of this disease · Crop rotation and the subsequent use of disease free seed are the most effective ways to minimise the incidence of this disease · All linseed varieties are classified as susceptible to pasmo · Linseed provides a valuable disease break from the common winter cereal diseases Crown rot, Common root rot and Yellow spot · Linseed is also resistant to Root lesion nematode and there the soil nematodes can not multiply as they would under a wheat or chickpea crop.

Insects:

Heliothis	· Linseed crops are extremely susceptible to heliothis attack with Helicoverpa punctigera usually the dominant pest in linseed, rather than H. armigera · The larvae can cause severe damage to the flowers and developing seedpods, and control measures will normally be required. · Regular inspections of the crop should be made twice a week from the start of budding onward. · Egg numbers and their stage of development should be closely monitored · Larvae should be controlled before they exceed 8mm in length · The threshold is 2-4 larvae/sq metre.

Harvest:



Harvest time is between November – December. The crop is non-shattering and reasonably weather resistant. Although extended periods of flowering and uneven maturity can be a problem when soil levels are high. In some situations, it may be worth while waiting for the second round of flowering to be completed to gain higher yields as long as Heliothis numbers can be controlled. A desiccant such as Reglone can be used to halt crop growth and reduce green material in preparation for harvest. A moisture content of 9% is allowed and there is a standard oil content of 40%. Grain weight is 72 kg/hl.

Potential Yields:

The crop usually yields 40-50% that of wheat. In dryland situations between 1-2 t/ha can be expected and 2-3t/ha in irrigated blocks.

Price Indication:

The price fluctuates widely dependent of supply and demand at between $320 - $480/tonne.

Study Crop:

LUPINS

Recommendation: ✗

Because of Lupins sensitivity to high temperatures and time frame for production, it is deemed to be an inappropriate crop for rotation with cane in the Isis Supply Area.

Market:

Of the approximately one million tonnes of lupin annually produced in Australia, 99% of the production is used for both the domestic and export stockfeed market, while the remaining 1% is used for human consumption. Lupin seed competes directly with other high protein feeds, and as such, the price is determined by the availability of substitutes such as field peas and soybean meal. Given the restricted market opportunity of Lupins for human consumption, contracts should also be organised before growing Albus lupin varieties for this market.

Soil Requirements:

Lupins perform best in a light textured, well-drained soil, preferring acid to neutral soils with a pH in the range of 4.5 to 7.5. Although they do have the ability to tolerate some alkaline soils with a pH of up to 8.0, provided of course that these soils are free draining and not subject to prolonged waterlogging, given the susceptibility of lupins to root rot, and that the soil does not contain free lime in the 0-60cm profile of the soil. The free lime content of the soil should be below 4%.

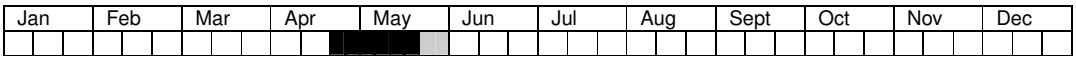
Climatic Conditions:

Lupins are sensitive to high temperatures, above 30^{o}C and hot drying winds, particularly during the flowering stage. As a result of these climatic restrictions, lupins have a very narrow planting window and severely restrictive growing opportunities in the Isis Cane Supply Area.

Varieties:

Narrow leaf lupin	· White flowered types with white round seeds and a protein content of around 30% · Merrit and Gungurru are the preferred varieties because of their early maturity and drought tolerant properties.
Albus Lupin	· A blue flowered variety with large, flat white seeds that are twice the size of the narrow leafed types · Appear to perform better than the narrow leafed lupins on heavier soils, provided that water logging is not a major problem · Need to use only certified seed, as broadleaf lupin may contain bitter off-types. · Available varieties include Ultra, Kiev Mutant and Hamburg · Mini Bean is a relatively small seeded variety that is early maturing and under PBR. · Contracts should be organised for all Albus varieties prior to planting
Yellow Lupin	· A different species of lupins with adaptation to highly acidic sands containing high levels of aluminium. · Higher seed protein content than all other lupins, and also has higher sulphur amino acids and lysine.
Wodjil	· Released under PBR from Western Australia, and is the first sweet yellow lupin with early flowering for Australian conditions. · Highly resistant to brown spot & pleiochaeta root rot, and is immune to cucumber mosaic virus. · Tolerant of manganese deficiency, and highly efficient at extracting phosphorus from soil · Tolerant of mild water logging – very susceptible to aphids and anthracnose.

Planting Time:



With the warmer climate of the Isis Supply Area, lupins would need to be planted between late April and May. Lupins are highly susceptible to frost damage, and in highly frost prone areas such as Wallaville, would need to be planted in late May. The reason for the later planting in these frost prone areas is that lupins appear to be more tolerant to frosts during their vegetative stage. Later plantings than this should be avoided and temperature is also of concern and flowering will cease at temperatures above 30^{o}C. Crops tend to flower an average of approximately 100 days after planting.

Row Spacing:

Lupins are conventionally planted in broadacre situations, where spacings of up to 90cm have been used with no effect on yield. The only recommendation with respect to wide rows, is to ensure varieties susceptible to lodging are avoided.

Seeding Rates:

Populations of between 30-45 plants/sq metre are recommend in most situations. Specifically, Narrow leaf lupin varieties should be planted at a rate of 70kg/ha and Albus lupin varieties at 120-150kg/ha.

Planting Depth:

Lupins should be planted into moisture at a depth of between 20-50mm.

Inoculation:

Lupins require to be inoculated with Group G inoculant (Lupin and serradella inoculum).

Nutrition:

Lupins do not require Nitrogen fertiliser, provided they have been properly inoculated. They do, however, have a high phosphorus requirement and approximately 8-10kg/ha of phosphorus should be applied in deficient situations. Zinc and sulphur levels should also be considered prior to planting.

Weed Control:

There are a number of herbicides available and registered for lupins, the recommendation regarding the appropriate use of these herbicides is to consult with an agronomist.

Diseases:

Cucumber Mosaic Virus (CMV)	· Potentially the most important disease in Queensland · Spread by aphids and infected seed · Albus lupin varieties are all resistant to CMV

Brown leaf spot, phomopsis stem blight and grey leaf spot are serious problems in southern lupin crops, but have not been a problem in lupin crops in Queensland to date.

Insects:

Lupins require to be intensively monitored for heliothis from flowering through until pod fill, with the Albus lupin varieties especially susceptible to heliothis damage. Other insect pests that can impact on lupins include lucerne seed-web moth, aphids, thrips and blue oat mite.

Harvest:

Lupins should be harvested as soon as they are ripe as pods become brittle and can shatter badly. Losses of up to 40% can occur from shattering at harvest. Moisture at harvest should be a maximum of 14% and grain weight can be expected to be around 75kg/ha.

Potential Yields:

Yields of between 1 – 2t/ha are achievable.

Study Crop:

MAIZE (INCLUDING POPCORN)

Recommendation:

Maize is considered to be a crop of opportunity with respect to this study. It has the potential to offer significant economic returns for growers who produce the crop and fits ideally into a cane rotation. The hesitation with endorsing a maize crop as a rotational crop, it that maize is a grass, as is cane, and will not break the pest and disease cycle in the soil that would be achieved by a grain or legume crop. Maize also results in significant soil compaction, an issue that is currently being addressed by the Isis Sugar Industry. As such, maize is a 'fence sitter' and can't be classified as an appropriate or inappropriate crop at this stage.

Description:

Maize is a multipurpose summer cereal, grain and silage crop. The Australian maize industry is valued at up to $35 million annually, and this primarily consumed in the domestic market, although a small amount, usually of specialised varieties, is grown for export. Grower interest in maize has been renewed, predominantly because of low prices in other crops, temporary shortages of other feed grains and increased demand for processing maize in countries such as Japan, stemming from fears of GMO contamination of US maize.

Uses:

Specific maize varieties are available for the production of grits used in breakfast food and corn chips. Other varieties are used for stock feed and are often very high yielding. A small, mostly export market, exists for special maize types, including hard textured processing quality grain, starchy maize, waxy maize and white maize.

Market:

Different markets exist for the different end products.

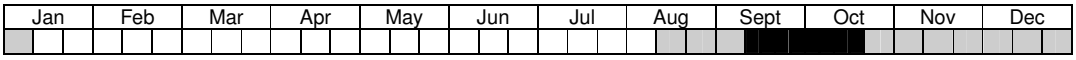
For maize grain, the normal merchant channels exist, or under contract to millers, starch manufacturers or corn chip or breakfast cereal manufactures. Price premiums apply for grain of various processing quality and the feed market tends to have lower prices but enjoys more flexibility with regard to the range of hybrids used, allowing growers to make use of higher yielding hybrids.

Silage maize is normally sold direct to feedlots and dairies at an agreed price per tonne in-field. Farmers growing for stockfeed grain and silage need to be particularly aware of the stringent requirement of most buyers in relation to chemical residues.

Varieties:

All waxy, white maize and popcorn varieties must be grown in isolation, as pollen from an outside source will affect grain quality. Guidelines for isolation include separating crops planted at the same time by at least 800m and a minimum six week time lapse between planting other maize crops to avoid cross pollination.

Planting Time:



Planting time for maize in this area would be likely to have an optimum window of between mid September to mid October. Although maize could successfully be planted as early as mid August and as late as mid January, although there is an increased likelihood of disease development during these later planting stages. A minimum soil temperature of 12^{o}C is required at seed depth before attempting planting. This is as cold conditions after establishment will slow the growth of the seedling and often turn foliage purple, largely due to reduced phosphorous availability at lower soil temperatures. However, once temperatures begin to rise again, the crop continues to grow normally and planting at this time will avoid flowering in mid summer heat.

Row Spacing:

An average row width for maize is 90 cm, however growers should plant in accordance with harvester front width.

Seeding Rates:

The aim for a plant population for an irrigated block in this area should be between 60,000 – 75,000 plants/ha, although the individual recommended rates for each variety should be obtained from the respective seed company.

Planting Depth:

Seed should be planted into moisture at a depth of between 50 – 75mm. The seed should be planted deep enough to allow the roots to develop in moist soil and grow down into subsoil moisture ahead of the drying front.

Seed Germination:

A minimum germination percentage for planting seed no longer applies, although growers should check actual germination of seed by referring to information on seed bags. As a general guide though, 60-90% emergence should be achieved with a precision planter and 50-70% with a press wheel and 30-50% without a press wheel.

Nutrition:

Crop nutrition has a marked impact on maize quality and yield. The cost of fertiliser is a major component of the growing costs, and as such it is wise for growers to adopt a systematic approach to develop fertiliser use practices to suit their own ground and cropping practices.

Nitrogen	· Yield goals should be the basis for determining nitrogen fertiliser requirements · While maize is a high nutrient demand crop, it is intolerant to high levels of fertiliser placed in contact with the seed at planting. · Nitrogen deficiency signs in maize include light green or yellowish lower leaves; V-shaped yellow areas at tips of leaves; premature drying along the midrib and the leaf tips; stunted and slow flowering; short and poorly filled ears.
Phosphorus	· As with most other summer crops, maize is not generally responsive to phosphorus · Soil testing is the most reliable guide to phosphorus fertiliser requirements, and soil type should also be considered with this. · Phosphorus deficiency sings include purplish coloured leaves; stunted plant growth; delayed flowering; poorly developed root systems; reduced kernel size and number.
Potassium	· Some districts are experiencing potassium depleted soils to the point where crop yield will be limited without the use of fertiliser potassium. · Soil testing and strip trialling will help detect potassium deficiency early. · Potassium deficiency symptoms include scorched appearance on the outer leaf margins of young plants; yellow to brown discolouration on the lower leaf; greater tendency of crop to lodge at harvesting; small ears that fail to fill at the tip.
Zinc	· Maize is particularly sensitive to zinc deficiency and every effort should be made to ensure adequate zinc supply to the crop. In situations where zinc levels in the soil are known to be low, growers should consider using a zinc compound fertiliser at planting. · Zinc deficiency symptoms include light streaking and broad whitish band extending to the leaf midribs; green leaf tips, edges and midrib; stunted plants with shortened internodes; new leaves nearly white in colour; purplish coloured leaf edges and stalks.
Sulphur	· Some long termed farmed soils may be responsive to sulphur fertilisers. · Gypsum applied at low rates has proven effective and is the cheapest form of sulphur · Sulphur deficiency symptoms include pale green or yellow coloured young plants with only limited stunting; older plants with pale green to yellow upper leaves and green lower leaves.
Molybdenum	· The molybdenum contained in the seed is normally sufficient for the maize plant · Although, on some leached acid soils molybdenum deficiencies can occur · Deficiencies can be corrected by application of molybdenum mixed with other fertilisers · Molybdenum deficiency symptoms include the tips of lower leaves turning yellow, brown off and die shortly after plant emergence and the dying of plants whiles others are short and stunted.

Irrigation:

Irrigation is dependent based on variety selection. Under conditions of adequate soil moisture, mid to slow maturing hybrids will produce a higher yield than quick maturing hybrids and as such growers aiming for maximum yields should consider a mid to full season maturity hybrid. However, in situations where irrigation is limited or where the number of irrigations is wished to be limited, growers should select a mid season hybrid which can produce more yield per mega litre of water.

All corn should be planted into a full profile of soil moisture and then left until the pre-tasselling stage. Flowering is the critical stage for determining final crop yield, and irrigated crops should be well watered during flowering and through to physiological maturity. It may be necessary to irrigate every week in hot, dry weather.

The effective rooting depth of maize is 100cm and even mild water deficits during vegetative growth stages will decrease leaf area. This will reduce the plants photosynthetic ability and have severe consequences on grain yield. Even if early soil moisture at planting has been adequate to produce maximum leaf area, moisture stress later will cause leaf senescence and therefore yield depression.

Moisture stress must be avoided in the period three weeks before flowering and at flowering as it can slow pollen shed. Sustained early moisture stress will increase the interval between pollen shed and silk emergence, decreasing pollination rate and therefore grain formation. Visual symptoms of moisture stress in maize are when leaf margins start to curl inwards. However, moisture stress can occur usually well before visual symptoms are apparent. Excessive soil moisture at seedling and flowering stages can have disastrous effects on maize establishment and yield.

Maize requires 4-8 mL/ha of water.

Weed Control:

It is alleged in maize that there is no substitute for good cultural weed control, which involves chemical and/or mechanical weed control in preceding crops and fallows. Although there are a number of herbicides registered in Queensland for in-crop use in maize and growers are advised to consult with their agronomist on the most suitable option for their situation.

Diseases:

Maize dwarf mosaic	· Causes mosaic and ring spot patterns of light and dark green patches on the leaves. Stunting can result from an early infection. · Caused by Johnson grass mosaic virus and can be a problem where susceptible hybrids are grown, particularly in southern Queensland. · Spread by aphids and is maintained between seasons in Johnson grass
Wallaby Ear	· Symptoms include dark green leaves that remain at an acute angle to the stalk. Veins on the lower surface at least, are thickened and stunting can result from early infection. · Symptoms occur as a result of feeding by the small, pale-coloured leafhopper · The disease is generally more severe in late plantings and coastal districts, including the Isis. · Ear development on severely affected plants is very poor · Spraying with a recommended insecticide to reduce high leafhopper populations is beneficial, particularly in young crops.
Turcicum Leaf Blight	· Identified by grey/brown water soaked spindle shaped spots, often 10 cm long. These may coalesce over an entire leaf. · Can be serious in susceptible hybrids when warm, wet weather favours infection and disease development, especially in late planted crops.
Common Rust	· Causes reddish brown pustules to 2mm long in scattered groups · This fungus may cause some losses in susceptible hybrids, especially when cool to warm weather favours infection and disease development. · Most hybrids possess some resistance to common rust, but this may be insufficient to counteract the higher levels of disease that occur on plantings between December to early January.
Ear Rot	· Distinguished by powdery whitish-pink fungal growth on cob. · Little information available on the relative susceptibility of different hybrids to this disease, although husk cover and pendulous ears reduce the incidence of this disease. · Prompt harvesting can also reduce losses due to ear rot, even if moisture levels are slightly higher and drying is necessary.

Insects:

Heliothis	· It is difficult to obtain adequate insecticide spray coverage of hatched heliothis as foliage leaves shield them. At the larva stage heliothis are capable of obtaining shelter in the cob leaves and as such, because of uncertainty of getting an economic kill, insecticide application for heliothis control in maize grain crops at this period is seldom recommended. · High populations on the tassel prior to silk emergence may warrant control to prevent larva migrating to the cobs.
Cutworms	· Cutworm caterpillars may climb plants and feed on leaves, but typically cut through stems near ground level and feed on the top growth of the felled plants. · Large caterpillars can cut through several stems per night and considerable crop damage is expressed as a general patchiness, or distinct bare areas in infested fields · Control methods include managing weed growth for about 4 weeks prior to planting · If insecticide application is warranted, it is best applied in the late afternoon, as the larvae hide during the day.
Armyworms	· Armyworms have a considerable impact on maize and control may include spraying the entire paddock.
Yellow Peach Moth	· The Yellow Peach Moth is an occasional pest of maize. · The caterpillars tunnel into cobs and produce a mass of webbing and droppings over the entrance of the tunnel

Harvest:

The crop maturity for maize from planting to harvest stage takes 4 and a half to 6 months, depending on variety, seasonal conditions and time of planting. Grain moisture should not exceed 14% when delivered to merchants or storage.

Harvesting practices can minimise hairline cracking and broken grain by keeping drum speed below 400 rpm. The grain should be tried to be handled as little as possible to avoid cracking.

Potential Yields:

Under reasonable seasonal conditions, growers could anticipate a grain yield of 5-6 tonnes/ha in dryland situations and 8-10 tonnes/ha if irrigated. Silage yields of around 42t/ha could be expected in an irrigated system.

Price Indication:

Market prices for maize silage fluctuate, but around the $30 to $35/tonne (standing in paddock) appears to be an average indicative price. With maize, the buyer is responsible for the chopping and cartage costs.

Potential Benefits:

While not a benefit, it is necessary to highlight that maize grown for silage is very exploitative of soil nutrients. Very little crop residue remains after chopping and removal of the crop. Nutrient return to the soil is very small. It is therefore necessary to give special attention to soil nutrition in a silage production system.

Additional information of interest:

Sweet corn has not been covered in this study as it is regarded as a horticultural crop and sweet corn agronomy is more intensive than for maize grain.

Study Crop:

MILLET AND PANICUM

Recommendation: ✗

While as a crop, millet offers potential economic benefits to growers, for serious commercial production, on farm storage is required to reduce the risk of the versatile market place for this crop. The crop also returns minimal nutrients to the soil and as such is of little benefit to subsequent cane crops. The timing of the production period of the crop is suitable for it to be produced in rotation with cane.

Description:

Millets are quick maturing summer cereals that are commonly used in double-crop situations or when changing over rotations.

For the purposes of this study, panicum has also been encompassed under the Millet category, as Panicum and Red Panicum are generally classified as Foxtail Millets.

Market:

Millet grain is used mainly in the birdseed trade, and prices can fluctuate dramatically. On farm storage is needed to spread supply and provides growers with some control over marketing options and price.

Soil Requirements:

Millets prefer soft, non-crusting soils. White French millet is more suited to lighter-loamier soils, while Panorama, Japanese and Shirohie will perform better on heavy soils. Japanese and Shiorhie are the most tolerant to waterlogging.

Varieties:

Millets and panicums, are small seeded, quick maturing summer crops, ideal for double cropping and changeover cropping. Panorama millet, White French millet and Shirohie are the main millets grown for the bird seed trade, with more than 80% of the Queensland crop currently grown in the Darling Downs region.

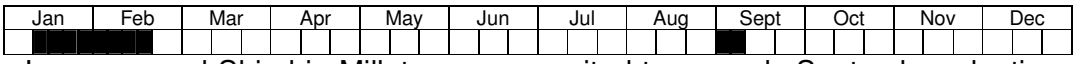
The hybrid and open pollinated pearl millets are grown solely for grazing purposes. Acceptance of pearl millet as a forage crop was limited until recent release of semi-dwarf hybrids, which combine high productivity and easy grazing management. Siberian millet is treated as a grazing crop, while Japanese millet could be considered for either grazing or grain.

French Millets are available in white and red seeds. The White French has recently been reselected to reduce the level of brown seed contamination from 5% to less than 1%, and this will assist in marketing the grain on the international market. French Millet is very open with drooping heads and hairy leaves making it not suited for grazing or hay. It is suited to lighter, loamier soils, and able to cope with hot, dry conditions better than other millets. Although it does tend to ripen unevenly and is very prone to shattering. There is also a variety, Awa, which is large seeded and grown under contract for the export confectionary trade. There is only a very small limited market for this variety, which is grown primarily in the Dawson-Callide region.

Japanese Millets are dual purpose, being suited to grain or grazing. They prefer medium and heavy clay soils, provided establishment conditions are satisfactory. These millets are relatively waterlogging tolerant and prefer high fertility. They are suited to irrigation, and can tolerate moderate levels of soil salinity.

Foxtail or Setaria Millets are adapted to a range of soils, and can be grown on heavy clays, provided the crop is not subjected to prolonged waterlogging. The two types grown in Queensland are the Giant Setaria and Dwarf Setaria. Caution needs to be given to the Foxtail millets, which contain glucosides and can be toxic to horses when grazed.

Planting Time:



Japanese and Shirohie Millet are more suited to an early September planting as they can germinate and emerge at lower temperatures than other millet species. Whereas January as through until February is the generally preferred planting time for Panorama and White French millets, as it provides a more even ripening of the crop in the cooler autumn weather.

Row Spacing:

Row spacings of 18 cm are recommended.

Planting Depth:

Under good soil moisture conditions, planting seeds to a depth of 30mm is preferable. Sowing deeper than this will reduce emergence. Satisfactory seedbeds for shallow plantings are difficult to prepare on heavy clay soils. Increased seeding rates on these soils to compensate for a lower establishment may be necessary. Rolling may improve establishment, as can the use of presswheels.

Seed Germination:

Millet can expect a 60-70% establishment in loamy soil, naturally this is lower in heavy soils or in poor seedbed conditions.

Nutrition:

Nitrogen is recommended to be applied to millet at a rate of 25-35 kg N/ha. Excess nitrogen may produce tall crops that are prone to lodging and higher rates may be justified under double crop conditions. Phosphorous can be applied at between 5-10 kg P/ha on soils low in phosphorus.

Weed Control:

Millets are fast growers and when sown on broadacre, they will often out-compete many weeds. There are some herbicides registered for use on post-emergent broadleaf weeds, but consultation with an agronomist should be undertaken prior to ensure appropriate chemical control is used, particularly as not all varieties can tolerate certain herbicides. Crops should be sprayed when roots have developed and the plant has fully tillered. Spraying during stem elongation can cause severe damage including reduced growth, head deformities and increased lodging.

Diseases:

Japanese and Shirohie millets have no major disease problems, while Panorama millet shows good tolerance to head blast.

A number of smuts can affect seed heads and developing grains in millets. These include Head Smut in White French, Kernel Smut for Foxtail millets and Covered Smut in Japanese, Shirohie and Siberian millets. All these smut diseases are seed-borne, so it is important to seek clean seed and not to retain planting seed from visibly affected crops. As a precautionary step, growers should consider treating planting seed with thiram seed dressing.

Leaf and head blast affects White French millet and many of the Foxtail millets. The leaf symptoms include oval shaped spots with dark margins, sometimes joining together to produce large dead areas. Blasting causes premature senescence, with no grain production in all or parts of the head. The fungus survives on diseased crop residues as well as on some grasses. Wet weather favours infection, with later plantings generally less susceptible to damage.

Charcoal rot is a soil fungus disease that can cause premature dieback and is responsible for 'white-heads' in the crop. It appears to be particularly prevalent in the Foxtail Millets.

Insects:

While serious insect pests are not generally considered a problem, millets should be monitored for heliothis, cutworms, armyworms, locusts and shoot fly as these insects can occasionally reach damaging levels and can be controlled using conventional insecticides.

Harvest:

Uneven ripening and lodging is a common problem in most of the Millets, with White French also having a shattering problem. As the crop threshes so readily and is prone to lodging, it is advisable to harvest early, when the grain has a high moisture content. Artificial drying is then required to minimise heating of the grain and mount growth when in storage.

Millets thresh easily at 18-20% moisture, and will then need to be dried to below 13^{o}C for safe storage. Drum speeds of 600rpm in a conventional header and 500 rpm in a rotary header. Higher drum speeds can dehull seed, especially White French millet. Use of a slow fan speed and a round hold bottom sieve. It is advisable to use a sheet instead of a rake on the rear sieve.

Potential Yields:

Production in the Darling Downs region, of where 80% of the Queensland Millet crop is produced, averages 23,000t from 18,000 hectares, with an average yield of 1.2t/ha.

Gross Margins:

Below listed, as indicative guide, are the gross margins for a dryland winter fallow crop of panorama millet. These figures should be used for information purposes only.

ITEM			DRYLAND WINTER FALLOW CROP	
INCOME				/ha
Expected Price ($/t on farm)				$280
Expected Yield (t/ha)				1.4
EXPECTED INCOME ($/ha)				$392
VARIABLE COSTS	COST	$/unit	rate/ha	$/ha
Operations ($/ha)				
Boom spray	$1.30	/ha	4	5.20
Plant – air seeder	$4.00	/ha	1	4.00
Harvest (own equip)	$15.00	/ha	1	15.00
Labour costs				5.00
Fallow spray (L product)				
Glyphosate (CT) + Surpass	$5.10 + $4.60/L		1.2+1.0L	10.72
Glyphosate (CT)	$5.10	/L	(1.2L) x 2	12.24
Seed (kg)	$1.40	/kg	20kg	28.00
Fertiliser (kg product)				
Starter Z	$0.55	/kg	25kg	13.75
Various nitrogen products	$0.47	/kg	30kg	14.10
Herbicide				
Starane	$21.00	/L	0.35L/ha	7.35
TOTAL VARIABLE COSTS ($/HA)			$92.00	
GROSS MARGIN ($/ha)			$300.00	

Special Equipment Requirements:

As prices can fluctuate dramatically, on farm storage facilities (in addition to forward contracting) is recommended.

Study Crop:

MUNGBEAN (INCLUDING BLACKGRAM)

Recommendation: ✓

The versatile planting period and potential dollar returns to growers make mungbeans appear to be a viable option for production in a cane rotation in the Isis Region. Mungbeans have the added additional bonus of being a legume crop, which can enhance subsequent cane crops through nitrogen fixation. Further investigation will need to be explored with respect to varietal section for the district and growers will also need to be vigilant with insect management, given the high populations of current mungbean insects in this district from past break cropping and the horticultural industries.

Description:

In the pulse industry, the term mungbean refers to mainly green-seeded types, with pods borne towards the top of the plant.

Market:

Returns for growers for graded and bagged mungbeans are very dependent on supply and demand of the world market. World mungbean prices are largely determined by both the volume of production and quality of the crops in China and Burma. Price trends usually become obvious around December when harvest of the Chinese crop is finalised.

As an indication, average prices over the last few years have brought the following returns for the various different qualities:

Sprouting grade beans	$550-$700/t
Cooking grade beans	$450-$550/t
Processing grade beans	$380-$500/t
Gradings	$100-$120/t

Processing grade is a broad quality classification for lower quality beans. Prices can vary by as much as $100/t at any time of the year for beans within this broad processing grade classification depending on appearance and quality.

Grading costs of approximately $75/tonne are deducted from this machine dressed price to arrive at a net on-farm return to the grower. These grading costs include grading, bagging and laboratory testing fees when appropriate.

Approximately 80% of current Australian production falls into Processing Grade.

Gross margins for mungbeans should be conservatively based on a net on-farm price of $500/tonne to the grower for good quality processing grade beans.

Varieties:

Mungbean	
Berken	· Medium large, evenly sized, bright green seed that is relatively easy to market, as it produces a large sprout preferred by buyers · Popular because of ease of marketing, readily available seed and good potential premiums · Very prone to powdery mildew, weather damage and cracking · Heavy crops may lodge badly
Black Pearl	· Very similar to Berken in all respects, exception of seed colour which is bright glossy-black with a greenish tinge. · Variety does not appear to suffer from the same degree of seed colour deterioration as the other varieties when exposed to either extreme heat or weather damage prior to harvest · Developed by Jamar Grains Pty Ltd and subject to PBR.
Celera	· Small, bright green seed · High levels of hard seed (30%) limits its access into some of the sprouting markets, it is still a very popular variety in many of the European and Asian countries · Good resistance to cracking and weather damage than other mungbean varieties · Is late maturing when grown in central Queensland, and dryland yields have been unreliable. · Very prone to lodging
Delta	· Large, bright green seed that has a shiny lustre · While sprout quality is superior to Berken, given its occasional problems with hard seed, may limit acceptance into the sprouting market. · Has good early vigour, plant height and quick maturing. · Appears to have a yield advantage over other varieties in high yielding situations · Lodging resistance not as good as Emerald and has low levels of resistance to powdery mildew · More prone to shattering than other varieties, likely to occur under hot, dry, harvest conditions, especially where harvest has been delayed.
Emerald	· Released by CSIRO through the Australian Mungbean Association and subject to PBR. · Medium large, bright green seed, almost identical in appearance to Berken · Levels of hard seed may be quite high, and currently limits its acceptance into sprouting markets. · Demand for this variety is mainly for cooking and processing markets in Asia · Although it is taller than most other varieties, it is less likely to lodge than Berken · Maturity can be delayed and uneven where soil moisture levels remain high during the grain filling period · High levels of hard seeds can cause problems with volunteer plants in subsequent rotational crops

Green Diamond	· Small seeded variety with similar grain quality to Celera · Superior to Celera agronomically, and has out yielded it by an average 20% · Relatively quick maturing variety that has an even pod set and is quick to dry down, it has performed very well in spring plant situations. · Green Diamond has an erect growth habit with the pods carried high in the canopy · Slightly taller than Celera and less prone to lodging · Often performs better than other varieties under relatively drier conditions, and may be more suited to double crop situations and the drier western areas · Along with White Gold, is the only variety with any tolerance to tan spot disease · Returns for this variety have tended to be good early in the year, but can drop away in the winter if the market becomes over supplied.
Satin	· Easily identified by its dull green seed coat · Seed size slightly smaller than Berken and tends to be more variable than some of the other varieties · While Satin is preferred by some sprouters because of its high yield of good quality sprouts, it is not accepted into the Japanese market · Is an improvement on Berken in both yield and weather tolerance, although the seed can discolour readily · Tall variety that often flowers and matures more evenly than the other lines.
White Gold	· Large, green seeded type with much larger seed size than all other commercial varieties. · Low levels of hard seed and good sprout quality should make it suitable for the premium markets · Good consistent performer in all regions · Relatively tall, erect variety with similar lodging resistance as Emerald · Best available resistance to Tan spot and a good powdery mildew resistance. · More suited to late plantings than the other highly susceptible varieties

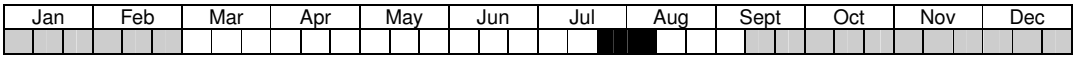
Black gram Closely related species to mungbean, but with dull grey black seeds and pods borne throughout the bush	
Regur	· A dark grey coloured seed that has good resistance to cracking and weather damage at maturity · Under wet conditions, more likely to produce seed of reasonable quality · More tolerant to waterlogging than the mungbean varieties, but often more difficult to harvest as is usually shorter growing than mungbeans, and pods are also set lower on the bush · Tends to flower over a prolonged period, ripening unevenly · Can make excessive vegetative growth under favourable growing conditions and is prone to lodging · Flowers can abort if prolonged periods of overcast, wet weather are experienced at flowering · Nodulation is often a problem with Regur, and the crop can be responsive to nitrogen fertiliser. · Some growers opt to grow Regur in a back to back rotation after mungbeans to help overcome nodulation problems · Strong demand for high quality Regur beans for export to Japan · A number of grading sheds and grain traders specialise in the marketing of Regur · Processing grade beans are sold into other markets for dhal and flour · Regur is not recommended in central Queensland where plants only grow very short, and delayed maturity limits yield

Planting Conditions:

Mungbean varieties should be clearly separated at planting. Varietal mixtures are unacceptable in the cooking and sprouting grade beans market and will usually attract substantial discounts. Unless harvest equipment and storage facilities can be thoroughly cleaned, restrict planting to one variety.

The importance of achieving an even strike, and an even maturity, cannot be over-emphasised for mungbeans. Taking extra care at planting can help even up flowering and harvest maturity. This makes both insect management and harvesting more straight forward.

Planting Time:



Based on available literature, for this region, given the climatic conditions and seasonality requirements, it would be suggested that the preferred planting period would be late July to early August, although September through to February is generally the recommended planting period. Trials would need to be conducted to substantiate this time frame.

At the end of the day though, varietal selection is particularly important when planting outside the preferred planting window. The literature suggests the most consistent results with spring plantings in southern Queensland have been achieved with late September/early October plantings in situations with

at least 90cm of stored soil water. Late October/November plantings are considered a riskier proposition because of the increased risk of experiencing dry, heatwave conditions on the young emerging seedlings. Green Diamond and Satin are suited to early plantings in spring because they are less susceptible to weather damage at harvest, and mature more evenly than the other varieties.

Row Spacing:

Mungbeans have been successfully grown using a wide range of planting equipment and row spacings ranging from 18 cm to 1 metre. The available planting equipment at the time and farm layout will largely influence the final decision on the row spacing and plant configuration. A recent trend being adopted by a number of growers is growing the crop in wider rows of 50 – 100cm, often planted up and back.

This is primarily due to the greater number of row crop planters' now available, controlled traffic, and the adoption of shield and band spraying. These wider rows are also beneficial in allowing the greater use of ground rigs for pesticide application and give growers better control of when insecticides are being applied to their crop.

Seeding Rates:

Plant population targets for mungbeans in an irrigated system are 250,000 – 400,000 plants/ha.

Planting Depth:

Seeds should be planted into a depth of 30-50mm. Ideally seeds should be planted with a zero-pressure wheel. Press wheels should be avoided, particularly if they exert heavy pressure directly over the row. Rolling can prove beneficial, as it helps level the entire surface, and can significantly help the harvesting operation.

Inoculation:

Inoculation with Group I (Cowpea and Mungbean) inoculum is essential. Poor nodulation is a common problem in mungbeans and can result in a significant yield reduction (up to 50%) in situations where residual nitrogen levels in the soil profile are already low.

Seed Germination:

All seed sold in Queensland must clearly state the germination percentage (%) and purity of that seed line. Seed with a higher germination of around 80-90% is preferred. Growers need to be aware that hard seed levels may be included in the germination percentage stated on the label. The main implication of having a high level of hard seed is in terms of uneven germination and establishment. Hard seeds planted into marginal moisture may not germinate until the next in-crop rainfall event after planting. Hard seeded lines should also be avoided for the same reason on lighter soils. The seed zone can dry out rapidly at planting time, with hard seed failing to germinate until there is a follow up rain.

Nutrition:

Nitrogen	· While mungbeans have a relatively high nitrogen requirement, the crop should not generally need nitrogen fertiliser, provided plants have effectively nodulated
Phosphate Response	· In low VAM situations, large responses to applied phosphate fertilisers are likely where soil bicarbonate P levels are low · Where soil VAM levels are high, responses to applied phosphate fertiliser are only likely in situations where soil bicarbonate P levels are below 10 mg/kg.
Sulphur	· Sulphur deficiency is most likely to occur in double-crop situations where soil sulphur levels have been depleted · Using single superphosphate to apply the above phosphorus rates will also alleviate any potential sulphur deficiency · Where soil phosphate levels are adequate, low rates of gypsum is another cost effective method of correcting sulphur deficiency
Zinc	· Mungbean are very responsive to zinc · Severe deficiencies stunt plants and produce dead leaf tissue between the veins. · Mild deficiency can be diagnosed by the upward 'cupping' of the uppermost leaves · Zinc seed treatments may be a cost effective control option in situations where soil P levels are adequate, but zinc levels are likely to be deficient.

Irrigation:

Mungbeans are sensitive to excessive waterlogging and the importance of good layout and drainage cannot be over-emphasised. Waterlogging events greater than 5 days duration can cause root nodules to die-back, with subsequent nitrogen deficiency problems in the crop.

Being relatively quick maturing, one of the major advantages of mungbean is their low water use, and relatively high $ returns per mega litre. Growers should avoid irrigating too early in the growth of the crop, as it can encourage excessive vegetative growth. The preferred strategy is to pre-water and then plant on a profile of soil water. The first in crop irrigation is usually best applied around 7 days before the start of flowering (about 30-40 days after planting).

Weed Control:

Broadleaf weed control options are very limited in mungbeans, and growers should plan a weed strategy prior to planting. Mungbean seed containing weed seeds can be difficult to sell and can incur substantial discounts.

There are a limited number of options for use in chemical weed control, and it is important to consult with an agronomist prior to use.

Diseases:

Powdery mildew	· Powdery mildew is favoured by cooler growing conditions, and is often widespread in late crops. · Infection becomes apparent during February, and usually increases in severity during the March-April period · Can be particularly severe during the autumn period if crops are also under moisture stress · Symptoms consist of greyish-white fungal growth on the surface of leaves, stems and pods. · Can cause significant yield loss if it develops before or at flowering, particularly if the crop is under moisture stress · Late infections during the pod filling stage can cause leaf drop, but do not appear to seriously effect yield. · Sulphur has been used as a control mechanism, but is only a preventative treatment and must be applied during the early stages of disease development to be effective.
Charcoal Rot	· While charcoal rot can cause infected plants to die prematurely and may reduce yield, its biggest impact is upon the marketability of sprouting grade beans · The disease is seed borne and causes a soft, wet rot of the sprouts during the germination process · Many overseas sprouting markets now specify that the seed must be free from the presence of charcoal rot fungus · Little is known about the conditions that favour seed infection, other than that it appears to be very seasonal and is very dependent on growing conditions · It appears that practical control measures will be difficult to implement as the disease is long lived in the soil, has a very wide host range and is seed borne
Legume little leaf	· Affected plants develop a spindly, erect growth habit with small, 'cupped' leaves · Flowers are distorted, with green petals · Affected plants often fail to produce pods, and if they do, they are generally distorted with the beans either failing to develop inside the pod or turning brown in colour – this can be a major cause for downgrading of the sample and discounted returns to growers. · The disease is spread by leafhoppers
Puffy pod Disorder	· Condition where pods develop a blotched, puffy appearance · Seeds in infected pods do not mature properly, and often turn brown and may develop secondary rots

Tan spot	· This is a seed borne bacterial disease which is often present at a low level in most crops · Symptoms include a large, irregular, dry, papery lesions on leaves that coalesce to form large brown dead areas, commonly with yellow margins around the dead leaf tissue · These areas dry out to a tan coloured patch which may tear and fall out, giving the leaf a ragged appearance · The disease is seed borne, and while it may occur as early as the seedling cotyledonary stage, it is more commonly seen from the second trifoliate leaf stage onwards · Affected plants remain stunted, show severe yellowing and may not seed. · The disease is spread from infected seedlings to other plants in the stand by wind blown rain. · Once infected, symptoms develop very rapidly if the crop is subjected to adverse growing conditions · It is not possible to eradicate the disease, the problem can be managed by using relatively clean seed and through crop rotation.
Gummy Pod	· Bacterial infection that occurs following the overproduction of sugar by the floral nectaries on the mungbean plant. · Condition triggered by a combination of heat and moisture stress, and causes extensive gumming and foaming of pods during the early stages of their development. · Can be followed by collapse of the stalks supporting the pods and then pod drop · Bacterium is commonly found in mungbean flowers throughout most crops · Appears to build up to serious levels when crops are severely heat and moisture stressed · No practical in-crop control measure – regular cleaning of harvest equipment to remove gum build up is often required. · Crop desiccation will often help reduce harvest difficulties.

Insects:

Heliothis	· Larvae normally feed on the flowers and bore into the pods to eat the developing seed. · Holes made in pods allow water to enter when it rains, which causes seed discolouration and weathering, which can lead to the crop being downgraded from the higher priced sprouting and cooking grades to processing grade. · Egg laying usually commences around flowering, although there are instances where mungbeans are damaged during the vegetative stage · The young unopened buds are severely damaged and do not flower properly, if at all. · Spray threshold is 1 larvae/square metre · Infestations at flowering can be difficult to detect as the small larvae feed inside the growing terminals and flowers · A range of control options are available for heliothis control, and growers should discuss with their agronomist before spraying.
Green Vegetable Bug	· Green vege bugs are a sucking insect that use their long thin mouth part to suck nutrients from the seed · If seeds are stung when very small, they usually abort causing direct yield loss · When partly developed seeds are stung, the seed usually becomes shrivelled and is removed when put over the grading table · If seeds are stung as they approach maturity, visual symptoms are less obvious, often only a small brown sting mark or discolouration · Stung seeds absorb water very quickly during the sprouting process, and result in poor or uneven germination · Spray thresholds are based on 1 bug/square metre for lower grade processing beans · There may be some justification for reducing this spray threshold even lower where large bonuses are being paid for premium processors or sprouting grade beans.
Mirids	· Timing of mirid control is absolutely critical in mungbeans as the 'first flush' of flowering occurs rapidly over a 4-6 day period. Poor pod retention at this stage will push the crop into an extended period of staggered, uneven flowering and often into terminal drought stress. · Mirids can cause extremely high levels of bud, flower and pod abortion, and have been responsible for cases of total crop failure · During feeding, mirids pierce the plant tissues with their sharp mouth parts and release a chemical enzyme that destroys cells within the localised feeding zone. · The affected tissues rapidly dull in colour, then black, desiccate and die · Favoured feeding sites include plant terminals, immature leaves, buds, flowers and young immature pods. · Spray threshold 0.25 mirid per square metre. · Preferred management strategy is to implement a thorough scouting programme from the very onset of bud initiation through to flowering and pod fill

Bean pod-borer larvae	· Infests crops from flowering onwards and causes similar damage to heliothis · They are a major pest in the Dawson-Callide area · The larvae live inside flowers and pods and produce distinctive webbing around the top of the plant. · Because the larvae feed in sheltered sites it is vital that they are detected early, while they are very small and feeding in flowers or young pods · This will ensure a better chance of targeting the grubs which are still moving from one feeding site to another · By the time webbing is seen, most grubs are burrowed inside pods and cannot be effectively controlled with insecticide
Bean Fly	· Very small, shiny-black flies lay eggs on leaves · Young larvae burrow down the stem causing damage to the vascular tissue · Bean fly can cause seedling death and crop lodging due to the stem damage
Thrips	· Infestations of thrips can be a problem during the bud initiation stage and peak during flowering · In addition to causing flower drop, damaged buds can also be shed before the flowers open · Thrip may also cause malformed pods in which the grain remains small and shrivelled · No established spray thresholds, but many growers are opting to control this pest during the critical stage of flowering and pod setting if populations exceed 4 thrips per flower · Thrips can also cause severe stunting in seedling mungbean crops

Harvest:

Mungbeans require to be desiccated prior to harvest and growers will need to check with their agronomist to determine registered desiccants.

Potential Yields:

Yields of up to 1.25 to 2.75 t/ha can be achieved in an irrigated system, with slightly less yields then this is a dryland situation.

Gross Margins:

As an indicative guide only, gross margins obtained from farming mungbeans have been detailed below:

			WINTER FALLOW (SPRING PLANT)		DOUBLE CROP (SUMMER PLANT)	
INCOME				/ha		/ha
Net price to grower ($/tonne) after grading costs have been deducted (approx $70/tonne)				$500		$500
Expected Yield (t/ha) Graded				1.2		0.8
EXPECTED INCOME ($/ha)				$600		$400
VARIABLE COSTS	**COST**	**$/unit**	**rate/ha**	**$/ha**	**rate/ha**	**$/ha**
Operations ($/ha)						
Boom spray	$1.30	/ha	7	9.10	6	7.80
Plant – air seeder	$4.00	/ha	1	4.00	1	4.00
Harvest (own equip) including tractor and field bin	$15.00	/ha	1	15.00	1	15.00
Labour costs				14.00		14.00
Fallow spray (L product)						
Glyphosate (CT) + Surpass 300	$.10 + $4.60/L		(1.2+1.0L)	10.72	(1.2+1.0L)	10.72
Glyphosate (CT)	$5.10	/L	(1.2L) x 2	12.24		
Seed (kg)	$1.40	/kg	20kg	28.00	20kg	28.00
Inoculum	$5.00	/250g	1	1.00	1	1.00
Fertiliser (kg product)						
Starter Z (N,P,Zn)	$0.55	/kg	25kg	13.75		
Sulphate Ammonia	$0.42	/kg			25kg	10.55
Herbicide						
Grass herbicide (Post-em) (Select, Falcon WG, Verdict)	Approx $25	/ha			1 spray	25.00
Spinnaker WDG (Pre-em)	$370	/kg	70g	25.90		
Insecticide						
Dimethoate	$8.40	/L	0.25L	2.10	0.25L	2.10
Larvin 800WG 835/15kg	$55	/kg	350g	19.25	350g	19.25
Desiccation						
Roundup MAX	$7.40	/L	1.2L	8.90	1.2L	8.90
Freight						
200km	$20	/tonne	1.2t	24.00	0.8t	16.00
TOTAL VARIABLE COSTS			$188.00		$162.00	
GROSS MARGIN ($/ha)			**$412.00**		**$238.00**	

Study Crop:

NAVY BEAN

Recommendation: ✓

While by no means an easy crop to grow and one that delivers variable financial return to growers, navy beans are a crop that should be persevered with in the district. Based on reasonably successful trials of the crop in the area last season and the high market demand for this crop, navy bean have the potential to be produced in this district as a cash crop for cane farmers, provided adequate management practices are adhered to. Concern still exists though in the benefits of a navy bean crop to subsequent cane crops.

Market:

Navy beans are grown for the canning (baked bean) and edible dry bean package trade. This means the visual appearance of the final product is of vital interest to the buyer, although navy beans do keep well and are easily transported.

The recent average annual production in Australia is less than 6000 tonnes with the majority grown in Queensland and northern NSW.

With the move to New Zealand by the Heinz cannery, SPC has now become the largest domestic user of navy beans. As the navy bean market is relatively small, growers are advised to seek market trend and price information prior to planting.

Since 1993, Bean Growers Australia has assumed all the responsibilities for seed supply, intake, handling, drying, grading, storage and dispatch of navy beans. BGA payments for Navy Beans are made on a pool basis or GMP contract and vary between different grades. Grades of navy beans are determined by bean size, the amount of admixture, splits and staining of the sample.

Soil Requirements:

Growers should avoid soils and blocks which can become waterlogged. Navy beans grow on a fairly wide range of soils provided they are well drained, friable and fertilise with soil pH preferably in the range 5.5 to 7.5. For soils outside this range, small areas should be trialled first.

Navy beans are a crop that has a high dependency on VAM. Thus if planting a crop into long fallow country, the levels of this beneficial soil fungi is likely to be low. High rates of phosphorus and zinc fertilisers will only partly compensate for low VAM.

Varieties:

Spearfelt	· Great all rounder that now makes up 90% of the crop grown from far north Queensland to northern New South Wales · Higher yield potential than Actolac · Some susceptibility to Peanut Mottle Virus · Little lodging with erect plant structure · Very good for direct harvesting · Threshes out well with little shattering · Rust resistant
Rainbird	· Higher yield potential than Actolac · Good resistance to Peanut Mottle Virus (PMV), and is therefore a good option if peanuts are growing nearby. Some susceptibility to bacterial blight · Direct heading is possible because pods are higher off the ground · Prone to splitting and cracking – less prone to splitting and cracking than Actolac but more so than Spearfelt · Vines less than Actolac and Sirius · 5-7 days longer to mature than Spearfelt · Recommended in either dryland or irrigated situations · Rust resistant.
Sirius	· Higher yield potential than Actolac · Some susceptibility to Peanut Mottle Virus (PMV) · Can be prone to splitting and cracking, but less than Actolac · Good bush size and pod height, some lodging but still very good for direct harvesting · Vining can be a problem · Slower to mature than Spearfelt · Best under dryland conditions · Rust resistant
Actolac	· Superior root system to Kerman and therefore has better tolerance to stress conditions · Susceptible to rust · Less suited to direct harvesting than Rainbird, Sirius and Spearfelt and is more prone to shattering and splitting if not harvested at high moisture content · Recommended for all soil types · Very quick maturing crop 84-91 days.

Planting Conditions:

Field preparation should aim to produce a fine, level seedbed to ensure an even depth of planting and good seedling emergence. Poor land preparation is often a major factor in poor crop responses.

For Navy Bean germination, a minimum soil temperature of 17^{o}C is required and flower abortion occurs at 35^{o}C and above.

Row Spacing:

Wider rows of 75-90cm suffer less disease problems, although narrower spacings may have a yield advantage under favourable growing conditions or irrigation. If planting on narrower rows, increase plant populations to assist direct harvesting.

Seeding Rates:

Seedling rates should be between 30 to 40 kg/ha for a dryland cropping situation up to 45 to 50 kg/ha for irrigated systems. This is in order to achieve plant populations of between 125,000 to 175,000 plants/ha in dryland farming conditions and 225,000 to 250,000 plants/ha in irrigated systems.

Planting Depth:

Aim to plant into, rather than onto moisture – usually 30-50mm deep. On clay soils, establishment declines rapidly below 50mm planting depth. Poor emergence is often a problem on crusting soils.

Inoculation:

Despite being a legume crop, navy bean is not inoculated as it relies on soil and applied nitrogen.

Nutrition:

Nitrogen	· Unlike most other legume crops, navy bean plants need nitrogen much earlier and at higher rates than their nodules are able to supply it. To realise full yield potential the crop is reliant on either soil or fertiliser nitrogen supply. · There is only limited benefit from nitrogen fertiliser where soil nitrate levels are above 30mg/kg. When these levels are below 30mg/kg, nitrogen should be applied pre-plant or at planting. · Fertiliser should not be placed in contact with the seed.
Phosphorus	· Navy bean are highly responsive to applied phosphorus where soil test levels fall below 20mg/kg.
Potassium	· Potassium should be applied in situations where know deficiencies exist.
Sulphur	· Using single superphosphate to apply the above phosphorus rates will alleviate any potential sulphur deficiency · Alternatively, the use of ammonium sulphate as the nitrogen can be a sound option, especially on high pH soils.
Zinc	· Usually one foliar zinc spray is recommended. · Two sprays may be required on soils with known zinc deficiency problems.

Irrigation:

Navy bean can be successfully grown under both flood and spray irrigation, provided waterlogging can be avoided. Best yields are achieved by planting into good subsoil moisture and ensuring that the crop does not stress from just before budding through to maturity. Beans are very sensitive to damage from saline irrigation water, particularly where spray irrigation systems are being used. It is advisable to check water quality when using bore water for irrigation.

Weed Control:

A clean fallow and inter-row cultivation are mechanical options for weed control, alternatively growers should consult with their agronomist to decide on preferred chemical options.

Diseases:

Charcoal Rot	· This disease has become the most serious disease of navy beans over the last five years · It is a common soil fungus which survives in the soil for a long time and has a wide range of host plants including soybeans. · Also referred to as Ashy Stem Blight · Symptoms include a black area on one side of the stem where the old seed cotyledons were attached · This area spreads eventually to encircle the stem. · Seedling death can be in isolated plants or result in total loss of the plant stand. · Weather conditions, particularly hot and dry, cause stress to seedlings is usually associated with infection. · Older plants can show similar symptoms at any stage of crop growth. · It is through the fungus infects the plant at seedling stage but remains symptomless until the plant undergoes stress. · Dryland crops that have had good early growing conditions and then hot dry conditions at flowering are particularly susceptible. · Plant growth can be severely affected or there may be plant death · The stems of dead plants are usually ashy coloured with small black dots on the surface · There is no proven control measures at present other than trying to plant into good soil moisture and avoid hot conditions at emergence.
Damping off	· A seedling disease caused by a soil dwelling fungus associated with the breakdown of organic material which causes seedlings to rot before or after emergence. · Control is by reducing undecomposed trash levels in the planting row, and by planting no deeper than 5 cm.
Common bacterial blight	· Appears on leaves, causes small angular water soaked spots which coalesce to form large brown dead areas, commonly with bright yellow margins. · Stems have dark green or tan streaks; pods have small water soaked spots with yellow ooze in the centre. · Two devastating bacterial diseases that can be most effectively controlled by the use of disease-free seed.
Rust	· First notice on older leaves as small yellow spots · As it progresses, the centres of these spots become raised and reddish-brown, with a mass of small, powdery spores emerging through the ruptured surface. · Spots are known as pustules and can also be found on stems, pods and young leaves · A high incidence of this disease will result in death of leaves · Most current varieties have good resistance to rust at the present.
Peanut mottle virus	· Symptoms include cultivars showing a mild leaf mottle · Sometimes more severe symptoms are evident including dead areas on the leaves and reddish brown discolouration of the leaf veins and stems · The disease is spread by aphids from peanut crops, and can be a serious disease when navy bean crop grown near to peanuts · Rainbird is the only variety with full resistance to this disease.

Sclerotinia	· Appears as a brown, watery soft rot on the stem, leaves and pods, with masses of white, fluffy fungal growth. · Large, irregular black resting bodies form in the rotted tissues · Can cause severe losses under cool, damp conditions · Disease attacks plants from early flowering onwards, the spores infecting flowers with dying petals which carry the disease down into the crop · Under ideal conditions, the disease can spread very rapidly and is worst below the leaf canopy of thick crops where conditions are the most humid · Best form of control is through crop rotation · Other crops that host the disease include peanuts, soybeans and chickpeas. · Chemical control is very expensive and can be difficult to implement because of problems achieving good spray penetration down into the crop canopy.
White mould	· A dry rot may be detected in the root and stem of the plant · White fungal growth can be seen on the root or stem and small brown sclerotia the size of cabbage seed. · This fungus occurs in the soil and can survive for several years. · High soil temperatures, fluctuating soil moistures and an abundance of un-decaying organic matter favour the disease

Insects:

Navy bean are very susceptible to insect attack and crop monitoring is required during all growth stages – even low yielding crops may warrant spraying.

Heliothis	· Most significant pest in navy bean and can reduce both grain yield and quality · The small whitish eggs are individually laid on the top of the leaf surface in the upper canopy during flowering · Heliothis does most of its economic damage by feeding on flowers and pods as they develop. · Infestations may sometimes occur during the vegetative stage · When scouting for heliothis, open flowers and check for small larvae, as well as shaking plants to dislodge larger larvae. · The level of infestation, larvae size, crop stage and the presence of pod sucking insects will al influence the choice of chemical and rate of application
Green Vegetable Bug	· The other primary insect pest of navy beans is GVB · They feed on the developing seed and while they can significantly reduce yields, their biggest impact is on seed quality. · The damage navy bean by piercing the pods and sucking the developing seed inside. · This results in abortion of small pods and seeds, shrivelling of partly developed seeds and potting and staining of large developed seeds. · The plant can usually compensate for early damage by increasing the size of undamaged seed. · Because price penalties for staining of seed are high, most of the economic damage is to seed quality.
Bean fly	· Adult is a small black fly which lays its eggs on the upper leaves of the plant · When the larvae hatch, they burrow in through the stem of the plant · Early infestations can destroy seedling crops and should be monitored from emergence through until the mid-vegetative stage
Flower Thrips	· Very small insects that feed within flowers once they open · Sucking insects that can cause flower drop and malformed twisted pods that are difficult to thresh · Can only be detected by opening up the flowers and inspecting inside · Populations above four thrips per flower usually warrant spraying
Bean pod borers	· Can infest navy bean during budding and flowering · Larvae feed on buds, flowers and pods · Early detection and control is very important · Spray if more than three larvae are found per metre of row or at early flowering if moths present at flowering · Rarely a problem when crops are treated for heliothis at flowering.

Jassid	· Mobile, small sap-sucking insect commonly found hopping and flying around the plant · Insects feed by rupturing the cells in the leaf surface, which is usually evident as a white silver spotting · Heavy infestations cause a silvering or stripped effect over the upper leaf surface of the crop · Do most damage to young seedling crops, particularly if they are stressed. · Healthy, actively growing crops tend to tolerate jassid infestation and do not generally require spraying
Soybean looper	· Foliage feeding caterpillars that can often be found in navy bean crops, but rarely warrant spraying unless very high numbers result in flower and pod damage.
Mirids	· Small light-green or brown elongated bugs that are extremely mobile and often difficult to detect · Damage plants by causing flowers and young pods to abort

Harvest:

Harvesting navy beans is an imperfect science, so it is important to take steps to minimise harvest losses and mechanical damage. Even thought here is no recipe for harvesting navy beans, following some do's and don'ts should help growers to deliver the best possible sample to the bin. Harvesting planning should begin before planting for best results. Harvest is generally 14 to 16 weeks after planting.

To minimise pod shattering and cracking of the grain, harvest when the seed moisture content is about 13-16%. If possible, use a drum speed of 200 to 250 rpm and set beater speed at 100% of drum speed. Below 12% moisture severe grain cracking can occur.

Desiccation may be required where the crop has matured unevenly, or where green weeds are present at harvest time. Optimal time to desiccate is difficult to determine however a guide would be when 85% of the pods are completely brown or yellow. Growers should as usual consult with their agronomist for registered desiccants and the preferred option for their individual situation. A moisture content of 15% is the maximum acceptable for storage by BGA, without a drying charge being imposed. Payment weight is worked back to a 13% moisture basis. Severe cracking can occur in the grain when handling beans below 12% moisture and belt elevators rather than augurs should be used.

Potential Yields:

An average yield of 0.75 t/ha can be achieved in dryland cropping situations and 1.8 t/ha average in irrigated crops.

Gross Margins:

As an indicative guide, navy bean gross margins from the Darling Downs/Moreton area have been detailed as follows. This information is only presented as a guide, and does not reflect the true cost of growing navy bean in the Isis Cane Supply area.

ITEM			IRRIGATED		DRYLAND	
INCOME				/ha		/ha
Expected Price ($/t on farm with GRDC levy $7/t deducted)				$643		$643
Expected Yield (t/ha)				2.00		0.80
EXPECTED INCOME ($/ha)				$1,286		$514
VARIABLE COSTS	**COST**	**$/unit**	**rate/ha**	**$/ha**	**rate/ha**	**$/ha**
Operations ($/ha)						
Heavy till	4.70	/ha	1	4.70	1	4.70
Medium till	3.80	/ha	1	3.80	1	3.80
Light till	3.50	/ha	2	7.00	2	7.00
Inter row	3.75	/ha	2	7.50	2	7.50
Boom spray	1.30	/ha	3	3.90	3	3.90
Aerial spray	8.00	/ha	2	16.00	2	16.00
Plant	4.00	/ha	1	4.00	1	4.00
Harvest	10.15	/ha	1	10.15	1	10.15
Fallow spray (L product)						
Glyphosate	5.00	/L	0.8	4.00	0.8	4.00
Seed (kg)	1.40	/kg	50	70.00	35	49.00
Fertiliser (kg product)						
Nitrogen	0.73	/kgN	100	73.29	50	36.65
Phosphorus (Starter P + Zn)	0.53	/kg	60	31.50	40	21.00
Zinc	1.04	/kg	4	4.16	4	4.16
Herbicide (L product)						
Trifluralin	6.30	/L	1.7	10.71	1.7	10.71
Basagran	34.00	/L	1.7	57.80		
Insecticide (L product)						
Endosulfan	8.96	/L	2.1	18.82		
Dimethoate x 2	8.20	/L	0.8	6.56		
Bt	11.83	/L	2.0	23.66	2.0	23.66
Thiodicarb	26.39	/L	0.75	19.79	0.75	19.79
Irrigation (ML/ha)	40.00	/ML	4	160.00		
TOTAL VARIABLE COSTS			$537		$226	
GROSS MARGIN ($/ha)			**$749**		**$289**	

BREAK-EVEN YIELD (tonnes/ha)	0.83	0.35
BREAK-EVEN PRICE ($/tonne)	$269	$283

Study Crop:

OATS

Recommendation: ✗

Given that no market exists for oats in Queensland and that a number of other, more beneficial crops, could be used as a green manure crop, this study finds that oats are not suitable for production in rotation with a cane crop in the Isis Area.

Uses:

Oats are the main winter forage in Queensland as they are able to produce good quality feed when most pastures are dormant. Grower rely on oats for livestock fattening during their finishing period from winter to early spring as compared with other pastures, oats produce better live-weight grain.

Market:

With over 200,000 hectares of oats grown annually in Queensland, its benefit to the grazing industry is estimated at $97 million. Grazing or bailing is the only market for Oats in Queensland, given that grain varieties are not suited to this climate, therefore there is only a limited niche market for oats as feed.

Varieties:

Grain oats are of minor importance in Queensland as there are no grain varieties suited to the warmer growing conditions. Planted at a similar time to wheat so as to avoid frost damage at flowering, oat grain frequently has to mature in hot dry weather. This promotes small and shrivelled grain, rather than pump-kernelled grain that is required by the oat grain feeding and milling markets. The seed still has god germination and is used for the generation of planting seed.

Planting Time:

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
				■	■						

Due to susceptibility to disease and temperature, the planting window for oats is extremely narrow between May to June.

Row Spacing:

18-25cm row spacings are the recommended widths.

Planting Depth:

Oats should be planted at a depth of 50 – 75mm.

Diseases:

A major limiting factor to growing oats for forage or grain is the frequent occurrence of diseases, such as leaf and stem rusts caused by the fungus Puccinia. Leaf rust appears as small light orange pustules, mostly on leaves and leaf sheaths. Stem rust produces dark, reddish brown pustules on leaves, stems and heads. Both rusts spread rapidly during warm, wet weather and have less impact during cool, dry conditions. Both rusts survive between cropping seasons on wild oats and volunteer oat plants, thus providing a continual supply of inoculum for rust outbreaks each year.

Harvest:

Oats are generally not harvested in Queensland as there are no grain varieties suited to our growing conditions. However oats can be used for haymaking.

Study Crop:

PEANUTS

Recommendation: ✓

Given the success of current peanut break crop rotations with cane in the area, it makes sense that peanuts are a viable crop to be introduced into the cane system. Peanuts have the capacity to offer some significant economic returns for growers and have an established market with ongoing agronomic advice available in this district. Growers will need to consider, however, the non-return of nutrients to there soil, following a peanut break crop.

Description:

Peanuts have traditionally been grown under the rain fed conditions in the red volcanic clays of the South Burnett. Increased market demand for the high quality food product has seen development of new production areas with irrigated sandy loams and more intensive practices.

Market:

The main processing plant for peanuts is in Kingaroy where shelling, grading, blanching, roasting and packaging for distribution occurs. The crop is consumed mainly in the Australian domestic market with an increasing amount going to export where premiums can be earned due to the inherent high quality of peanuts produced in Australia. Australian production does not satisfy demand, and the shortfall is made up with imported peanuts.

The majority of the crop is handled by the Peanut Company of Australia and a number of shelling plants also clean, shell, grade and market peanuts. Payment for peanuts is based on kernel quality with different prices for the range of kernel size in a given load.

Soil Requirements:

Peanuts yield best in well-drained, friable soils. Harvest losses can be very high in hard setting and heavy clay soils. Sandy and some forest soils may be low in calcium and lime or gypsum may be required to prevent empty shells in Virginia type peanuts. Growers should be aware of the levels of organochlorine pesticide residues and heavy metals in their soils prior to planting.

Varieties:

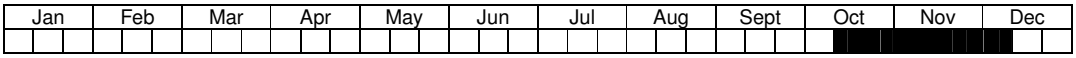
Virginia varieties that are characteristic of an erect growth habit is the conventional variety grown in this area, with Streeton remaining one of the best varieties in terms of yield and drought tolerance. A new variety, Conder has been released primarily for irrigated central Queensland farming systems and has shown mixed results in rain fed systems. Runner types with a more prostrate growth habit are the preferred varieties for irrigated conditions.

Planting Conditions:

Peanuts need to be rotated with crops as they return very little organic matter to the soil and result in soil structure decline if a block is continually producing them. Poor yield (reduced by up to 15% if double cropped) and the build up of disease results from double cropping, so ideally peanuts should be grown every three to four years in rotation with cane.

Peanuts do not need a really fine seedbed, some clods, up to 25mm, can be tolerated.

Planting Time:



Virginia and Runner varieties are generally planted in the Isis area between mid-October to early December. Soil temperature should be about 20^{o}C at planting depth. If planting a large area, staggered plantings are recommended to minimise the risk of a wet harvest or end of season drought.

Seeding Rates:

Peanut seed is easily damaged. It should be treated with care and not be thrown around or left in the sun. The right sized planter plates should be used and the planting tractor should be driven at a moderate speed – not too fast. Seed should also be treated with a recommended fungicide to reduce seedling disease.

For irrigated crops, a plant population of at least 120,000 plants/ha should be aimed for with approximately 750 to 1800 seeds/kilogram.

Inoculation:

Peanut seed must be inoculated, either through water injection or a dry mix in the seed box. Group P inoculant is to be used.

Seed Germination:

Seed germination can occur within 24 hours under ideal conditions, and once the radicle has emerged from the seed, it is virtually unstoppable. Cool wet conditions within the first 24 hours can destroy emergence. The seed is very susceptible to soil borne pathogens and adequate seed treatment is essential.

Nutrition:

Soil tests should be conducted every season with peanuts. Peanuts make use of residual fertiliser left over from other crops in the rotation. Phosphorus, potassium, calcium and sulphur are the most common nutrients that need to be applied to peanuts, they do not respond well to banded fertiliser application at planting, because of their extensive root system. Under irrigation, the trace elements boron, zinc and molybdenum should be monitored.

Calcium is absorbed directly from the soil by the developing pod and low calcium levels lead to empty shells. Supplemental calcium sources like lime or gypsum are used to raise calcium soil levels. A soil test will indicate whether more calcium is required. Lime should be applied and incorporated into the soil prior to planting, especially on acidic soils.

Zinc deficiency should be corrected by applying zinc sulphate monohydrate to the soil and boron deficiencies with elemental boron. Magnesium deficiencies can be corrected with elemental magnesium or dolomite.

Irrigation:

Overhead irrigation is probably the preferred option, but can increase the level of leaf disease if followed by rain soon after. Pre-watering is recommended prior to sowing, allowing seed to remain in dry soil for several days may result in poor germination and seedling vigour.

Slight water deficits, which occur during early vegetative growth, do not usually result in yield loss. Excessive irrigation during early plant growth may result in excessive vegetative growth and shallow root development. Irrigation during early vegetative stage is recommended only to limit severe water stress.

Once pegging and pod formation has begun, it is recommended that the pegging zone be kept moist as this facilitates the uptake of calcium by pods, essential for seed development.

Peak water use occurs at about 12 to 16 weeks from emergence during pod fill and maturity and can be as high as 75mm/week. During pod fill it is essential to maintain adequate moisture in the pegging zone to achieve maximum kernel quality through calcium absorption.

Water requirements are 3 to 7 mega litres/ha, depending on season and soil type.

Weed Control:

Effective weed control is essential in peanuts as weedy crops result in very high harvest losses due to mechanical difficulties at digging and threshing. Control is implemented with block design, and two inter-row cultivations are usual to control seeds. This practice also helps with harvesting making the loose soil easier for the pegs to penetrate. A combination of cultivation and herbicides is usually necessary. Hand chipping can be cost effective.

Having said this, there is an increasing trend in irrigated systems to avoid inter-row cultivation through the use of residual herbicides as evidence suggests cultivation can increase soil borne disease.

Diseases:

Rust & Net blotch	· Spores are spread during wet weather, dew and irrigation · It takes about 7-10 days after infection before the disease becomes evident · Crops should be checked twice a week for leaf diseases on older leaves and underneath leaves · Rain fed peanuts can tolerate a low level of infection before yield is lost · Under irrigation, leaf disease can increase rapidly · The foliage diseases can be managed with a regular fungicide program
Leafspot	· Leafspot fungi cause dark brown to black spots on the leaves and these will first show on the oldest leaves · The fungi will survive on peanut stubble so peanuts following peanuts will be infected earlier than peanuts after another summer crop
Peanut rust	· Will only infect peanuts · Rusty lesions are mainly found on the lower surface of leaves · Living peanut plants are needed for rust to survive, so all volunteers should be eliminated · Usually spreads form small, isolated patches
Net blotch	· Forms fine, dark brown lines on the top surface of the leaf · These develop into smudgy, brown/black areas which extend through to the lower surface · Most severe later in the season in cool, showery conditions.

Insects:

Heliothis	· Less of an issue in peanuts than in other legume crops, but high populations can occur in years of widespread heliothis activity. · May need control if more than 12 larvae/metre or are feeding on leaves before flowering · Up to one third defoliation prior to flowering can be tolerated without yield loss.
Mirids	· The provisional threshold for mirids in peanuts is 4/metre row · Spraying with the registered insecticide kills beneficial insects attacking heliothis and the need to control mirids must be weighted against the risk of inducing an outbreak of heliothis – which may be difficult to control with current pesticides
Lucerne seed web moth	· A spasmodic but major pest of peanuts · Capable of causing severe damage in some years · Attacks all parts of the plant, except the leaves · It's there feeding of harvestable pods that is of greatest concern · Damaged kernels are completely unacceptable as edibles, and this together with the increased aflatoxin risk, can result in major penalties for infested peanuts · Develop best in hot dry weather, particularly after flowering · Damage is worst on light soils · It is likely that irrigation and heavy rainfall close to harvest suppress activity · No pesticides are currently registered
Jassids	· Heavy infestations cause a silvering or stripped effect over the upper leaf surface, but rarely decrease yield · Do most damage to young seedling crops, particularly if they are stressed under hot, dry conditions
Mites	· Two-spotted or Red Spider mite is rarely a problem, primarily because of the low overall use of pesticides · Peanut mites are much larger and cause similar damage · Are most common on young plants in periods of drought · Suppressed naturally with rain, and plants rapidly outgrow damage.

Harvest:

Harvesting of peanuts involves:

Digging	· Where the tap root is cut, soil is shaken off and the bushes inverted and left to dry in a windrow
Threshing	· Where the windrow is picked up and the pods separated from the bush by a specialised Peanut Thresher
Cleaning and drying	· Where the pods are cleaned of extraneous dirt, sticks, stones and then artificially dried to safe storage moisture
Delivery	· To a processor in semi trailers with specially fitted high sides. Peanut pods weigh around 300kg/cubic metre.

Harvesting operations must be timed correctly and the specialised equipment used must be correctly adjusted. The decision to dig peanuts can be difficult to assess, as the crop is indeterminate. Peanuts flower over a long period, so there will be over-mature, mature and immature pods at harvest. Digging too early will result in lightweight kernels and many immature pods in which the kernels shrivel and are only suitable for crushing for oil.

Ideally, peanuts should be dug when around 60-70% of pods show darkened veins on the inside of the shell. This may not always be possible. It is important to pull and check the pods of several plants in a particular block to determine when to harvest. Before digging, consider peg strength, disease, weather conditions, soil conditions, and the area to be harvested.

Curing

Leaving peanuts to dry down to 13% moisture in the field is a risk, as it may take 7 to 14 days and risk the crop from aflatoxin, rain, birds and over-drying. Threshing at a high moisture content and artificial drying is essential for consistent production of good quality peanuts. 18-20% is the ideal threshing moisture.

Potential Yields:

Dryland yields in the South Burnett tend to average 1.8t/ha and average yields of 4.0 can be achieved for irrigated crops, although some growers are beginning to achieve yields up to 7.5t/ha. The delivered crop is shelled and then graded into different sized kernels and payment is made on the basis of these grade and quality.

Gross Margins:

High quality peanuts from irrigation can return up to $800/tonne while drought stressed rain fed peanuts can still return $400/tonne.

Potential Benefits:

Growers should be aware that peanuts remove large quantities of nutrients from the soil. Every tonne of peanut hay contains the equivalent of 40kg of muriate of potash and 16kg of superphosphate. Nut-in-shell peanuts contain 16kg of muriate of potash and 30kg of super in each tonne. It is vital to replace these nutrients removed from the block.

Additional information of interest:

Peanuts are a difficult crop to grow under zero till. They are easy to establish and grow well under zero tillage, but there is a risk of harvest difficulties if there is a dry finish to the season. There have been a few commercial crops of zero tillage peanuts; some have been inter-row cultivated to assist harvesting, while other have been harvested with conventional peanut equipment. Effort is being put into developing a system of controlled traffic and growing the peanuts in raised beds. This overcomes the potential harvest problems in the dry years.

Study Crop:

PIGEON PEA

Recommendation:

Pigeon Pea is an 'either/or' crop that wont save the sugar industry in the Isis area, but given the right circumstances and situation, does have potential. It's not a high income crop, however, it does offer a potential market, is quite drought resistant and is ideal for rotation with a cane crop. Its susceptibility to heliothis though is of concern and this would need to be stringently monitored. Being a legume crop, it also offers nitrogen benefits to subsequent cane crops. Pigeon Pea is an option for rotation with cane, but should not be heavily investigated as a viable option.

Description:

Despite considerable interest in pigeon peas, particularly in the 1980's, plantings of this crop have appeared to have declined sharply over the last decade. The main reason for this has included the relatively low commodity prices of approximately $300 per tonne to growers. Pigeon pea also are extremely susceptible to heliothis damage over a prolonged grain-filling period and this situation can be further aggravated by problems with heliothis resistance to insecticides during the February-March period. There is also inconsistent yields due to agronomic constraints such as poor nodulation, waterlogging. As such, growers interested in growing pigeon peas for grain should obtain contracts prior to planting, consider a row crop system that will enable band spraying and cost inputs for heliothis to be kept to a minimum and seriously assess the suitability of their soil type for pigeon pea production.

Market:

India is the major producer of pigeon pea, growing approximately 2 million tonnes annually, which is 90% of the world market. The seed is processed and sold as a dry split pea (dhal) for human consumption. This product is easily substituted with dhal from other pulses such as chickpea, mungbean and blackgram. India is also the major importer of pigeon pea, though there is only a relatively limited quantity of pigeon pea traded on the world market.

Soil Requirements:

Although pigeon pea are reported to grow on a wide range of soil types, ranging from strongly acid to alkaline, they do not appear to tolerate waterlogged conditions, compacted or high density soils and high pH soils. Soils with a pH of around or below pH 7.5 appear to be more reliable in growing good pigeon pea crops.

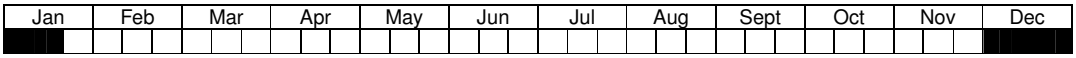
Climatic Conditions:

As pigeon pea is a tap-rooted, short lived perennial shrub, it is relatively tolerant of dry conditions. This drought hardiness enables the crop to be grown in environments which are only considered suitable for sorghum.

Varieties:

Most of the older varieties have been superseded by a variety called Quest. A whitish seeded variety called Campea has also been released, but can be difficult to access planting seed. The variety E-76 was recently stockpiled for commercial release. Pigeon pea varieties will readily outcross if two or more varieties are grown in close proximity, due to cross pollination by bees. Seed crops should be separated by at least 5km from other varieties.

Planting Time:



Commercial grain crops are generally planted during December to mid-January. Grain crops appear that they would mature in approximately 110-120 days in this region and as such this planting should occur this period prior to the likely incidence of the first frost in the area.

Row Spacing:

The crop is grown on row spacings of 18-100cm although narrow row spacings of 18-50cm will encourage more even flowering and maturity.

Seeding Rates:

Plant populations of 10-15 plants/square metre are considered to be adequate under most dryland conditions and seeding rates of 15-20kg/ha will often be required to achieve a population of 10-15 plants/square metre. This is due to the highly variable nature of germination and establishment in pigeon pea.

Planting Depth:

Seeds should be aimed to be planted to a depth of 3 to 5 cm into moist soil in order to reduce the risk of problems with poor establishment. Situations where soil crusting is a high risk should be avoided.

Inoculation:

Pigeon pea requires to be inoculated with Group J (CB 1024). The levels of nitrogen fixation are highly variable, especially where pigeon peas are being grown on highly alkaline black earths with a pH of above 8.0. The use of nitrogen fertilisers may still be worth considering though in potentially high yielding situations, eg. Under irrigation.

Nutrition:

Pigeon pea are extremely sensitive to low VAM situations and 'long fallow disorder'. Growers should avoid planting this crop where the fallow period is longer than 10-12 months. Fertiliser is the same as for other legume crops including zinc, phosphorus, potassium and sulphur.

Weed Control:

As pigeon peas only make slow early growth, they are extremely sensitive to weed competition. There are a number of products currently registered for control in Queensland.

Diseases:

There are no major diseases of pigeon pea that are recorded in Australia. There is some concern over the current status of pigeon pea in relation to hosting and multiplying black root rot fungus, as other pulse crops have been reported to perform this characteristic.

Insects:

Heliothis	· Pigeon peas are often severely attacked by heliothis, and can completely devastate a crop if left untreated. The first flush of egg laying usually coincides with the start of flowering, and crops should be regularly scouted from this stage onwards. · Problems with heliothis management in pigeon peas are further complicated by the prolonged and uneven pattern of flowering and pod-fill in the crop.
Bean pod borer	· Egg laying occurs at flowering, although this usually commences slightly later than for heliothis. Most insecticides used for heliothis control will also control this pest. Young hatchlings feed on the flowers and buds and are readily controlled with insecticides.
Green Vege Bug	· Crops should be closely monitored for this pest.

Harvest:

Since pigeon pea is a perennial, the plant can still be very green despite the pods having dried to below harvest receival moisture. Frosts will kill the plant, and are known to be used to naturally desiccate the foliage prior to harvest.

Potential Yields:

Yields are common in the range of 0.5 to 2.5 t/ha.

Study Crop:

SAFFLOWER

Recommendation:

Safflower is an interesting crop that appears to be agronomically suited to this area, given its drought tolerance, climatic conditions and soil requirements. It appears to have great market potential and offer significant financial returns to growers, although on farm storage is a requirement. If a market is secured for this crop, trials may be beneficial, particularly to dispel concern that safflower may be classified somewhat as a weed in a cane rotation, given its woody stem and thistles.

Description:

Safflower is a winter-spring growing plant, native to Asia and Africa, and is in the same family as Sunflower. It is an erect, woody stemmed branching plant with thistles, and is produced in large quantities throughout the USA, Mexico and India, and to a lesser extent China and Africa where it is used for human consumption and to make dye. It has also been grown for a number of years under irrigation, and in the summer rainfall areas of Australia (Queensland and New South Wales).

Uses:

Safflower is primarily used for culinary oil purposes, and like sunflower oil, it is rich in linoleic acid, an essential fatty acid. The seed is also used in the birdseed market as well. The flowers have been known to be used for there medicinal purposes as they are a laxative and induce sweating and have often been used as an infusion to deal with complaints regarding measles, eruptive skin disease and can be used to stimulate the menstrual flow.

Market:

Most Safflower is sold to domestic oilseed crushers for oil and meal production, although small amounts are exported in some seasons. Some is also sold as birdseed. Agracorp is the market agent that is listed to discuss safflower market prospects.

Soil Requirements:

Safflower should be planted into a block with a high level of stubble residue to prevent soil moisture loss over summer. Well drained soils with a near neutral pH and good water holding capacity are best. Safflower is reasonably salt tolerant and has a tap root which can exploit moisture down to 1.5m, therefore good yields will be most likely when the soil moisture profile is full at seeding. The block should have a low broadleaf weed problem, because in crop broadleaf herbicide options are limited.

Climatic Conditions:

Safflower can be grown in areas with little or no rainfall over spring and summer, as long as the golden rules of management are followed. It has a wider planting window than the other warm season crops, with good cold tolerance as a seedling and excellent drought tolerance as a mature plant.

Varieties:

Good disease and drought tolerant varieties such as Sironaria and Sirothora are recommended.

Planting Conditions:

Conventionally, safflower is normally grown in rotation with cereal crops, but is also known to be grown in rotation with legumes, pastures, fallows, oilseeds and cover crops. Potential growers would need to check the herbicide history of the block and the plant back periods for residual herbicides used.

Planting Time:

Safflower is normally planted between mid June and late August, once the soil temperature reaches 10^{o}C at a depth of 10cm at 9.00am. Safflower will tolerate frost during the rosette stage, but becomes susceptible to frost during stem elongation and branching, so planting should not take place 10 weeks before the last frost normally occurs.

Row Spacing:

Safflower has been grown successfully on narrow row spacings (18-75cm) in low rainfall areas, however, 1 m row spacings are emerging as the preferred width as they reduce the risk of moisture stress during critical growth stages (budding, flowering and seed development).

Seeding Rates:

Safflower should be planted at 8 – 12 kg/ha. Plant density, row spacing and even distance between each plant in the row are not as critical to success as they are in other grain producing crops. At low plant densities or uneven plant distribution, Safflower will branch out to compensate. Excessively high plant densities can lead to moisture stress. Low seeding rates can be targeted when sowing with precision seeders, or in marginal dryland areas. Higher seeding rates should be targeted if sowing with less accurate equipment (combines, airseeders) or in areas with more stored soil moisture and/or in crop rainfall.

Planting Depth:

Seeds should be planted into moisture at approximately 3-5cm. Growers should plant deeper if the top 5cm is dry, but it is important to remember that the deeper seeds are planted the colder the soil gets and the longer it will take for the plant to emerge. Establishment levels will vary depending on the type of seeding system used. Press wheels set at 2-4kg/cm width of press wheel will ensure good seed/soil contact without compacting the soil.

Nutrition:

Safflower appears to have a similar nutrient requirement to Wheat. A 0.5t/ha Safflower crop will need approximately 30kg/ha N, 15kg/ha P and 30kg/ha K. Trace elements should be applied 3-5 weeks after emergence as a foliar treatment. Safflower is not as responsive to N as wheat, and can access it from depth, so an application of N at seeding is all that is normally required.

Weed Control:

Good weed control is essential in Safflower as the crop will not compete well with weeds in the early stages of growth. There are a number of grass herbicides which can be used post emergent, however there are only a few options for broadleaf control, and all are pre sowing or pre emergent.

Diseases:

Alternaria Leaf Blight and Phytophthora Root Rot are the main diseases of concern in major Safflower growing areas, however, current varieties have reasonably good resistance to both these diseases.

Insects:

Problem pests include Heliothis and Rutherglen Bug. Soil insects such as cutworm occasionally cause damage during establishment, but do not normally warrant spraying. Heliothis and Rutherglen Bug are most damaging between budding and grain fill.

Harvest:

Safflower is an annual plant which will ripen and dry off without the need for chemical desiccation. The crop is physiologically mature when the stems and bracts around the seed head dry out and turn brown. Safflower does not lodge or shatter easily, and is normally ready for harvesting 4 – 6 weeks after wheat. Harvest can be done with a conventional header and front. Ground speed, wind speed and drum speed should be slightly lower than that used for wheat. Growers should harvest at 8% moisture, unless of course they have the capacity to dry grain on farm. Receival standards are 8% moisture, 34% oil and 4% admixture.

Price Indication:

Safflower normally fetches around $600/t.

Special Equipment Requirements:

As safflower is normally grown under contract to an oilseed crushing company, but because it is a minor oilseed, it is not always possible to deliver immediately, and growers sometimes have to wait for storage to become available. As such, on farm storage and grain drying/aeration facilities are essential.

Study Crop:

SESAME

Recommendation:

Sesame is a crop of potential. It appears that it would be suitable to be grown commercially in the area, however there are a number of compounding factors limiting the production of sesame. These namely include a secure market and investigation into mechanisation with respect to harvesting. The future predictions in relation to the world sesame trade also indicate the potential of this crop.

Description:

Sesame is an important crop as it has a number of agricultural attributes including its adaptation to tropical and temperate conditions, growth on stored soil moisture with minimal irrigation or rainfall and can produce good yields under high temperatures and has a high value grain.

Uses:

Sesame is an ancient oil crop supplying seeds for confectionery purposes, edible oil, paste (tahini), cake and flour.

Market:

Sesame world production areas have remained generally stable over the years, but in some countries the crop is being marginalised. Competition from more remunerative crops and a shortage of labour have pushed sesame to less fertile fields and to areas of higher risk. Left unchecked, sesame production may decrease in the foreseeable future. This market outlook provides an opportunity for Australia to produce larger quantities of higher quality sesame seed to replace 'lost' world production.

Soil Requirements:

Sesame grows best on well drained soils of moderate fertility. The optimum pH for growth ranges from 5.4 to 6.7. Good drainage is crucial as sesame is very susceptible to short periods of waterlogging. Sesame is intolerant of very acidic or saline soils.

Climatic Conditions:

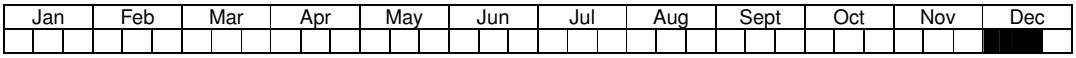
The response of sesame to both temperature and day length indicates that it is well adapted to wet season production in the tropics, or summer production in the warmer temperate areas. While there is some variation between cultivars, the base temperature for germination is about 16^{o}C. In temperate areas, soil temperatures determines the earliest date for planting. The optimum temperature for growth varies with cultivar in the range 27-35^{o}C. Periods of high temperature above 40^{o}C during flowering reduce capsule and seed development.

Hail and frost causes severe damage to sesame crops and strong winds as the crop matures will greatly increase the likelihood of lodging and pre-harvest seed losses.

Varieties:

Two sesame varieties have been developed for Queensland conditions, including Aussie Gold and Beech's Choice.

Planting Time:



The optimum planting date for sesame in Queensland is the second and third week of December.

Row Spacing:

Sesame seed should be planted in rows 30-50cm apart. If sesame is planted on 1 metre row spacings to fit with equipment configuration or irrigation arrangements, then the seeding rate should be reduced.

Seeding Rates:

Generally a seeding rate of 3.3 kg/ha of seed is required.

Planting Depth:

As sesame seed is small, planting depth should be no greater than 2.5cm and the seed should sown into moist soil.

Nutrition:

The fertiliser requirements for sesame will depend on the fertility of the soil, which will, in turn, vary with soil type and previous land use.

Irrigation:

The total amount of water required to grow a sesame crop ranges from 600 to 1000 mm, depending on the cultivar and the climatic conditions. The water requirement can be met from available soil moisture as planting, rainfall during the growing season and irrigation.

Weed Control:

Sesame grows slowly during the early stages of growth and is not strongly competitive with weeds. Poor weed control early in the life of the crop can result in greatly reduced crop yields. Zero tillage practices are being recommended in some growing areas in Australia, which involves planting the crop into a mulch that will reduce weed growth and has other benefits including reducing soil temperature, soil surface evaporation and protecting the soil from erosion. While no evidence at this stage, based on these practices, it is assumed that similar results may potentially be able to be achieved if sesame is direct drilled into cane trash.

Diseases:

Sesame is prone to root and stem diseases associated with waterlogging, while damping-off disease can also occur if humidity is high. To date, seven diseases affecting sesame have been identified, but only two of them, target spot and large cercospora leaf spot have severely affected grain yields.

Insects:

The only recorded problems to date from insects in Australia have come from the sesame leaf webber, heliothis caterpillars and green vegetable bug. Mirids may also infest sesame crops, although monitoring is critical as the yellow mirid is a beneficial and should not be sprayed while the green mirid may require control.

Harvest:

The indeterminate growth habit of sesame, with its subsequent uneven ripening of the capsules, creates difficulties for mechanical harvesting. However, techniques have now been developed that reduce seed losses during harvesting to less than 10%. It is important that the crop be completely dry before harvesting, as sap from green material passing through the header can discolour and taint the seed, creating off-flavours in subsequent processed products.

The recommended procedure for harvesting sesame is to spray the crop with a desiccant when at least 70% of the capsules have changed colour from dark green to light green or yellow.

The crop is harvested when 95% of the capsules have turned brown, which should be about 7-9 days after desiccation. At this stage, the grain moisture content will be about 6-7% in northern Australia. In temperate areas the moisture content is likely to be higher and the grain will require a longer time to dry before harvesting.

Sesame seed is easily threshed and relatively delicate, so drum speed should be reduced to about half of that required for cereals, and the concave clearance made as wide as possible. Seed damage during harvesting affects both the viability of the seed, storage and the quality of the oil.

For safe long term storage, sesame seed should be clean, have a moisture content no more than 6% and be stored at a relative humidity of approximately 50% and at a temperature less than 18^{o}C.

Price Indication:

An average price of $100/tonne can be achieved with sesame.

Additional information of interest:

One of the big drawbacks to the potential expansion of the sesame market in Australia is that extensive research is needed to adapt the crop to mechanical agricultural systems. Furthermore, as Australia is becoming more involved with Asian regional activities, where much of the world's sesame is grown, Australia's own agricultural self interest could be combined with its international extension and aid programs by taking the lead in a regional sesame research and development project.

Study Crop:

SORGHUM – GRAIN

Recommendation:

Undoubtedly sorghum will grow in the Isis Area, and is particularly easy to grow given that it is drought tolerant and is a quick maturing crop. However, it isn't suggested as a rotational crop, largely because there is a limited market, primarily as the crop is used for the feedlot industry. If production can access this market, then there may be opportunities.

Description:

Grain sorghum is a major component of the dryland cropping system of north-eastern Australia with approximately 60% of the Australian crop grown in Queensland.

Market:

The sorghum trade is completely deregulated. Sorghum produced in Australia is used almost exclusively for feed, especially cattle, pigs and poultry. None is used for human consumption, with a significant market exiting in the pet food industry. A minor export market exists, particularly to Japan.

Climatic Conditions:

Sorghum requires a warm, summer growing period of about 4-5 months.

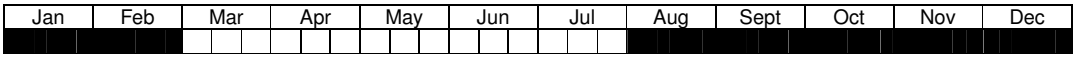
Varieties:

As lodging is a major problem, due primarily to moisture stress, lodging resistant hybrids are strongly recommended.

Planting Conditions:

Correct plant populations and row configurations are critical for reliable sorghum yields in marginal environments.

Planting Time:



Because of the variable rainfall in the grain growing areas of Queensland, the window of opportunity for planting sorghum is quite extensive and will vary between August to February. The general guide to when planting can commence is a minimum soil temperature of 15^{o}C at planting depth, provided this soil temperature is increasing.

Row Spacing:

At yield levels up to about 5 t/ha, row spacings of between 0.25 and 1.0m have little effect on yield. At higher yield levels, there may be a significant yield penalty at a 1.0m row spacing and spacings between 0.5 and 0.75m may be more suitable. Factors such as planter configuration and access to the block for spraying may also be influencing factors in the choice of row spacing.

Many producers have implemented changed practices in relation to their row configurations, and have adopted 'skip row' configurations as a risk management strategy aimed at improving yield reliability. Skip row configurations commonly used include single skip where every third row is not planted, and double skip, where two rows are planted and two not planted. A base row spacing of 1.0m is commonly used. Skip row systems can offer a number of benefits, including increased yield potential in marginal cropping areas and greater accessibility.

Seeding Rates:

The optimum plant population for a given situation is related to the yield target for that situation. As a general rule, the higher the yield target, the higher the plant population that should be used. If too low a population is used, there may not be enough plants present to achieve the yield target in a favourable season. If too high a plant population is used and moisture becomes limiting during the season, available soil moisture reserves may be utilised prior to flowering and moisture stress at flowering and during grain fill may result in low yields or total crop failure.

Planting Depth:

Seeds should be planted at 50-75mm into moisture and is assisted by the use of press wheels. It is only necessary to plant seed deep enough to give it sufficient moisture to germinate, and allow its roots to grow down through moist soil into subsoil moisture.

Seed Germination:

Germination rates generally average 90%, growers should check the bag label for the exact figure. Seeds with high laboratory germination usually have higher seedling vigour. Seed establishment can be low if hot dry conditions are encountered after planting. Press wheels should be used where possible.

Nutrition:

Nitrogen	· Nitrogen fertiliser application rates should be based on your target yield, seasonal expectations and previous block history. · Application rates will vary considerably from area to area. · Crop nitrogen requirements are supplied to sorghum as a nitrate in the soil, mineralised through the growing season and applied as a fertiliser. · Soil nitrogen levels can be determined using a soil test.
Phosphorus	· Summer crops tend not to be as responsive to phosphorus as wheat and barley. · Soil phosphorus levels need to be quite low before consistent responses to phosphorus fertiliser occur. · Deficiency symptoms include stunted plants and reddening of lower stems.
Zinc	· Yield responses to zinc from trial work and grower experience are common in many areas. · Zinc plays a vital role in a plant's ability to use nitrogen and transform it into yield and protein. · Zinc is a vital element to the plant and should not be overlooked in a balanced crop nutrition program. · Detection of zinc deficiency is not easy, but response to zinc fertiliser occurs frequently on old cultivation on heavy clay soils with high soil pH levels. · The availability of zinc to many crops is increased by the presence of mycorrhiza in the soil
Sulphur	· Sulphur responses appear to be quite common in sorghum, particularly on basaltic black earth soils. · Soil sulphur levels in this area are likely to be low, especially when gypsum and/or sulphur containing fertilisers have not been used regularly.
Potassium	· Potassium deficiency is rare in sorghum growing areas, but there is potential for the deficiency to occur. · Due to the gradual decline in soil potassium levels with crop removal and historically low fertiliser application rates, some red soils may require potassium fertiliser applications. · Potassium fertilisers cannot be placed in direct contact with seed at rates required. · Fertilisers should be applied by side banding at planting, combine drill preplant in fallow or broadcast and cultivated in fallow or prior to preceding crop.

Irrigation:

Sorghum is highly drought tolerant, but responds well to rainfall, especially during head forming and grain fill stages.

Weed Control:

Good weed control is critical for successful grain sorghum production, particularly in drier environments where weeds can rapidly deplete soil moisture reserves and summer weeds, especially grasses need to be adequately controlled. In addition to the use of herbicides, block selection is a critical weed control method.

Diseases:

Ergot	· Sorghum ergot is now endemic in Queensland. · It occurs at any time during the growing season · Readily identified by the 'honeydew' oozing from sorghum flowers · Ergot spores compete within pollen for a site on the sorghum flower making crops with impaired pollination at risk. · Ergot can reduce crop yield, cause harvest problems with stick honeydew, contaminate the grain sample and cause toxicity problems in livestock feeding heavily contaminated grain. · To minimise ergot contamination, growers should plant at recommended times and ensure even flowering.
Rust	· Early symptoms of rust on leaves are small purple red or tan spots. These enlarge to produce elongated raised pustules, which break open to release brown, powdery masses of spores. · Sorghum rust is more serious in late sown crops or susceptible hybrids in humid areas. · If the disease is serious, leaves are destroyed and pinching of the grain results.
Johnson grass mosaic virus	· Symptoms include mosaic, red leaf and red stripe. · Virus spread from plant to plant by aphids. · Control is by planting resistant hybrids, although a strain of the virus exists in Queensland, which can infect resistant hybrids.
Head Smut	· Symptoms include a booting stage where the head is replaced by a mass of black spores enclosed in a white fungal membrane, this membrane ruptures on emergence of the head and releases the spores. · Partially affected heads are sterile · Head smut is a soil borne disease that is favoured by cool weather · Best method of control is to sow resistant hybrids.
Leaf Blight	· Large elliptical spots up to 20 mm wide and 100 mm long, initially water soaked, but drying to straw-coloured spots with red, purple or tan margins depending on the hybrid. · Spores produced on leaf spots during moist weather are spread by wind. · The fungus survives on undecomposed sorghum residues, volunteer sorghum plants and Johnson grass. · Severe disease can cause pinched grain and lower yields. The disease may be serious on susceptible hybrids under humid conditions and in coastal areas. · Control is by sowing resistant hybrids where the disease may be a problem.

Insects:

The two main insect pests in grain sorghum are sorghum midge and heliothis. It is now possible to adopt a practical IPM strategy that eliminated the use of chemical sprays for both these pests in most years.

Harvest:

As a general guide, medium to medium-quick varieties will flower in 60-65 days when planted in October and 50-55 days when planted in late December.

As grain sorghum is a perennial plant capable of continued growth beyond physiological maturity of its initial grain crop. Preharvest treatment with glyphosate is a useful harvest aid, terminating crop growth by killing the development of immature tillers, desiccating green foliage and accelerating the natural drydown of mature grain. It improve timeliness of harvest and prevents unnecessary plant growth and wasting of accumulated soil moisture.

Glyphosate should be applied when the crop is physiologically mature at the "dough" stage, approximately 25-30% grain moisture, when a small black layer appears at the base of the seed. Plants will need to have sufficient unstressed green leaf at the top of the canopy to absorb glyphosate.

Harvest should not be delayed after glyphosate application as dead stalks are more likely to lodge especially in hybrids with only fair to moderate stand ability. Moisture stress during grain fill or strong wind after treatment can aggravate the problem.

If preharvest spraying is to become a regular management practice, choose grain sorghum hybrids with a four or five star lodging rating. Also, sorghum hybrids that produce a set number of tillers of uniform maturity (determinant) will respond better to treatment than those with tillers of varying maturity. Application rates are described on registered glyphosate product labels.

Study Crop:

SOYBEAN

Recommendation: ✓

Soybean production in the Isis Supply Area to date has been producing some incredible yields and has proved a very viable industry in the region, particularly in rotation with a cane crop. At the present, the market prospects for this crop continue to look good, particularly as there is an increased demand for soy health products. The construction of storage facilities and acquisition of equipment (if appropriate with regards to economies of scale), will continue to see this industry blossom in the Isis.

Market:

Soybean varieties with black-brown coloured hilums are usually contracted to either oilseed crushers or full fat processors. Varieties with lighter coloured buff hilums may also be suitable for the edible trade. Varieties conventionally grown in the Isis Area such as Warrigal and A-6875 are suitable for the production of soybean flour and have the ability to attract a price premium of approximately $20/tonne over the price for crushing beans. A-6875 is also sought after for the speciality tofu and soymilk markets..

Soil Requirements:

Suitable soils for soybeans range from traditional medium to heavy clay soils to the lighter and more acidic coastal soils. Soybeans grow best on a soil pH greater than 5.8, and as such lime treatments are recommended on acidic soils with pH less than 5.5.

Planting in soils with poor water holding capacity may mean a high risk of the crop suffering water stress at critical flowering and grain-filling stages. Poorly drained soils should be avoided as waterlogging poses a risk to successful seedling emergence and establishment. Planting on hills will give some protection against surface crusting.

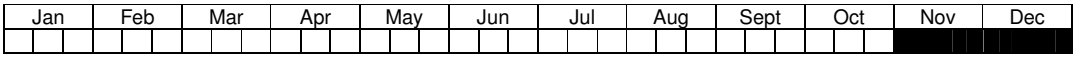
Climatic Conditions:

Soybeans are prone to grain weathering at, or near, harvest and this can be particularly important in coastal regions with inclement weather and prolonged rain delaying harvest. Weathering is the result of grain wetting and drying cycles leading to mould infection and discolouration of grain. Weathering tolerance implies a particular variety's capacity to resist or tolerate adverse weather conditions at grain maturity. If weathering conditions are severe, all varieties will eventually succumb to severe reductions in grain quality.

Varieties:

Be certain to select varieties suitable for the planting window and target market. A common reason for poor crop performance is incorrect varietal choice for a specific planting date.

Planting Time:



The principal planting window for soybean varieties that are suitable in this area is November to December, although there are some later varieties such as Leichardt, YY and Stuart that have a planting period from late December through to January.

Row Spacing:

The best results have been achieved from soybean grown as a row crop. Row spacings of 60 to 90cm are standard practice, however, narrower row spacings of 20 to 30 cm have advantages in high yielding irrigated crops, higher rainfall coastal crops, late plantings in January, and direct drilled crops.

Seeding Rates:

As seed size can vary from 5,000 to 7,000 seeds/kg, seeding rates should be adjusted accordingly.

Planting Depth:

Seed depth should be restricted to 30 to 50mm on medium clay soils, and 30mm maximum on wetter coastal soils. Growers should avoid using a roller or presswheel that press directly over the row after planting.

Inoculation:

To maximise nitrogen fixation and yield potential, all soybean seed should be inoculated with Group H (soybean inoculant) prior to planting.

Seed Germination:

All seed offered for sale must clearly state the germination percentage of that seed line. Use the best seed quality available, preferably over 80% germinable seed. 80 – 90% establishment is achievable in friable non-crusting soils when quality seed is used.

Fertiliser Requirements:

As a legume, soybeans fix nitrogen when properly inoculated and therefore only require phosphorus and potassium applied as a fertiliser. Fertiliser can be applied either during the planting process or pre-applied. Healthy soybean crops will also require trace elements, which can be applied foliar applications when the crop is young. The most common foliar sprays are zinc and molybdenum, but copper and boron may also be required if deficiencies occur.

Nutrition:

A soil analysis is highly recommended to determine specific fertiliser requirements. A starter nitrogen fertiliser may be required in situations with high levels of incorporated trash. Soybeans will respond to phosphorous and potassium fertilisers in deficient soils and a band fertiliser should be applied below and to the side of the seed. Sulphur, zinc, copper and molybdenum fertiliser may also be required.

Irrigation:

Flowering, pod-set and late grain fill are the critical periods to avoid moisture stress. Inadequate soil moisture pre-flowering will produce a short crop, which is difficult to harvest. A fully irrigated high yielding soybean crop will require a total of 6 – 8ML/ha from irrigation and rainfall. When water is limited, ensure its use is targeted at the critical flowering and pod-fill stages to maximise seed-set and grain quality.

Weed Control:

Coastal environments can have very high weed pressure. If weed control options are limited, planting in closer row spacings and maintaining a high plant population will be very important to aid crop competition with weeds.

Diseases:

Seedling root rots	· Symptoms include seed rotting in the ground and death of young seedlings after emergence · Outbreaks are most likely under cool, wet conditions · A large volume of buried trash in wet soils may compound these disease problems
Charcoal rot	· The disease usually appears between pod-fill and maturity with affected plants dying prematurely · Crops under severe moisture stress are particularly susceptible
Sclerotinia stem rot	· A white, cottony growth on the lower stem followed by the formation of large, black sclerotia. · The disease is favoured by cool, humid conditions and tall dense crops. · Avoid fields with a history of sclerotinia

Insects:

Insects may attack soybeans at any stage of crop development. The greatest risk is from flowering onwards when unchecked pests may cause serious yield and quality losses. Spraying during the vegetative stage may impact on beneficial insects, which buffer the crop against pest insect attack during the critical flowering/podding period. Growers should scout weekly during the vegetative stage and twice weekly from flowering onwards. The Isis Landcare Group has produced a 'Bug Book' to assist growers in the identification of insect species in soybean crops.

Heliothis	· Prior to flowering, soybeans can tolerate up to one-third leaf loss without yield penalty. · Larvae do most economic damage by feeding on buds, flowers and pods · Spray threshold from flowering on is 2 larvae/metre square
Green Vegetable Bug	· GVB can severely reduce both yield and seed quality by feeding on pods and developing seeds · Yield loss is confined to the first two weeks of podfill and spraying crushing soybeans for bugs after mid-podfill is a waste of time, although edible soybeans are at risk from quality loss until pods harden

Other insect pests in soybeans include soybean moths, loopers, podsucking bugs, field crickets, aphids, black field earwigs, lucerne crown borer, silverleaf whitefly and mites. Unnecessary spraying should be avoided to reduce the risk of minor insects inflicting significant crop losses and requiring additional control measures

Harvest:

Soybeans reach harvest maturity in about 4 to 5 months. Some crops may need to be desiccated, dependent on when they were planted. Coastal soybeans should be harvested as soon as possible after pod maturity to minimise losses, maximise grain quality and reduce the risk of wet weather damage. Harvesting at slow ground speeds and using a floating cutter bar can significantly reduce harvest losses. Reduced drum speeds and an open concave will restrict cracking of beans. Harvesting at higher moisture levels and using a grain dryer can further reduce potential losses.

Potential Yields:

Average yields for soybeans in this region have generally ranged from 1t/ha to 4t/ha.

Gross Margins:

As an indicative guide only, the following gross margin has been reproduced of a grower who produced soybeans in the Isis Cane Supply area in 2004. These costs have been illustrated only as a guide and should not be considered a reliable source.

INCOME	
Expected Price ($/t)	$443
Expected Yield (t/ha)	3.5
Expected Income ($/ha)	$1551
VARIABLE COSTS	
Seed	85
Inoculant	2
Fertiliser (GF402)	85
Foliar Fertiliser (Mo + ZnSO4)	2
Herbicide (Regalone)	40
Herbicide (Verdict)	40
Herbicide (Spinnaker – spot spray)	8
Insecticide (Decis)	22
Irrigation	120
Harvesting costs	100
Transport	88
Total Variable Costs ($/ha)	**$588**
GROSS MARGIN ($/ha)	**$963**
Price to cover total variable costs ($/t)	$168
Yield to cover variable costs (t/ha)	1.3

Potential Benefits:

Soybeans offer a number of benefits to growers when they are grown in rotation with cane. They break the cane monoculture and are easily adaptable into a cane rotation. They improve soil physical structure and promote healthier soil in terms of soil biota and reduce weeds, pests and diseases. They fix copious amounts of nitrogen and offer an additional income source for growers.

Additional information of interest:

A significant niche market is emerging for organic soybeans. This sizeable market already receives favourable prices, which were between $600-$900/tonne, and this demand is expected to dramatically increase since the opening of National Food's soymilk plant.

Study Crop:

SUNFLOWER

Recommendation:

Sunflower is a crop with a question of not so much whether it can be produced in the area, as to whether it can successfully be produced in the area. To be economically viable, the crop primarily requires a large production area and access to markets with adequate on site storage. These variables are achievable in the Isis area, but there are a number of crops that offer considerable more benefit for rotation with a cane crop than sunflower.

Market:

Oilseed sunflower is arranged through contract, and sunflower for birdseed is marketed through normal merchant channels.

Varieties:

All sunflowers grown in Queensland come from hybrid seed. Due to company competition, the search for higher yields and the fight against diseases, particularly rust, hybrid varieties change regularly. The different end uses of sunflower and their characteristics are listed as below:

Oilseed (poly)	· The majority of sunflower varieties growing in surrounding sunflower producing areas are high oil linoleic oilseed types. · Growers are paid on yield, and receive a bonus or dockage for every 1% of the oil content that is over or under 40%, respectively. · Oilseed varieties produce seed, which is predominately black, but some may have a faint grey stripe. · Ordinary oilseed sunflowers are termed linoleic type and contain predominantly polyunsaturated oils.
High Oleic (mono)	· High oleic sunflowers must be separated from ordinary oilseed or bird seed sunflowers. · It is critical not to mix ordinary (linoleic) sunflower seed with oleic sunflower seed when harvesting · Oleic sunflowers which are rejected by the oil crushers cannot be sold into the ordinary oilseed market · To date, high oleic sunflowers have commanded a price premium over oilseed sunflowers because of slightly lower yields. Growers should obtain contracts for high oleic sunflowers prior to planting.
Birdseed	· These varieties usually have a lower oil content, about 30% · The seed is black and white striped and should be plump and well filled · The market for birdseed varieties is small and early plantings usually command the best prices. · On farm storage is often required to manage market fluctuations.
Confectionery	· Like birdseed varieties, confectionery varieties are low in oil content and have black and white striped seeds, which are large and easily dehulled. · The market for confectionery seed is very small and it should not be grown without first obtaining a contract.

Planting Conditions:

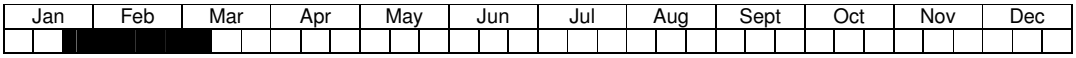
Evidence suggests that sunflower could be a favourable crop in this area, given its reliability on shallow soils and its option to be used for late summer plantings. Sunflower is also considered to be a very useful crop choice where summer grass weeds are becoming problematic due to farming systems.

As sunflower can draw moisture and nutrients from depth, a crop should only be planted into a full profile of subsoil moisture. In marginal moisture conditions, sunflower may not be the ideal crop choice because a failed crop cannot be grazed or baled.

Even distribution of sunflower seed is important to avoid yield loss and different dry down times of uneven head sizes. Even though sunflower plants may grow larger they never fully compensate for the yield loss caused where large gaps disrupt the regular arrangement of plants along the row.

Press wheels generally tend to improve plant establishment by providing better seed contact with moist soil. However, sunflower will not cope with as much pressure as cereal crops and heavy pressure can reduce plant establishment with sunflowers particularly at deeper seed placement.

Planting Time:



The planting window for the Isis Cane supply area would appear to be between late January and very early March. Earlier plantings are suggested to be less reliable due to high soil temperatures at planting and heat throughout the growing season, while later plantings are at risk of frost.

Row Spacing:

Sunflowers have been grown on a variety of row spacings, usually between 0.6m – 1.0m. Row spacing of 1.0m is becoming an industry standard as it allows for many management options in many crops, eg. Shielded spraying or inter-row cultivation. Field research projects are currently evaluating the merit of wider or skip-row configurations for use in sunflower.

Seeding Rates:

Growers should aim to establish between 60, 000 to 80, 000 plants/ha in an irrigated situation (25-30,000 plants/ha if dryland cropping), and edge towards the higher rate when sowing in high yield potential situations.

Planting Depth:

Sunflower seeds should be placed at a depth of between 40 to 70mm. At depths greater than this, seedling emergence will be reduced, particularly from the smaller seed sizes.

Seed Germination:

As the germination rates can vary significantly between seed lines, growers are advised to refer to the label on the seed bag.

Diseases:

There are a number of diseases that have the capacity to affect sunflower in this region, but only three of these could cause serious losses. The effect of these diseases can be lessened by good management practices, careful choice of hybrids and time of planting. Rust and Alternaria blight are the most common to likely affect this area, and while sclerotinia is less common, it can occasionally cause severe losses, particularly in crops that are planted later than February.

Insects:

Rutherglen bug	· Most bug invasions occur from budding to completion of flowering after numbers have built up on weeds. Bugs suck the sap from the stem behind the bud. · Large bug populations may cause the stem to wither and the bud to droop. · On the sunflower face, bugs can damage young seed as it develops reducing oil quality and yield. This is particularly important if seeking a confectionary market. · Damage is worse in dry weather when plants are suffering moisture stress. · Control may be warranted if populations reach 10 bugs/plant pre-flowering or 20-40 bugs per sunflower head post flowering. · Growers should avoid spraying insecticide when bees are very active during flowering.
Heliothis	· Sunflower can tolerate substantial heliothis infestations and still produce good yields · The larvae can cause damage to young buds by making feeding tunnels in the stem at the back of the bud or in the bud itself, causing it to die or be badly misshapen · Feeding injury to the back of sunflower heads may encourage head rots to develop when down-turned heads trap water after rain. · Heliothis feeding on the sunflower face may cause injury to developing seed · Mostly they feed on dead flowers and other head tissue around the head permitter under protection from the bracts. · When protected in this manner, heliothis caterpillars are difficult to reach with insecticide.

Study Crop:

TRITICALE

Recommendation: ✗

As triticale is more a broadacre crop and does not complement rotation timing with a cane crop, it's not considered to be a viable option in the Isis Supply Area.

Description:

Triticale is a cereal hybrid derived by crossing wheat with cereal rye.

Uses:

Triticale is a direct substitute for barley or wheat in animal feed rations. As triticale can out yield barley under good conditions, and has a dual purpose as grain or forage, it makes it a useful crop for mixed enterprise farms. While predominately used for stock food, there is an increasing interest in using triticale flour in a range of food products as it is high in natural fibre and has a distinct nutty, aromatic and naturally sweet flavour.

Market:

The market for triticale is small when compared with other winter cereals, as it is competition with barley as the preferred winter feed grain. It is marketed domestically through normal merchant channels or sold direct to either the end user of feedlots. As triticale has similar nutritional value to wheat, taking grain samples and testing for protein and metabolisable energy will assist sales into these markets.

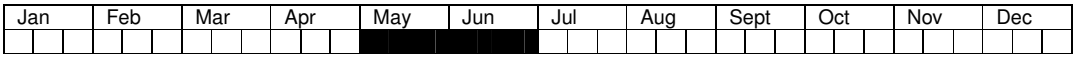
Soil Requirements:

Triticale will grow on similar soils to wheat and barley, and is also adaptable to soils that are too acidic for other cereals – to lighter, lower fertility soils where it can out perform other winter cereals.

Varieties:

Tahara	· Main variety for over a decade – but now superseded by new varieties · Main season variety with wide adaptability for grain production · Resistant to the major strains of wheat stem, leaf and strip rust · Straw strength is weaker than most of the new varieties
**No information is available in Queensland on the performance of other triticale varieties now available – the following information is provided from crops in NSW*	
Abacus	· Slightly later flowering than Tahara and Muir, allowing earlier sowing, but harvest is not significantly delayed · Similar height to Tahara, with drooping head and brown chaff
Credit	· Widely adapted main season sown variety with good straw strength
Everest	· Main season variety · Slightly higher yielding than Tahara · Very tall, high grain test weight
Muir	· Good main season sown variety · Preferred variety in high input, high yielding situations due to its resistance to lodging · Preferred as a cover crop for pasture sowings, because its shorter and stronger straw and more open canopy · Reputedly easier threshing · Tends to have better grain protein than Tahara
Prime 322	· Performs well Australia wide · Good adaptation · Rust resistant · Good straw strength · PBR – marketed by SunPrime Seeds
Treat	· Main season sown variety, slightly earlier maturing than Tahara · High test weight · PBR – marketed by SGB Australia

Planting Time:



The planting time for grain is between May and June.

Row Spacing:

Row spacings for triticale should be between 18-25cm, however, wider rows are used on planters modified to sow into crop stubbles, such is the case for wheat.

Seeding Rates:

There are approximately 32,000 seeds per kilogram and the rates of application rates vary between dryland and irrigated. Dryland requires a seedling rate of 50-75 kg/ha and irrigated cropping systems 75-100 kg/ha. Growers need to aim to achieve the same plant populations as for wheat, about 700,000 to 1,000,000 plants/ha, by setting the combine to 40% above the setting for suggested district wheat sowing.

The higher setting is required as the grain is larger than wheat and flows more slowly and the plants tiller less than wheat. Establishment should be in the range of 70 to 90%.

Planting Depth:

Seeds should be planted to a depth of between 50-75mm, otherwise refer to the planting depth for barley.

Nutrition:

The nutrition requirements of triticale are similar to that of wheat. In low fertile situations, triticale is very responsive to fertiliser and adequate nitrogen and phosphorus must be available to ensure a high yield and grain protein of above 10%.

Weed Control:

Triticale has a similar herbicide spectrum and tolerance level to wheat.

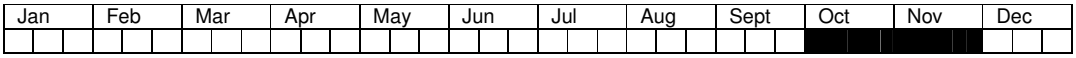
Diseases:

All recommended triticale varieties have affective resistance to stem, leaf and stripe rusts. However, they are susceptible to crown rot and common root rot.

Insects:

Triticale has similar insect problems to that of other winter cereals including cutworms, armyworms, blue oat mite and brown wheat mite. As triticale has a softer grain than other winter cereals, it is more prone to weevil attack. As a result, extra care must be taken in on-farm storage to keep the grain dry, cool and free of insects.

Harvest:



Harvest time for grain is between October and November. Grain moistures should be around the 12% and have a weight of about 65 kg/hL. A good grain test weight and plump grain depend on cool spring conditions.

Potential Yields:

The average yield for dryland conditions are between 1.4 to 2.6 t/ha. Although low yield is usually the result of growing the crop on poorer soils and individual blocks of fertile soil can yield up to 7 t/ha in irrigated situations.

Additional information of interest:

Triticale stubble is coarser than either wheat or barley.

Study Crop:

VETCH

Recommendation:

The success of using vetch as a rotational crop in the cotton industry suggests that it is definitely a crop that should be trialled and investigated for rotation with a cane crop. The nitrogen fixation ability of this crop, in addition to simplistic production warrants at least trials to demonstrate the effective benefit of a vetch rotation in cane. While the crop does not have any marketability, the economic benefits for subsequent cane crops through the production of a green manure crop ensure the relevance of the crop in a cane rotation.

Description:

Vetch has been grown on commercial cotton farms for several years in most cotton growing regions and studies have demonstrated that through growing vetch in rotation with cotton, subsequent cotton yields have been increased by up to 18 per cent.

Vetch is a sprawling and weak-stemmed cultivar, with purple pea like flowers. It grows through and over associated plants to produce a dense, intertwined sward.

Uses:

Vetch is emerging as a rotational crop for cotton farmers given its ability, like most other legumes, to take nitrogen from the air and 'fix' it in the soil so it can be used as a fertiliser by the plant. To date, cotton farmers have tended to adopted three ways to incorporate vetch in rotation with growing cotton, these have included:

1. *Wheat-vetch-cotton rotation*
   Vetch is sown in late February through to May following a wheat harvest in December. It is then slashed and ploughed into the ground as a green manure crop in mid to late winter. Cotton can then be planted in spring.
2. *Cotton-vetch-cotton rotation*
   Vetch is planted as soon as possible after the cotton is harvested in May. It is grown through winter then slashed and ploughed into the ground as a green manure crop in late winter to early spring. Cotton is then replanted in spring.
3. *Cotton-vetch-fallow rotation*
   Vetch is planted after the cotton crop is harvested around May. It is grown through winter then slashed and ploughed into the ground as a green manure crop in early spring. The filed is then left fallow for a year and cotton replanted the following spring.

Soil Requirements:

Vetch is adapted to a wide range of soils varying from heavy basalts to granites, but the soil must be at least moderately fertile for satisfactory production. The crop does best on well drained soils and does not tolerate waterlogging.

Climatic Conditions:

Vetch appears that it would grown in an area with an annual rainfall of 650mm and as it has an intermediate flowering habit, moderate temperatures and adequate moisture will allow it to grow on into the summer months. Its substantial root system and its ability to flower quickly and set seed in a dry spring give it good drought tolerance.

As vetch is largely grown in cotton producing areas of New South Wales, Victoria and South Australia, the temperature range of the crops is unclear. It is suggested that low temperatures restrict the growth of vetch during winter, while the crop experiences rapid growth in spring.

Varieties:

Two varieties of vetch, Namoi Woolly Pod Vetch and Capello have emerged as the preferred varieties following CSIRO Plant Industry Trials.

Planting Conditions:

Vetch can be planted into prepared seedbeds, direct drilled or surface planted. Although it has a large seed, the vetch seeling is weak and fragile and may not survive if the seed is planted in heavy soils at depths greater than 3 cm.

Planting Time:

Vetch is an annual crop that conventionally grows from autumn to spring in southern states.

Inoculation:

The seed must be inoculated with Group E inoculum.

Harvest/Crop Maintenance:

Trials to date indicate that it is best to incorporate vetch at least one month before planting the cash crop (in these situations, cotton), to allow for the decomposition of the vetch stubble. Herbicides do not assist in the destruction of vetch.

Price Indication:

While not an income producing crop, vetch has the very real capability of eliminating grower's nitrogen fertiliser costs for subsequent cane crops with its extraordinary nitrogen fixation capabilities.

Gross Margins:

As a rough indication, vetch costs approximately $100/ha to grow, however it is widely felt that this cost is substantially outweighed by the financial benefits accrued for subsequent crops.

Potential Benefits:

In trials in a cotton rotation, vetch's ability to fix nitrogen fax exceed those of other legumes such as faba beans, field peas, clovers and medics with vetch commonly fixing up to 200kg of nitrogen/hectare.

Vetch stubble also adds organic matter to the soil, and this has been illustrated with soil organic matter increases of up to 5 % in trials. Another important advantage of vetch that has been observed is that crops grown after a vetch rotation are better at taking up nitrogen, phosphorus, potassium, zinc and copper. Soil structure is also improved after a vetch rotation making not only cultivation easy, but improves root penetration and growth.

Study Crop:

WHEAT

Recommendation: ✗

As wheat is a broadacre crop and does not suit the time schedule of a cane rotation, it is not considered to be a viable option as a rotational crop in the Isis Supply Area.

Description:

Wheat is the major winter crop grown in the Southern and Central Queensland cropping districts, where approximately 800 000 ha are sown annually.

Market:

Wheat is marketed through many channels in Australia, including the Australian Wheat Board (AWB) and domestic millers. AWB markets and sells Australian wheat domestically and internationally to more than 70 countries, and classifies Australian wheat into the following six major market grades.

Australian Prime Hard (APH)	· Australia's top quality high protein milling wheat · Consists of specially selected white, hard-grained wheat varieties of exceptional milling quality · Normally segregated and sold at a guaranteed minimum protein level of 13% · Used to produce high protein Chinese style yellow alkaline noodles and Japanese noodles of superior brightness, colour and eating quality. · Also suitable for the production of high protein, high volume breads and wanton dumpling skins
Australian Hard (AH)	· A white wheat comprising specific hard grained varieties, with the No. 1 grade segregated at a minimum protein level of 11.5% · Is clean, dry and sound, ensuring the production of high quality flours at high extraction rates · Suitable for the production of a wide range of breads including European style pan, hearth and variety bread products · Also particularly suited to the production of Middle Easter flat breads and Chinese steamed products such as Mantou, Pao and Chinese style alkaline noodles
Australian Premium White (APW)	· Blend of white hard grained wheat varieties selected to ensure high milling performance and consistent flour quality · Minimum 10% protein level and hard grained characteristics of APW ensures free milling and excellent extraction rates · Suitable for a wide range of products including Asian noodles including Hokkien, instant and fresh noodles, and the production of Middle Eastern and Indian style breads and Chinese steamed bread.

Australian Standard White (ASW)	· Highly versatile medium to low protein white wheat representing excellent value for straight milling or blending purposes · Used in the production of a wide range of products including Middle Eastern, Indian and Iranian style flat breads, European style breads and rolls and Chinese steamed bread · The versatility of ASW ensures is popularity as a consistent and genuine value for money product
Australian Durum (ADW)	· Consists of selected wheat varieties with vitreous, amber coloured kernels with a minimum protein of 13.0% · Free milling grain is capable of achieving high yields of superior quality semolina with minimal residual flour production · The semolina produced exhibits high levels of stable yellow pigment and high water absorption, making it ideally suited to the production of a wide range of high quality wet and dry pasta products with excellent colour and shelf life.

Soil Requirements:

Wheat is suited to a wide range of soils, and particularly favours the deep clay soils with high moisture holding capacity.

Varieties:

There are a significant number of wheat varieties available for growers, and as such does not warrant mention here. Growers should consult with their agronomist the most suitable variety specific for their situation, with particular respect to the desired end user and market in addition to the time period for maturity that they require for their specific situation.

Planting Time:

The planting window for wheat is between April to July, although this is very susceptible to specific varieties and growers would need to consult the specific time frame that they could plant particular varieties.

Row Spacing:

Wheat is normally planted in 15 to 30 cm rows. Row spacings out to about 36 cm have little effect on yield in most seasons, although some yield reduction may be expected in very good seasons with wide rows. With the onset of zero tillage and moisture seeking machinery, there has been a recent trend to plant in rows as wide as 45 – 50cm. When planting in wider rows, the normal plant population should be maintained.

Seeding Rates:

The chances of optimal yields are improved by establishing at least 700, 000 plants/ha, even in seasons of low rainfall. With irrigation, high yielding dryland conditions or very early and very late plantings, populations of at least 1,000,000 plants/ha are recommended.

Planting Depth:

Optimum planting depth is 50 to 70mm. Coleoptile length will be reduced with warm seedbed conditions. Planting depth will therefore be more critical with early planting and varieties with short coleoptile length should be avoided during these times.

Nutrition:

Nitrogen	· As nitrogen is a primary constituent of grain protein, wheat of a high percentage protein is produced only where the crop is provided with adequate nitrogen supply · The approximate amount of nitrogen available in the soil can be determined by soil testing where tests should be taken at various places in the paddock. · Nitrogen fertiliser required will depend on the seasonal yield and protein levels, particularly if the expected yield is exceeded due to good climatic conditions then grain protein will fall below the protein targeted · Wheat grown under irrigation will require higher rates of nitrogen to achieve maximum economic yield and protein
Phosphorus	· Many soils in the wheat growing areas will respond well to phosphate fertilisers · Phosphorus deficiency symptoms include stunted plants, poor tillering and reddening of lower stems.
Zinc	· Zinc plays a vital role in wheat's ability to use nitrogen and transform it into yield and protein. · Zinc is as such a vital element to the plant and should not be overlooked in a balanced crop nutrition program. · The availability of zinc to many crops in increased by the presence of mycorrhiza in the soil. Crops grown after long fallows or other events that deplete soil mycorrhiza population will be most at risk of suffering zinc deficiency

Irrigation:

Wheat responds well to irrigation. Critical periods for water are at tillering and flowering. Reliable yields of 5t/ha can be achieved providing adequate nutrition and water are available. Water requirements, after planting in soil with a full moisture profile, will be approximately 2ML/ha.

Weed Control:

Good weed control in a wheat crop is essential if the crop is to make full use of stored summer rainfall and to prevent weed seeds from contaminating the grain sample at harvest. Weed management should be planned well before planting and options, such as chemical and non-chemical control should be considered.

Diseases:

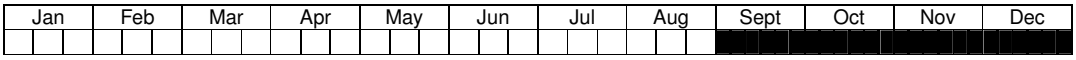
Diseases may severely affect yield and quality in wheat. In some cases these diseases are controlled through the use of simple cultural practices and good farm hygiene.

Other control measures include the use of resistant varieties, disease-free seed, fungicidal seed treatments to kill fungi carried on the seed coat, keeping the farm free from weeds, which may carry over some disease and through crop rotation.

Insects:

Insects are not normally a major problem with wheat, however, there will be times when they build up to an extent that control may warranted.

Harvest:



Harvesting can start as early as September and finish up until the end of December. Harvesting generally commences whenever the header is capable of giving a clean grain sample. This is usually when the moisture is below 20%. Where grain drying facilities are available, harvesting can start well before the crop dries down to the required 12.5% moisture and so reduce the time the crop has to stand at risk from weather damage in the field.

Potential Yields:

While yields vary widely from season to season, the long term average yield in Queensland is approximately 1.2t/ha, although paddock yields of up to 5t/ha can be achieved with good conditions providing nutrition is adequate and the crop is free from disease.

Gross Margins:

For the purposes of illustrating the costs in relation to the production of wheat, the following gross margin has been reproduced as a guide.

INCOME				
Yield (t/ha)				1.60
Price (on farm) of Barley-Feed ($/tonne)				$150
Income/Ha				$240
VARIABLE COSTS	**Number or Rate**	**Cost $/Unit**	**Cost $/ha**	**Total**
Operations				$47.00
Heavy till		7.00		
Medium till		5.50		
Light till	1	4.50	4.50	
Boom spray	4	2.00	8.00	
Plant	1	4.50	4.50	
Harvest	1	30.00	30.00	
Fallow spray (L or g)				12.50
Glyphosate	2.5	5.00	12.50	
Seed (kg/ha)	40	0.42	16.80	16.80
Fertiliser (kg/ha)				56.20
Starlomfos	30	0.54	16.20	
Urea	100	0.40	40.00	
Herbicide (L or g)				6.00
Gloan		0.32		
MCPA	1	6.00	6.00	
Total Variable Costs/Ha				$138.50
Gross Margin/Ha				**$101.50**

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