Department of **Employment, Economic Development and Innovation**

Mungbean management guide

2nd edition

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PULSE AUSTRALIA

AUSTRALIAN MUNGBEAN ASSOCIATION
www.mungbean.org.au

Queensland Government

Mungbean management guide

Mungbean production in Australia varies between 30 000 and 60 000 tonnes per year. It is a valuable summer crop as it is relatively drought-tolerant, quick-maturing and requires minimal fertiliser input. Nearly all (95%) of the Australian mungbean crop is bagged, containerised and exported. All stages of crop production and processing have to comply with strict hygiene practices to ensure the crop meets the highest standards for food safety and hygiene.

The quality of mungbean seed is important as processors need unmixed varieties with a high germination percentage. Although sprouting beans attract higher prices, processing beans are more popular as the quality standards are not quite as strict. Insect damage is one of the main reasons for downgrading.

Mungbean check list

- Discuss variety choice and marketing strategy with mungbean marketer.
- Purchase Australian Mungbean Association approved seed or, if using grower-retained seed, test for germination % and vigour before planting and replace every three years.
- Avoid paddocks with major variations in soil type or unevenness.
- Assess weed status of the paddock (in-crop broadleaf weed control options are limited).
- Stay within recommended planting windows.
- Determine residual herbicide risks.
- Fertilise according to paddock history (especially after a long fallow) and soil test analysis.
- Ensure effective inoculation.
- Ensure good, even plant establishment.
- Monitor disease status in crop.
- Timely insect control is essential. Check crops at least every week during vegetative stages and twice weekly from budding through to pod fill (depending on pest pressure).
- Timely, effective desiccation before harvest.

Varieties

Many of the countries that compete with Australia in the international mungbean market use traditional farming methods and hand-harvest their mungbeans. Although labour-intensive, hand-harvesting results in a grain product with exceptional seed quality. Australian mungbeans are sold against hand-harvested product; so to compete effectively, the Australian industry has developed varieties and management practices that enable the production of high-quality mungbeans under mechanised production systems.

Marketing of your mungbeans and choice of variety go hand-in-hand as the first steps in integrating mungbeans into your farming system.

Mungbean (*Vigna radiata*)

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

Crystal[Φ]

Crystal was released by the National Mungbean Improvement Program under licence to the Australian Mungbean Association in 2008, and is protected by PBR. Crystal is a large seeded, shiny green mungbean, and is a cross between White Gold, Emerald and other breeding lines.

Crystal is a consistent performer in all regions. Across five years of regional testing, it averaged 20% higher yields than Emerald. It offers significant advances in grain quality.

Crystal is a relatively tall, erect variety with similar lodging resistance to Emerald. It has the best available suite of resistance to powdery mildew, tan spot and halo blight. Crystal has low levels of hard seed, increasing its attractiveness to the cooking and processing markets.

Crystal has widespread regional adaptation and is suitable for both spring planting (September/early October) due to its weathering ability and conventional summer planting (December/January) due to its level of powdery mildew resistance. See *Crystal Variety Management Package* (www.mungbean.org.au).

Satin II[Φ]

Satin II was released by the National Mungbean Improvement Program under licnece to the Australian Mungbean Association in 2008. It is protected by PBR. Satin II is a dull green mungbean grown for a niche market. It has superior seed

Crystal

Satin II

Green Diamond

Regur

Characteristics of mungbean varieties

Variety	Seed colour	Weathering resistance	Height	Powdery mildew resistance	Lodging resistance	No. of seeds '000/kg
Berken	green	poor	short	susceptible	fair	15–20
Crystal[Φ]	green	fair	tall	mod resistant	good	14–17
Emerald[Φ]	green	fair	tall	mod susceptible	good	15–20
Green Diamond[Φ]	green	fair	medium	susceptible	good	27–30
Satin II[Φ]	green (dull)	fair	tall	mod susceptible	good	14–17

Note: *Seed size for some varieties may be up to 10% larger or smaller depending on growing conditions.*
[Φ] *indicates varieties that are protected under the Plant Breeders Rights Act 1994 (PBR). Unauthorised sale of seed of these varieties is an infringement under the Act. See www.ipaustralia.gov.au for Plant Breeders Rights.*

quality with increased seed size and improved evenness of seed colour, size and shape.

Satin II can outyield Satin by 20% and offers improved disease resistance to both powdery mildew and tan spot. It also has improved lodging resistance but similar maturity to Satin.

Seed segregation and varietal integrity are crucial if growing two or more different mungbean varieties. Varietal mixtures are unacceptable in the market place, and mixtures of shiny and dull seeded mungbeans would greatly reduce the value. See *Satin II Variety Management Package* (www.mungbean.org.au)

Reselected Emerald[Φ]

Released by CSIRO through the Australian Mungbean Association in 1993, it is subject to PBR. This variety has been reselected and increased from original breeders' seed in an effort to improve seed quality variability in lines of Emerald that had been in circulation for up to 10 years. In comparative trials, Reselected Emerald established higher plant populations than regular Emerald seed. Growers are advised to source Reselected Emerald.

It has medium-large, shiny green seed, almost identical in appearance to Berken. Levels of hard seed may be quite high (50%) and limits its acceptance into sprouting markets.

Maturity can be delayed and uneven where soil moisture levels remain high during the grain filling period. High levels of hard seed can cause problems with volunteer plants in subsequent rotational crops (especially cotton).

Green Diamond[Φ]

Released by CSIRO through the Australian Mungbean Association in 1997, Green Diamond is protected by PBR. It is small seeded, shiny green mungbean with hard seed levels as high as 70%.

Green Diamond is a relatively quick maturing variety that has an even pod set and is quick to dry down. It has performed well in spring-plant situations.

Green Diamond has an erect growth habit with the pods carried high in the canopy. It often performs better than the other varieties under relatively drier conditions, and may be more suited to double crop situations and the drier western areas.

Berken

Berken is a medium-large, evenly sized, shiny green seeded mungbean. It is still one of the preferred varieties grown for the sprouting market. Its popularity is largely due to ease of marketing, ready availability of seed and the premium achievable over some other varieties when seed quality is high. Berken is very prone to powdery mildew and tan spot. Heavy crops may lodge—grain is susceptible to weather damage and cracking. Without best management practices, it is difficult to achieve a premium for sprouting grade beans.

Black gram (*Vigna mungo*)

Black gram is a closely related species to mungbean, but with dull grey-black seeds, and pods borne throughout the bush. It is relatively more difficult to harvest as pods are set lower on the plant and maturity is often uneven.

Regur

Regur is a dark grey seed that is more tolerant to water logging than the mungbean varieties. It is often more difficult to harvest as it is usually shorter growing than mungbeans, pods are also set lower on the bush and it flowers over a prolonged period, ripening unevenly. Regur can make excessive vegetative growth under favourable growing conditions, and is prone to lodging.

Nodulation is often a problem with Regur, and the crop can be responsive to nitrogen fertiliser.

There is strong demand for high-quality Regur beans for export to Japan. There are a number of grading sheds and grain traders specialising in the marketing of Regur. Growers contemplating Regur must ensure effective segregation of black and green seeded mungbeans in the paddock, the header and in storage as mixed seed lots cannot be sorted and will be difficult to market.

Regur is not recommended in Central Queensland, where plants grow very short, and delayed maturity limits yield.

Planting

Mungbean varieties should be clearly separated at planting. Varietal mixtures are unacceptable in the market. Unless harvest equipment and storage facilities can be thoroughly cleaned, restrict planting to one variety.

The importance of achieving an even strike and even maturity cannot be over-emphasised. Taking extra care at planting can produce more uniform flowering, making insect management and harvesting more straightforward.

To achieve a better quality sample and higher returns growers should:

- Avoid paddocks with major changes in soil types that can result in uneven maturity.
- Avoid sowing wheel tracks that could result in staggered germination.
- Avoid paddocks with a rough seedbed or stones.
- Employ rolling or ‘prickle chaining’ on non-crusting soils as it helps level the surface and promotes more even emergence and maturity.
- Ensure an even planting depth right across the machine. This is particularly important with air seeders.
- Avoid sowing mungbeans if soil moisture levels are marginal, and likely to result in a patchy strike or staggered germination.
- Avoid seed lines with high levels of hard seed (dormant seed), which can result in an uneven, staggered germination.

The risk of herbicide residues can be a significant problem in mungbeans, as many growers treat the crop opportunistically and will either double-crop after winter cereals, or short fallow through from summer crops such as sorghum or cotton. In both cases, herbicide residues can pose a risk, particularly after dry or cold winter conditions. Plan an appropriate herbicide strategy within the preceding crop that will avoid the threat of residue problems in mungbeans.

Planting time

There are two main planting windows for mungbeans—spring and the more conventional summer planting. Planting within the preferred window is critical to maximise yield and grain quality. If planting outside these windows be sure to select an appropriate variety.

Spring planting

Spring planted mungbeans can produce reasonable yields provided that specific attention is paid to:

- stored soil moisture levels at planting (at least 90 cm wet soil)
- management of thrips on seedling plants
- control of mirids at flowering
- desiccation prior to harvest
- increased weed pressure.

The most consistent results with spring plantings have been achieved with late September/early October plantings in situations with at least 90 cm of stored soil water.

Late October/November plantings are considered a riskier proposition in western areas because of the increased risk of experiencing dry, heatwave conditions on the emerging seedlings and on plants at flowering.

Crystal is suited to early plantings in spring because it is less susceptible to weather damage at harvest, and matures more evenly than the other varieties.

Late planting

Crystal and Satin II are preferred for late plantings because they have a degree of resistance to powdery mildew.

Late planting can result in lower yields, as the crop often flowers around 35 days after planting, and the small plants fail to achieve canopy closure. If planting on narrower rows, increase the seeding rate by 5 kg/ha for plantings made after mid-

January. This helps compensate for smaller plant size.

Seed quality and varietal purity

Varietal purity is essential, as mixtures are unacceptable in both the sprouting and cooking trade. Mixed seed lines will often attract heavy discounts purely on their visual appearance. This particularly applies to contamination with varieties like Satin II, with its dull seed coat giving the appearance of weather damage in the sample. Mixtures can also create problems by germinating unevenly (a consideration for sprouting beans).

The quality of seed retained on-farm can deteriorate over two to three years due to genetic drift. These seed samples often look uneven and may have a large proportion of dull blue-green seeds mixed with shiny seeds.

Replace planting seed every two to three years.

Grower-kept and older seed stocks have poorer emergence than seed from the AMA Approved Seed Scheme.

Only purchase seed that is clearly labelled and has been inspected for disease, such as Australian Mungbean Association (AMA) Approved Seed.

Resellers of this seed are available from the AMA website (www.mungbean.org.au).

Germination

All seed offered for sale must clearly state the germination percentage and purity of that seed line. Seed with a high germination of around 80–90% is preferred. Growers need to be aware that hard seed levels (dormant seed) may be included in the germination percentage stated on the label.

Crystal has low levels of hard seed however Emerald and Green Diamond can contain hard seed levels as high as 70%. High levels of hard seed can result in uneven germination and establishment. This will complicate insect and harvest management decisions, and can dramatically reduce the financial return. 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 in western areas. The seed zone can dry out rapidly at planting time, with hard seed failing to germinate until there is follow-up rain.

The hard seed level of Emerald and Green Diamond should always be checked before planting. The level of hard seeds (by test) should be kept to a minimum. Above 20% hard seed is not advisable for use as planting seed. It is important to remember that hard seed levels may change over time, so any formal seed test should be carried out as close as practical to planting time.

Seed retained on-farm for planting purposes should be heavily graded to remove small seeds, and any cracked or broken grain. Seed from the AMA Approved Seed Scheme generates higher plant populations than ungraded, grower-kept seed.

Plant population

Dryland: 200 000–300 000 plants/ha.
Irrigated: 300 000–400 000 plants/ha.

Target population of 20–30 plants per square metre for dryland and 30–40 plants per square metre for irrigation should be planned for when setting up your planter.

Lodging can be a problem if plant populations exceed 40 plants/m^2, especially on wider row spacings.

If the emerged plant population is less than 10 plants per square metre, consider resowing.

Thin crops are short, yield poorly, mature unevenly, and can be extremely difficult to pick up at harvest.

Target populations on 1 metre-wide rows are ideally 20–30 plants/m^2. Higher populations will

Planting windows for mungbeans

Region	Range	Preferred
Queensland		
Darling Downs	early October–late January	mid December–mid January
Western Downs	late September–early February	early January–early February
Central Queensland	early September–early March	mid September–late February
North Queensland	June–early August	late July–early August
New South Wales		
North-west Slopes and Plains	mid-September–late January	early October–mid January
Liverpool Plains	mid-September–mid January	early October–early January

increase the risk of lodging, especially under irrigation.

You must calculate your planting rate each year as it can vary greatly depending on variety, germination and planting conditions.

Row spacing and planter configuration

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 planting configuration.

The recent trend on dryland crops is toward an increasingly higher percentage of the mungbean crop being grown in wider rows of 50–100 cm.

This is mainly due to the greater number of row crop planters now available, controlled traffic and the adoption of shielded and band spraying. Band spraying enables input costs such as insecticides to be kept to a minimum. Wider row spacings also allow for the greater use of ground rigs for pesticide application and gives the grower greater control of when insecticides are being applied to their crop. High temperature application (above 28 °C) is now widely recognised as one of the major causes of insecticide spray failures in summer crops.

Before growers make the final decision, they need to carefully weigh up the relative advantages of both wide and narrow row production systems.

Wide rows (50–100 cm)

- Greater ability to plant into heavy stubble cover (zero-till situations).
- Row-crop planters often provide more accurate seed placement, resulting in better establishment and more even plant stands. This can often result in more even crop maturity.
- Harvestibility—plants grow taller with a higher pod set as a result of 'within row' plant competition.
- In low yield situations, crops planted on wide rows often feed in better over the knife section due to the concentration of growth within the row.
- Input costs can be reduced by band-spraying insecticides and defoliants.
- Easier access for ground-spraying pesticides and desiccants.
- Under severe moisture stress conditions, the combination of wide rows and heavy stubble cover have often been observed to yield better than narrow rows.
- Easier access when checking for insects (e.g. using a beat sheet).

Narrow rows (15–40 cm)

- Potential yield benefit as yields increase above 1 t/ha.
- Yield margin gradually increases to 10–15% in favour of the narrow rows as yield potential approaches 2 t/ha.
- Quicker ground cover provides better suppression of weeds.
- Nitrogen fixation rates can be 15–30% higher on narrow rows.

Seed placement depth

Plant into moisture at a depth of 30–50 mm. Do not use presswheels that exert heavy pressure directly over the row. Ideally use wide, zero-pressure wheels. Rolling can be useful as it helps level the entire surface, and can significantly help the harvesting operation.

Inoculation

Use Group I (Cowpea and Mungbean) inoculant.

Inoculation is essential if nodulation problems are to be avoided. Poor nodulation is a common

Calculating planting rate

$$\textbf{Planting rate} = \frac{\text{target plant density per ha}}{\text{seeds/kg x (germination\%/100) x (expected establishment\%/100)}}$$

For example

Target plant density = 250 000/ha (i.e. 25 plants per square metre)
Seeds/kg = 13 500 (see table on characteristics of mungbean varieties on page 3)
Germination rate = 95%
Establishment rate = 85%

$$\textbf{Planting rate} = \frac{250\,000}{13{,}500 \text{ x } (95/100) \text{ x } (85/100)} = \textbf{24 kg/ha}$$

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 (i.e. double crop situations). Growers are urged to pay greater attention to inoculation practices if these problems are to be avoided.

Mungbeans are an introduced species and require the correct strain of nitrogen fixing bacteria in order to effectively fix nitrogen (the commercially available strain is CB1015).

A survey of commercial mungbean crops conducted by DEEDI in 2004/05 indicated that only 50% of crops were nodulated with the correct strain. Mungbeans will nodulate with a range of native soil bacteria but their nitrogen fixation is very erratic. The most effective method of ensuring nodulation with the applied strain of inoculum is to deliver the highest possible concentration of live cultures on to the seed and sow as quickly as possible.

DEEDI field trials have found water injection to be the most effective means of delivering inoculum, producing higher levels of nodule occupancy than slurry methods and uninoculated controls. However water injection will likely require modification to planting equipment and water volumes may be unsuitable for larger areas.

The most common means of inoculating mungbeans is to coat the seed with a slurry of peat-based inoculum immediately prior to planting. New developments in inoculum delivery have resulted in products that offer easier handling and more convenient application methods.

Only inoculate seed that you can plant that day. Seed should ideally be planted into moisture immediately after inoculation to maximise nodulation.

Avoid exposing recently inoculated seed to hot, drying winds, or direct sunlight as this rapidly kills the bacteria.

Nutrition

Nitrogen

Although the mungbean plant does have a relatively high nitrogen requirement, the crop shouldn't generally need nitrogen fertiliser provided plants have effectively nodulated (a 1.5 tonne/ha crop has a total nitrogen requirement of 100 kg N/ha).

Low rates of nitrogen fertiliser may be justified in situations such as:

- double-cropping immediately after winter cereals, where low rates of nitrogen (and sulphur) can get the plants off to a good, quick start. Consider 20–30 kg/ha sulphate of ammonia or Starter 15, depending on soil P levels
- in late planted crops where plants often fail to make sufficient growth to support a reasonable grain yield, consider using Supreme Z (StarterZ).

Phosphorus

In low vesicular-arbuscular mycorrhizae (VAM) situations (i.e. long fallows over 12 months duration or after canola), large responses to applied phosphate fertilisers are likely in situations where soil bicarbonate P levels are below 25 mg/kg.

Where soil VAM levels are high (double-crop situations or short fallows of less than six months) 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 available sulphur levels have been depleted by the previous crop. Sulphate ammonia at 20–30kg/ha will rectify a sulphur deficiency.

Zinc

Mungbeans are very responsive to zinc. Crop responses are likely where soil test levels are:

- below 0.8 mg/kg on alkaline black earths, grey clays and alluvial soils
- below 0.4 mg/kg on acid soils.

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.

Severe deficiencies can be corrected for a period of 4–6 years with a soil application of zinc sulphate monohydrate worked into the soil several months before planting.

In the first year after application, the soil applied zinc mono may not be fully effective, and a foliar zinc spray may also be required.

In zero-till or double-crop situations, deficiencies can be corrected by using one of the following options:

- phosphate-based fertilisers containing zinc
- foliar sprays
- seed treatment, e.g. Agrichem's Broadacre Zinc or Teprosyn Zinc.

A foliar spray of 1.0 kg zinc sulphate heptahydrate

+ 1.0 kg urea in at least 50 L of water/ha plus wetting agent will correct a mild deficiency. One to two sprays will need to be applied within four weeks of emergence.

Foliar sprays containing zinc sulphate heptahydrate are compatible with dimethoate, but will cause nozzle blockages if mixed with Blazer. Chelated forms of zinc are more expensive, but can be mixed with most herbicides and used in hard water.

Zinc seed treatments may be a cost-effective option in situations where soil P levels are adequate but zinc levels are likely to be deficient.

Agrichem recommend that Broadacre Zinc should be applied at 5 L of product per tonne of seed. To minimise any damaging effect on the rhizobia, the Broadacre Zinc treatment needs to be applied first and then allowed to dry before applying the inoculum.

Long fallow disorder

Stunted growth and low yields are often a problem where mungbeans are sown on soil that has been fallowed for 12 months or longer. As VAM levels decline in the soil, deficiencies of phosphate and/or zinc become increasingly common. Crops such as mungbeans are highly dependent on VAM. The need for higher rates of P and Zn should be considered in long fallow (low VAM) situations.

Alternatively, consider planting other crops such as sorghum, which handle long fallow disorder relatively better than mungbeans.

Weed management

Broadleaf weed control options are very limited in mungbeans, and growers should plan a weed strategy with their agronomist prior to planting.

Mungbean seed lots containing weed seeds can be difficult to sell, and can incur substantial discounts. Contamination of the sample with either grain sorghum seed or thornapple is of particular concern, as they are extremely difficult to remove by grading. These two weeds should be removed from the crop either with herbicides, or by hand roguing.

Contamination of the sample with wheat and barley seed can also cause problems as they are difficult to remove during grading, and can result in heavy discounts when being traded in the sprouting market. Contamination with cereals is most likely to occur in double-crop situations where mungbeans follow wheat or barley. Delaying planting until a kill can be achieved on volunteer cereals can often rectify the problem. Otherwise a grass herbicide will be required in-crop. Read product labels for details of application rates and withholding periods.

Trifluralin and pendimethalin can sometimes reduce seedling vigour and affect establishment in mungbeans. Trifluralin should be applied 2–3 weeks prior to planting to minimise the likelihood of crop damage. Avoid using high rates if applied just prior to planting. Trifluralin requires incorporation and is not suitable for zero or reduced-till situations. Spinnaker is a residual herbicide with extended plant back periods. Check with your agronomist before use.

Growers using acifluorfen should take particular note of label recommendations and discuss with an agronomist prior to use since nozzle selection, water volumes, weed growth stage and choice of surfactant can have a significant impact on the results obtained. Avoid applying acifluorfen during the heat of the day as burning of the foliage may occur. To minimise burning, apply very early

Herbicides registered for use in mungbeans (2010)

Herbicide	Example trade name	Rate/ha	Timing
imazethapyr (700g/L)	Spinnaker 700 WDG	100–140 g	pre-plant
pendimethalin (440g/L)	Stomp 440	1.9–2.25 L	pre-plant
trifluralin (480g/L)	Treflan 480	1.2–1.7 L	pre-plant
chlorthal-dimethyl (900 g/kg)	Dacthal 900 WG	5–12.5 kg	planting
acifluorfen (224g/L)	Blazer	1–2 L	post-emergent
butroxydim (250g/L)	Factor WG	120 or 180 g	post-emergent
clethodim (240g/L)	Select	250–375 mL	post-emergent
haloxyfop-P (520g/L)	Verdict	100 or 150 mL	post-emergent
quizalofop-P-ethyl (99.5g/L)	Targa	125–1000 mL	post-emergent

Refer to current product label for rates and full directions prior to use.

Mungbean is a useful crop for controlling grass weeds

Colonies of powdery mildew on upper leaf surface

morning, late afternoon or at night. See the label for registered use pattern in mungbeans.

Mungbeans offer an excellent opportunity to control difficult-to-manage grass weeds with Group A herbicides registered for use in mungbeans. When using Group A herbicides, make sure coverage is adequate, use adjuvents to improve uptake and only apply to actively-growing small plants.

Central Queensland weeds

The range of weeds encountered in Central Queensland often pose major problems and require a planned approach, using a combination of the available herbicides. Because of specific-use characteristics of the limited range of herbicides available, it is best to plan a weed management strategy with your consultant prior to planting.

Disease management

Powdery mildew

Powdery mildew on mungbean is caused by the fungus *Podosphaera fusca*.

Symptoms: Infected plants have a greyish-white powdery growth on the surface of leaves, stems and pods. Late infections during the pod filling stage can cause leaf drop but do not appear to seriously affect yield.

Conditions favouring development: Favoured by cooler conditions, and is often widespread in late-planted crops. The fungus survives on other living hosts, and is spread by wind. Infection becomes apparent during February, and usually increases in severity during March and April. Significant yield loss can occur if powdery mildew develops before or at flowering, particularly if the crop is under moisture stress.

Management: Crystal, Satin II and Emerald have moderate levels of resistance to powdery mildew, and are the preferred varieties for late plantings sown after the end of December. While mildew is slower to develop on these varieties, the disease can still be quite damaging if it occurs prior to, or at flowering.

Foliar sprays with a registered fungicide, or one under permit, is warranted where infection occurs at or prior to flowering. DEEDI trials have shown that fungicide sprays, when applied early, can result in up to a 30% yield increase. High water rates and thorough coverage are critical. Some of these are protectant fungicides, and must be applied during the early stages of disease development to be effective. Spraying late in the afternoon or at night will help minimise any leaf burn. Consult an agronomist about spray options and timing.

Tan spot

Tan spot is caused by the bacterium *Curtobacterium flaccumfaciens* and is usually present at a low level in most crops. It can cause widespread and serious losses.

Symptoms: Infected plants have large, irregular, dry, papery lesions on leaves that coalesce to form large brown dead areas, commonly with yellow margins around the dead areas. These areas usually tear and fall out, giving the leaf a ragged appearance. Infected flowers usually die. Early infection results in stunting, yellowing, and poor set seed.

Conditions favouring development: Tan spot is seed borne, and while it may develop in the seedling stage, the disease is more commonly seen from the second trifoliate leaf stage onwards. The bacterium is spread from infected seedlings to other plants in the crop by wind-blown rain (particularly hail) and mechanical damage (machinery and abrasion from dust storms).

Tan spot lesions on mungbean leaf

Early symptoms of tan spot lesions on a seedling

Symptoms develop rapidly if the crop is subjected to adverse growing conditions, such as heat or moisture stress.

Management: While it is not possible to totally eradicate this disease, using low risk seed and practising good crop rotation will minimise its impact. Alternate hosts, such as cowvine and bellvine, must be controlled. Cowpea and soybean also host the disease.

While seed lines are often inspected for the disease, it is not possible to guarantee total freedom from the disease. Infected plants may not develop symptoms under favourable growing conditions, and consequently the disease can go undetected. Crystal and Satin II have the highest levels of resistance to tan spot.

Halo blight

Halo blight is a seed-borne bacterial disease caused by *Pseudomonas savastanoi pv. phaseolicola*. Halo blight has caused significant losses in all areas and can be particularly severe in spring-sown crops.

Symptoms: On young leaves there is an extensive yellow halo surrounding a smaller (1–2 mm) area of brown, shiny tissue. The halo may be less pronounced on older leaves and lesions may appear similar to bacterial blight (*Xanthomonas* sp.). Circular watersoaked spots develop on pods.

Halo blight symptoms on leaf

Halo blight lesions and ooze on pods

Conditions favouring development: Symptoms develop during cool, humid conditions following rain, most notably in spring crops. Significant yield losses can result if the disease develops before flowering or during pod development.

Management: Planting low risk seed is the most effective control measure. Rotation with non-hosts (summer and winter cereal crops and cotton) and incorporation of residue will be effective only if seed-borne transmission is minimised.

Charcoal rot

Soil-borne infection by the charcoal rot fungus *Macrophomina phaseolina* ultimately causes a dry rot of the stem and often plant death. Charcoal rot infection of seed intended for the sprouting market results in a soft, wet rot of the sprouts during the germination process. Many of our overseas sprouting markets specify that seed lots must be charcoal rot-free.

Symptoms: An early sign of stem infection is the presence of brown lesions at the base of the plant and/or where the branches join the main stem. Infected plants usually die prematurely, and the stems turn ashy-grey, often with minute black specks (microsclerotia) evident within the affected area. Yield can be significantly reduced.

Conditions favouring development: Charcoal rot generally occurs after flowering during a period of heat and/or moisture stress, and results from infection of the roots by soil-borne microsclerotia.

Ashy-grey stem of plant infected with charcoal rot

By contrast, evidence suggests that seed infection occurs during rain periods, when microsclerotia are splashed from the soil surface onto developing pods. The disease can be particularly severe after sorghum, but stress at, and after, flowering is the key driver.

Management: Avoiding paddocks where charcoal rot has been a problem in the past, planting on good soil moisture, and practicing agronomic practices to minimise stress, can reduce the risk from charcoal rot.

Gummy pod

This bacterial disorder (*Gluconobacter* spp.) occurs following the fermentation of sugars secreted by the floral nectaries on the mungbean plant.

Symptoms: Stems, pods and pod-stalks become covered with a sticky white froth that exudes from the nectaries. This can be followed by collapse of the stalks supporting the pods, and then pod drop.

Conditions favouring development: While the bacterium is commonly found in mungbean flowers, the production of froth occurs when crops are severely heat and moisture stressed. It tends to be a more widespread and serious problem in the drier western areas.

Management: There are no practical in-crop control measures. Regular cleaning of harvest equipment to remove froth build-up is often required. Crop desiccation will often help reduce harvest difficulties.

Puffy pod disorder

Symptoms: Pods develop a blotched, puffy appearance. In the most severe cases, up to 50% of the pods within affected crops may display

Gummy pod—foaming on pod

Puffy pod disorder—normal pods (left) vs puffy pods

symptoms of the disorder. Seeds in infected pods do not mature properly, often turn brown, and may develop secondary rots.

Conditions favouring development: This disorder appears to be due to a physiological stress (most likely moisture stress) because no pathogens have been isolated from affected plants.

Management: If the level of puffy pod in a crop is significant, harvest affected pods before they mature. Desiccate promptly, and use a low drum speed and high air flow to eject unthreshed puffy pods out of the header.

Legume little leaf

Symptoms: Affected plants develop a spindly, erect growth habit with small, 'cupped' leaves. Flowers are distorted, with green petals. If pods develop they are usually distorted, and seeds in these pods either fail to develop or turn brown. This discoloration can be a major cause for downgrading of the sample and discounted returns to growers.

Conditions favouring development: The disease, caused by a phytoplasma, is spread by leafhoppers, which have a wide host range on other crops and weeds. Dry seasonal conditions

Little leaf virus on mungbean

promote the movement of leafhoppers from infected weeds to mungbean crops.

Management: Control is generally not warranted, but it is recommended to monitor leafhopper numbers.

Tobacco streak virus

Tobacco streak virus (TSV) was identified in 2006 in mungbean crops in the Central Highlands region of Queensland. The impact ranged from minor to severe. TSV has not yet been found in other mungbean growing areas.

Symptoms: TSV-infected mungbean plants are usually stunted and wilted with dead (necrotic) stems and tips. Yellowing of leaves followed by spreading necrosis is common, sometimes with necrotic line patterns. Plants that are infected early have the worst symptoms and often die prematurely. Major weed hosts of TSV show no symptoms.

Conditions favouring development: Thrips are the only known vector of TSV through the transmission of virus-infected pollen. Several common broadleaf weed species are hosts of TSV, with parthenium

TSV symptoms on leaves, stem and pods

Mungbean plant affected by TSV

National disease resistance rating

Description	Tan spot	Powdery mildew	Halo blight
Resistant			
Moderately resistant	Crystal		
Moderately susceptible	Satin II	Crystal, Emerald	Regur
	Emerald, Green Diamond	Green Diamond, Satin II	Crystal, Emerald, Green Diamond, Satin II
Susceptible	Berken	Berken	Berken
Very suscepible			

weed being a widespread and key host of the virus in central Queensland. The physical damage caused by thrips feeding on the plant enables infected pollen to enter the mungbean plant where the virus multiplies.

Management: While it is difficult to predict the impact of TSV in mungbean, there are strategies to minimise the risk of infection:

- maintain farm hygiene, in particular the control of parthenium weed
- avoid planting mungbeans close to pastures, particularly those containing dense infestations of parthenium and other broadleaf weeds
- if crops are planted close to parthenium-infested pastures, either spray out pasture close to the mungbean crop or leave a buffer
- avoid planting mungbeans into marginal soil moisture, especially near parthenium infested pasture
- TSV is potentially seed-borne, so ensure planting seed is from crops with no signs of TSV.

Insect pests

Insect management

Insect pests can significantly reduce mungbeans' profitability, reducing both yield and seed quality. Accordingly, insect damage is one of the main reasons for downgrading mungbeans.

Crops should be inspected at least weekly during the vegetative stages and twice weekly from budding onwards (depending on pest pressure). While early damage is less likely, high pest pressure in seedling/early vegetative crops can lead to a massive reduction in yield potential. The onset of budding marks a critical stage when the crop becomes more attractive to major pests including mirids and helicoverpa. Mungbeans are at greatest risk from podsucking bugs from early podfill until late pod ripening.

Crops not converting buds/flowers to pods may contain damaging pest numbers, which are aborting or eating these structures before they progress to pods. However heat and moisture stress can also abort buds and flowers. It cannot be automatically assumed therefore that pests are to blame for poor pod set.

Mungbeans can compensate for moderate early damage by retaining undamaged buds and flowers that otherwise might be shed naturally. Under favourable growing conditions, they can even compensate for severe early damage by setting new buds and pods. However this can result in uneven and delayed harvest maturity. In addition, their compensatory ability is negated if there is sustained significant pest pressure.

Helicoverpa (*Helicoverpa armigera, Helicoverpa punctigera*)

Pest status: Helicoverpa are major mungbean pests. They can attack at any stage from seedlings to late podfill but mungbeans are most attractive to helicoverpa from budding onwards. The more-difficult-to-control *H. armigera* predominates in summer crops, and also in spring crops in coastal and tropical regions.

Damage: Helicoverpa can attack all above-ground parts of the mungbean plant. High populations can severely damage seeding and young vegetative crops, especially if they are drought stressed. In these situations, larvae feed more on the plant's terminals and axilliary buds (the precursors to floral buds), and less on the leaves themselves.

Once crops reach flowering, larvae focus on buds, flowers and pods. Small pods may be totally consumed, but larvae target the seeds in large pods. Crops are better able to compensate for early than late pod damage. However in dryland crops, where water is limiting, significant early damage may delay or stagger podding with subsequent yield and quality losses. Damage to well-developed pods also results in weather staining of uneaten seeds due to water entering the pods.

Monitoring: Beat sheet sampling is the preferred sampling method for medium to large helicoverpa larvae. Small larvae should be scouted for by inspecting (opening) vegetative terminals and flowers. Damage to vegetative terminals and buds are often the first visual clues that helicoverpa larvae are present. Ideally, mungbeans should also be scouted for eggs and moths, to pinpoint the start of infestations and increase the chance of successful control.

- Inspect crops twice weekly at all stages.
- Sample 6 widely spaced locations per field.
- Take 5 one-metre long samples at each site with a 'standard' beat sheet.
- Convert larval counts/metre to larvae/m^2 by dividing counts by the row spacing in metres.

Helicoverpa armigera larva (medium—12 mm) with diagnostic dark saddle

Beat sheet sampling may only detect 50% of small larvae in vegetative and podding mungbeans, and 70% during flowering, as they feed in sheltered sites such as leaf terminals. However, many small larvae may be lost to natural mortality factors before they reach a damaging size and this cancels out sampling inefficiencies in most crops.

Thresholds: *Vegetative crops:* A new provisional threshold of 4–5 larvae/m² has been set for mid to late vegetative crops with good soil moisture, and is based on data from soybeans. Lower the threshold in seedling and small vegetative crops, particularly if soil moisture is limited. Take action if larvae are targeting buds and terminals rather than leaves.

Budding/flowering/podding: Thresholds are tabled below. For current (2010) crop values, the threshold is approximately 2 larvae/m², but can potentially vary between 1 and 3 larvae/m², depending on control costs and crop values.

Green mirid (*Creontiades dilutus*) and brown mirid (*Creontiades pacificus*)

Pest status: Mirids target buds and flowers causing them to abort and are one of the key pests of mungbeans. Mirid populations can gradually build up in vegetative crops and may be above the flowering threshold before budding, but have no impact on yield at this stage. It is critical to scout crops regularly to pick the start of budding as this is a critical stage for mirids and other key pests.

Risk period and damage: Budding, flowering and early-podding crops are at greatest risk.

- Mirids attack buds, flowers and small pods.
- There is no evidence mirids cause 'tipping' of terminals or yield loss in vegetative crops.
- Influxes of mirid adults often follow north-west winds in spring.

Adult green mirid

- Mirids are very damaging because they are typically present in crops in increasing numbers for 3–4 weeks from early budding.

Monitoring:

- Crops should be inspected twice weekly from budding onwards until post-flowering.
- Mirids are very mobile and in-crop populations can increase rapidly.
- In row crops, the preferred method is beat sheeting, as this method is also the most effective for helicoverpa and pod-sucking bugs.
- Sample 5 one-metre lengths of row (not consecutive) within a 20 m radius, from at least 6 sites throughout a crop.
- Avoid sampling during very windy weather as mirids are easily blown off the sheet.
- Thresholds for mirids in mungbeans vary from 0.3–0.6/m², depending on application costs and mungbean prices.

Thresholds: Thresholds for mirids in mungbeans vary from 0.3–0.6/m², depending on application costs and mungbean prices.

Economic threshold for controlling helicoverpa in flowering/podding mungbeans (larvae/m²)

Cost of control# = value of damage ($/ha)	Mungbean crop values ($/t)										
	$400	$450	$500	$550	$600	$650	$700	$750	$800	$850	$900
$20	1.4	1.3	1.1	1.0	**1.0**	0.9	0.8	0.8	0.7	0.67	0.63
$25	1.8	1.6	1.4	1.3	**1.2**	1.1	1.0	1.0	0.9	0.84	0.79
$30	2.1	1.9	1.7	1.6	**1.4**	1.3	1.2	1.1	1.1	1.01	0.95
$35	2.5	2.2	2.0	1.8	**1.7**	1.5	1.4	1.3	1.3	1.18	1.11
$40	2.9	2.5	2.3	2.1	**1.9**	1.8	1.6	1.5	1.4	1.34	1.27
$45	3.2	2.9	2.6	2.3	**2.1**	2.0	1.8	1.7	1.6	1.51	1.43

*Economic thresholds above are based on a rate of damage of 35 kg/ha per larva per square metre (larvae/m²). Cross-reference the cost of control versus crop value to determine the economic threshold (ET). E.g. if the cost of control = $40/ha and the crop value = $600/t, the ET = 1.9. Spray only if the helicoverpa population **exceeds** the threshold, which is the 'break even' point where the cost of control = the cost of pest damage.*

Control:

- Shortening a crop's flowering period reduces the risk of mirid damage.
- Flowering periods can be shortened by planting on a full moisture profile and by watering crops just before budding.
- Consider planting crops in at least 50 cm rows (as opposed to broadcast planting) to facilitate easier pest sampling).
- DEEDI trials show that the addition of salt (0.5% NaCl) as an adjuvant can improve mirid control at lower pesticide rates. Reducing dimethoate rates (typically by 50%) greatly reduces their impact on beneficial insects and also the risk of flaring helicoverpa. While even lower reductions are possible (e.g. by 66%), very low rates have insufficient residual activity to control hatching nymphs and should be avoided if there is high mirid pressure.
- The efficacy of dimethoate, the preferred mirid pesticide, is greatly reduced in alkaline water, so always add a buffer such as Li700 if necessary.

Green vegetable bug (GVB) (*Nezara viridula*)

Pest status: This species is the most damaging pod-sucking bug in mungbeans due to its abundance, widespread distribution, rate of damage and rate of reproduction. Very high populations are frequently encountered in coastal crops.

Risk period: Adult bugs typically invade summer legumes at flowering, but GVB is primarily a pod feeder with a preference for pods with well-developed seeds. Mungbeans remain at risk until pods are too hard to damage (i.e. very close to harvest). Damaging populations are typically highest in late summer crops during late pod-fill (when nymphs have reached or are near adulthood).

Damage: Pods most at risk are those containing well-developed seeds. GVB also damages buds and flowers but mungbeans can compensate for this early damage. Damage to young pods causes deformed and shrivelled seeds and reduces yield. Seeds damaged in older pods are blemished, difficult to grade out and reduce grain quality.

Green vegetable bug (normal adult)

Bug-damaged seeds are frequently discoloured, either as a direct result of tissue breakdown or water that may gain entry where pods are pierced by bugs.

Sampling and monitoring: Inspect crops for GVB twice weekly from flowering until close to harvest.

- Sample for GVB in early to mid morning.
- Beat sheet sampling is the most efficient monitoring method.
- Sample 5 one-metre non-consecutive lengths of row within a 20 m radius. This constitutes one (1) sample site.
- Sample at least 6 sites throughout a crop to accurately determine GVB populations.
- Convert your bug counts/row metre to bugs/m² by dividing counts/row metre by the row spacing in metres.

Thresholds: Pod-sucking bug thresholds in mungbeans are determined by seed quality, the maximum bug damage permitted being only 2%. GVB thresholds typically range from 0.3–0.6/m² depending on the crop size (seeds/m²).

Because thresholds are determined by % damage, the larger a crop (the more seeds per unit area), the more bugs that are required to inflict critical (threshold) damage, and the higher the threshold.

In practice in infested crops, GVB and other pod-

Economic threshold for controlling green vegetable bug (GVB/m²)

GVB/m² required to damage	Crop size based on seeds/m²							
	500	1000	1500	2000	2500	3000	3500	4000
2% of seeds	0.17	0.34	0.52	0.71	0.90	1.10	1.30	1.52
1.4% of seeds	0.12	0.24	0.36	0.50	0.63	0.77	0.91	1.06

 # The podsucking bug threshold is based on the likely quality and crop value downgrade if >2% of seeds are damaged. To ensure this critical level is not exceeded, consider taking action beforehand when the GVB population reaches that required to cause 70% of the critical 2% damage (i.e. 1.4%).

sucking bugs are usually present from 28–35 days prior to harvest, and populations increase rapidly as a result of in-crop breeding.

Redbanded shield bug (RBSB) (*Piezodorus oceanicus*)

Redbanded shield bug in Australia was previously classified as *Piezodorus hybneri* and more recently as *P. grossi*.

Pest status: Redbanded shield bug is a major mungbean pest. While normally not as abundant as GVB, it is nearly as damaging, and is far more difficult to kill with current pesticides. Despite its name, only the females have red bands, the males having pale cream bands.

Damage: Damage is similar to that caused by GVB, with early damage reducing yield, and later damage reducing grain quality.

Thresholds: Convert your redbanded shield bug counts to GVB equivalents to determine their damage potential. Do this by multiplying them by 0.75. If GVB are also present, total the two counts (plus those of any other pod-sucking bug species) to determine the damage potential of all the pod-sucking bugs present in your crop.

Monitoring: As for GVB. Beat sheeting is the preferred sampling method. Look for the distinctive dark twin-row egg rafts, which indicate the presence of egg-laying RBSB adults.

Large brown bean bug (*Riptortus serripes*) and small brown bean bug (*Melanacanthus scutellaris*)

Pest status: As damaging as GVB. Frequently found in mungbeans, but more frequent on the coast. Harder to sample than GVB as the adults are very flighty, and the nymphs look like ants.

Risk period: As for GVB.

Damage: Both large and small brown bean bugs are equally damaging and are as damaging as GVB.

Redbanded shield bug (female, 9 mm)

Damage is similar to that caused by GVB, with early damage reducing yield, while later damage reduces the quality of harvested seed.

Bean podborer (*Maruca vitrata*) (previously *Maruca testulalis*)

Pest status: A major pest in coastal and tropical regions.

Damage:

- Bean podborer Infests crops from early budding onwards.
- Eggs are laid on or in the flowers (inserted between the petals). Young larvae feed inside the flowers before moving to developing pods when mid-sized.
- Seeds in damaged pods are eaten out by larvae.
- Entry holes also let in water, which stains the remaining seeds.
- An early infestation sign is webbing of flowers.
- Infested pods have a well-defined entry hole (usually one/larva), frequently ringed with frass.

Monitoring and control:

- Open all flowers from as many racemes as possible to look for larvae (at least 30 racemes randomly sampled across a crop).
- Divide the total number of bean podborers detected by the number of racemes sampled,

Large brown bean bug (female Riptortus, 16 mm)

Bean podborer larva (large, 16 mm)

and multiply by the estimated number of racemes/m².

- Current threshold are 3 larvae/m² but accurate assessments are difficult where larvae are feeding inside flowers or pods.
- Pesticides are most effective if applied before larvae enter pods.

Thrips

Pest status: Thrips are widespread and regular pests of mungbeans. While they are key vectors of Tobacco Streak Virus (TSV), trying to control thrips is not an effective TSV management strategy. The best TSV strategy is to eradicate all weeds hosting TSV adjacent to the crop.

Damage—flower thrips:

- Crops are at greatest risk during flowering and podset.
- Nymphs and adults feed in growing points and inside flowers which can result in flower abortion and pod distortion.
- Deformed pods may be difficult to thresh, resulting in further yield losses.

Damage—seedling thrips:

- Spring crops adjacent to cereals are at greatest risk of infestation.
- Plants are infested as they are emerging from the soil.
- Despite the alarming symptoms, seedling thrips rarely have any impact on crop yield or time to harvest.
- In cool weather, low temperatures rather than thrips are responsible for poor plant growth.
- Spraying seedling thrips after the symptoms become apparent is mostly a waste of time.

Monitoring, thresholds and control:

- Open and examine flowers for thrips.
- If flowers cannot be assessed immediately, store in 70% alcohol to dislodge thrips and prevent thrips escaping.
- Control thrips if, on average, more than 4–6 thrips/flower are found.
- Vigorously growing crops can better compensate for flower abortion.
- Remove weeds such as parthenium that host TSV. These weeds are also a potential source of infested pollen that can be blown into mungbean crops.

Check inside flowers for thrips

Silverleaf whitefly (SLW)

Mungbeans are not a preferred host of silverleaf whitefly. While adults are often seen on mungbeans, SLW nymphs only develop poorly.

Irrigation

Mungbeans are highly efficient users of water and usually do not respond to irrigation during podding. They are sensitive to excessive waterlogging and the importance of good layout and drainage cannot be over-emphasised. Waterlogging events lasting more than five days can cause root nodules to die back, often causing nitrogen deficiency problems in the crop.

Furrow irrigation

The following irrigation strategies have been developed to help minimise the impact of waterlogging in pulse crops.

- Select fields with reasonably steep grades
- Fields should not have any low spots. Ideally, they should be laser-levelled
- Form-up high volume hills or beds which drain quickly after rain
- Select fields with short runs (200–400 m)
- An efficient tailwater system to rapidly drain water away from the paddock
- Irrigate down every second furrow
- Apply water quickly, preferably in 4–8 hours by adjusting the number of siphons per furrow
- Irrigating after light rain can speed up irrigation time
- The first irrigation should be applied before soil cracks open right up

Nitrogen fertiliser can be used to offset the effects of waterlogging. This can be applied as a foliar urea spray prior to irrigation, or as 15–25 kg urea/hectare in the irrigation water (water run).

Being relatively quick maturing, one of the major advantages of mungbeans is their low water use and relatively high financial returns per megalitre.

A strategy of irrigating at planting and then at

Insecticides for mungbeans (2010)

Pest	Active ingredient	Trade names	Rate/ha	Impact on non-target species	WHP# (days)	Comments
Helicoverpa	alpha-cypermethrin	Dominex, Fastac etc	EC: 0.3–0.4 L ULV: 1.9–2.5 L	extreme	7	target larvae < 5 mm for best results
	Bt—*Bacillus thuringiensis*	Dipel SC	1-4 L	no impact	NA	target hatchlings for best results
	cypermethrin	Cypermethrin, Scud, Sonic	EC: 0.3–0.4 L ULV: 1.9–2.5 L	extreme	7	target larvae < 5mm for best results
	deltamethrin	Decis options, Ballistic	EC: 0.5 L ULV: 2.5 L	extreme	7	target larvae < 5 mm for best results
	esfenvalerate	Sumi-Alpha Flex	0.4–0.5 L	extreme	14	target larvae < 5mm for best results
	gamma-cyhalothrin	Trojan	0.05–0.06 L	extreme	14	target larvae < 5mm for best results
	indoxacarb	Steward	0.2–0.4 L	moderate	21	only 1 spray allowed per crop*
	lambda-cyhalothrin	Karate, Matador, Zeon	0.06–0.07 L	extreme	14	target larvae < 5mm for best results
	methomyl	Lanate, Marlin, Nudrin	0.5–2 L	highly disruptive	7	target larvae < 7 mm for best results
	nuclear poyhhedrosis virus (NPV)	VivusMax Vivus Gold Gemstar	0.150 L 0.375 L 0.375 L	no impact	NA	target larvae < 7–10 mm. ideally apply when temp > 25 ˚c and never if < 18 ˚c
	thiodicarb	Larvin, Showdown	0.5–0.7 L	highly disruptive	21	target larvae < 7mm for best results
Soybean loopers	indoxacarb	Steward	0.2 L	moderate	28	only 1 spray per crop*
	bt—*Bacillus thuringiensis*	Dipel, Farmoz Btk	1–4 L	little or no impact	nA	preferred pre-flowering option
Bean podborer	methomyl	Marlin, Nudrin	1.5–2 L	disruptive	7	spray while larvae in flowers
GVB	deltamethrin	Decis options, Ballistic	EC: 0.5 L ULV: 2.5 L	extreme	7	most effective option
	methomyl	Lannate, Marlin, Nudrin	1.5 L	highly disruptive	7	poor control where dense canopy
Mirids	dimethoate	Dimethoate	0.5 L	disruptive	7	most effective option
	indoxacarb	Steward	0.4 L	moderate	28	don't use if >2/m²
Aphids	dimethoate	Dimethoate	0.5 L	disruptive	7	
Jassids, leafhoppers	dimethoate	Dimethoate	0.8 L	disruptive	7	rarely a problem
Thrips	dimethoate	Dimethoate	0.8 L	disruptive	7	check in flowers
Beanfly	dimethoate	Dimethoate	0.8 L	disruptive	7	repeat maybe needed in 7 days
True & false wireworm	chlorpyrifos**	Chlorpyrifos 500	0.1L/2.5 kg seed	disruptive	NA	grain bait

*# WHP = withholding period (days). *Maximum allowed for on label.*
***Currently under permit, check www.apvma.gov.au prior to use.*
Refer to all current product labels for full directions prior to use.

Furrow irrigated mungbean crop

budding has been found to be most cost-effective in many situations.

Other points to consider:

- Crystal offers greater yield potential than other varieties
- narrow rows will maximise yields under favourable conditions
- a plant population of at least 30/m² will maximise yield
- higher yields will be achieved on 2 m beds than on 1 m hills. The high lodging pressure on 1 m hills can reduce yields by up to 300 kg/ha.
- irrigating too early can delay or inhibit nodulation
- the short duration of current varieties places a ceiling on achievable grain yield
- coordinate irrigation with insect control strategies.

Irrigating too early in the growth of the crop will encourage excessive vegetative growth. The preferred strategy is to pre-water and then plant on a full profile of soil water. The first in-crop irrigation is usually best applied around seven days before the start of flowering, i.e. 30–40 days after planting.

On the heavy black earths (Darling Downs, Emerald, Liverpool Plains), one in-crop irrigation applied around flowering is usually sufficient to achieve reasonable yields. On the lighter grey clay soil types, two irrigations may be required with flood irrigation systems.

Avoid growing hard-seeded lines such as Emerald under irrigation as the hard seeds can cause volunteer problems in cotton farming systems.

Spray irrigation

This is an option in some areas and has the advantage of allowing smaller amounts of water to be applied more frequently. This helps reduce waterlogging and can lift yields. Avoid heavy spray irrigation of young plants as the caked-on dirt from mud splash can reduce growth and thin the plant stand (especially in crusting soils). Approximately 50 mm of water per week will normally be required during flowering and pod-fill.

Yield potential

Dryland	double crop	0.25–1.25 t/ha
	winter fallow	0.75–2.0 t/ha
Irrigation		1.25–2.75 t/ha

Grading losses will usually reduce marketable yields by 5–20%.

Harvesting

The preferred moisture content for delivery to the packing sheds is in the range of 12–14%. The maximum moisture for beans in storage is 12%.

Browning and discolouration of seed

A high proportion of high moisture beans (above 14%) in the sample can lead to browning and discolouration of those beans when held in storage or during shipment to export destinations. This browning of the seed coat often occurs after delivery to the packing shed, usually a month or more after harvest.

Classification of deliveries may be delayed on suspect lines with a significant proportion of high moisture beans in the sample. These suspect lines may be put into short-term storage until the full extent of the problem becomes evident.

Desiccation

Mungbeans have an indeterminate flowering habit. This means that they do not have a defined

Registered products for desiccating mungbeans (2010)

Active ingredient	Example trade name	Rate (L/ha)	Days to maximum desiccation	Withholding period (WHP) days
Diquat	Reglone	2.0–3.0	5–6	0
Glyphosate	Roundup Power-Max	various	7–16	7

Refer to the current product label for rates and full directions prior to use.

flowering period and will continue to flower while there is adequate soil moisture. Consequently, they can have flowers, green pods and black pods present on the plant at the same time. This growth habit can make the harvesting decision difficult. The ideal stage for harvest to maximise yield and quality is when the majority of pods are physiologically mature and 90% of the pods have turned yellow through to black.

At this stage the crop should be considered ready for desiccation and harvest.

The key point when desiccating mungbeans is the use of a robust rate of glyphosate and allowing sufficient time for the crop to dry down before commencing harvest.

Product choice: Glyphosate (e.g. Roundup PowerMax) and diquat (e.g. Reglone) are the registered herbicides for desiccation.

Glyphosate is the preferred treatment. This translocated herbicide, when used at the higher rates, provides the most consistent dry-down of both leaf and stem moisture.

Diquat is a desiccant that provides rapid dry-down of leaves, but poor dry-down of moist stems. It is used mainly when rainfall is imminent. If rainfall interrupts harvest, regrowth may occur as early as 10 days after application and may require re-treatment.

Plant vigour: Large healthy crops that are actively growing with adequate levels of soil moisture require higher product rates than would normally be the case.

Variety: Crystal and Emerald are more likely to require high product rates because of their ability to remain green and healthy late in the season.

Water quality and pH: Reduced results may occur if water containing suspended clay or organic matter (e.g. from dams, streams and irrigation channels), or high levels of calcium, magnesium or bicarbonate ions is used. Water pH should be neutral to acidic. Consider buffering to optimise spray performance.

Spray application: Refer to the product label for complete application details.

Time to harvest: There is a tendency for growers to harvest too soon after desiccation.

The rate of dry-down of the crop will depend on the choice of desiccant product, rate used and temperature and moisture conditions. Wait for maximum dry-down of leaf and stem moisture, which can take 5–6 days with diquat and 7–16 days for glyphosate.

Dessicated mungbeans ready for harvest

Marketing

The mungbean marketing system is unique, particularly in comparison with those used for other pulse and grain crops. To be successful growers need to understand the mungbean consumers' fundamental requirements, including:

- Consumers purchase mungbeans as a vegetable. While a popular vegetable in Asia, in Australia mungbeans are often thought of as another 'grain' crop.
- The marketing of mungbeans to other countries is not unlike marketing our vegetable crops in Australia. The buyer places a high degree of emphasis on product familiarity, appearance and quality. These markets also tend to be highly volatile, reflecting changes in supply and demand.
- What can appear as a good sample to the Australian farmer may be unacceptable to some buyers, creating confusion for the grower.

If the Australian mungbean crop were to be accumulated as one bulk commodity, the whole crop would be downgraded to the lowest quality, resulting in lower returns for the majority of mungbean growers.

World mungbean prices are largely determined by both the volume of production and quality of the crops in China and Burma, and as a result are constantly responding to supply issues in these exporting countries. Price trends usually become

Mung dahl (top) and retail products (below)

obvious in December when harvest of the Chinese crop nears completion and both the volume and quality of production in that country is more apparent.

Mungbeans are classified into five grades:

- sprouting grade beans
- cooking grade beans
- no. 1 processing grade beans
- processing grade beans
- manufacturing.

Less than 5% of the total mungbean crop goes into the sprouting market. Processing grade is a broad classification for lower quality beans. Prices can vary by as much as $150 per tonne at any time of the year for beans within this broad processing grade classification depending on appearance and quality, i.e. whether good or poor quality processing grade.

Growers should consult their local Australian Mungbean Association member (www.mungbean.org.au) for the latest prices and marketing information.

Companies such as Selected Pulse Foods offer further market options by processing beans into mung dahl, which is sold on the Australian domestic market.

Grading costs are deducted from the machine dressed price to arrive at a net on-farm return to the grower. These costs include grading, bagging and laboratory testing fees where appropriate.

Communicate with your AMA member regarding potential grading losses and costs involved in grading and storing your product prior to sale. Refer to the AMA *Code of practice for grading sheds*.

Growers should develop a sound working relationship with their AMA member and trust that they will do the best for the grower.

Commodity vendor declarations are required by packing sheds to maintain high levels of hygiene and food safety within the Australian mungbean industry. The information provided on the forms is the basis of an industry-wide quality assurance scheme that is a significant advantage in marketing the Australian mungbean crop to overseas and domestic buyers.

The AMA is the peak industry body representing mungbean growers and marketers in Australia.

Accredited mungbean agronomists

DEEDI, Pulse Australia and the Australian Mungbean Association offer a series of training courses for agronomists. The need for this training is necessary as mungbean management requires specialist technical knowledge and practical skills. This course provides agronomists with the most current research information and best management practices required to assist growers to achieve more reliable and profitable mungbean production.

The program consists of a 2-stage approach:

- a structured 2-day technical workshop
- detailed in-crop monitoring.

Once these 2 stages are complete and deemed to meet industry best management practice the participant becomes an ‘accredited mungbean agronomist’.

If you are considering growing mungbeans it is strongly suggested that you employ the services of an accredited mungbean agronomist to ensure that you are receiving the highest possible standard of service, and maximise your profitability. A complete list of accredited agronomists is available at www. mungbean.org.au

Gross margin for mungbeans

Income		Price ($)	Dryland (fallow)		Irrigated	
Price $/t (MD bagged)	Sprouting	870				
	Cooking	820				
	No.1 Processing	770	90%		90%	
	Processing	700				
	Manufacturing	600				
	Gradings*	150	10%		10%	
				$/ha		$/ha
Less	Freight to store	12				
	Processing and bagging	100				
	Levies	6.74				
On-farm price ($/t)		575				
Yield (t/ha)			1.2		1.9	
Gross income ($/ha)				690		1093
Variable costs				**$/ha**		**$/ha**
Primary tillage		8.76/ha				
Secondary tillage		6.98/ha				
Inter-row tillage		3.34/ha			1	3.34
Boomspraying		5.00/ha	6	30.00	4	20.00
Planting		6.98/ha	1	6.98	1	4.55
Fallow spray	Glyphosate CT @1.2 L	6.05/L	2	14.52	2	14.52
	Plus surpass @ 1 L	7.00/L	1	7.00		7.00
Seed	Crystal	1.85/kg	25 kg	46.25	33 kg	61.05
Inoculum		7.70/pkt	0.25 pkt	1.93	0.33 pkt	2.54
Fertiliser	Supreme Z	1040.00/t	30 kg	31.20	60 kg	62.40
Herbicide	Spinnaker	$370.00/kg	0.07 kg	25.90		
	Select				0.25 L	6.48
Insecticide	Dimethoate @ 0.25 L + 0.5% salt	12.95/L	1	3.24	1	3.24
	Indoxacarb @ 0.4 L	71.50/L	1	28.60	1	28.60
Aerial spray		16.00			2	32.00
Scouting		10/ha		10.00		10.00
Irrigation	Furrow	56.49			2.5	141.23
Desiccation	Roundup PowerMax	9.10/L	1.8 L	16.38	1.8 L	16.38
Contract header		270.00/hr	4.5 ha/hr	60	3.5 ha/hr	77.14
Fuel		1/L	10.8 L/ha	10.78	13.9 L/a	13.86
Total variable cost ($/ha)				**293**		**504**
Gross margin ($/ha)				**397**		**588**

These gross margins were calculated on indicative costs and retails prices. They may vary significantly from those of an individual on-farm enterprise but are presented as a guide to help you to prepare your own on-farm budgets.

** Saleable grading losses can vary between 5% and 20%.*

Mungbean gross margin (fallow) – effects of price and yield

Expected on-farm price ($/t)	Expected yield (t/ha)						
	0.84	0.96	1.08	1.20	1.32	1.44	1.56
403	45	94	142	190	239	287	335
460	94	149	204	259	315	370	425
518	142	204	266	328	390	453	515
575	190	259	328	397	466	535	604
633	239	315	390	466	542	618	694
690	287	370	453	535	618	701	784
748	335	425	515	604	694	784	874

Mungbean gross margin (irrigated) – effects of price and yield

Expected on-farm price ($/t)	Expected yield (t/ha)						
	1.33	1.52	1.71	1.90	2.09	2.28	2.47
403	31	108	184	261	337	414	490
460	108	195	282	370	457	545	632
518	184	282	381	479	577	676	774
575	261	370	479	588	698	807	916
633	337	457	577	698	818	938	1058
690	141	545	676	807	938	1069	1200
748	490	632	774	916	1058	1200	1342

These gross margins were calculated on indicative costs and retails prices. They may vary significantly from those of an individual on-farm enterprise but are presented as a guide to help you to prepare your own on-farm budgets.

Mungbean

AUSTRALIAN MUNGBEAN ASSOCIATION

~ The summer crop alternative ~

Visit:

www.mungbean.org.au

For the latest information on:

- ***Research results***
- ***Marketing of your mungbean crop***
- ***Profitable mungbean production***
- ***News and happenings in the mungbean industry***
- ***Industry publications***
- ***AMA members and traders***

For more information email: info@mungbean.org.au

AMA Approved Mungbean Planting Seed

Growers should replenish their planting seed every 3 years with AMA Approved Planting Seed to ensure:

- ***Greatest seedling crop vigour***
- ***Freedom from off-types***
- ***Lowest risk of seed-borne diseases such as halo blight and tan spot.***

Contact your local AMA Member for your seed requirements today.

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AUSTRALIAN MUNGBEAN ASSOCIATION

Queensland Government | PULSE AUSTRALIA | NSW Industry & Investment | GRDC Grains Research & Development Corporation

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