

# Potato information kit

Reprint – information current in 1997



## REPRINT INFORMATION – PLEASE READ!

For updated information please call 13 25 23 or visit the website [www.deedi.qld.gov.au](http://www.deedi.qld.gov.au)

This publication has been reprinted as a digital book without any changes to the content published in 1997. We advise readers to take particular note of the areas most likely to be out-of-date and so requiring further research:

- Chemical recommendations—check with an agronomist or Infopest [www.infopest.qld.gov.au](http://www.infopest.qld.gov.au)
- Financial information—costs and returns listed in this publication are out of date. Please contact an adviser or industry body to assist with identifying more current figures.
- Varieties—new varieties are likely to be available and some older varieties may no longer be recommended. Check with an agronomist, call the Business Information Centre on 13 25 23, visit our website [www.deedi.qld.gov.au](http://www.deedi.qld.gov.au) or contact the industry body.
- Contacts—many of the contact details may have changed and there could be several new contacts available. The industry organisation may be able to assist you to find the information or services you require.
- Organisation names—most government agencies referred to in this publication have had name changes. Contact the Business Information Centre on 13 25 23 or the industry organisation to find out the current name and contact details for these agencies.
- Additional information—many other sources of information are now available for each crop. Contact an agronomist, Business Information Centre on 13 25 23 or the industry organisation for other suggested reading.

Even with these limitations we believe this information kit provides important and valuable information for intending and existing growers.

**This publication was last revised in 1997. The information is not current and the accuracy of the information cannot be guaranteed by the State of Queensland.**

This information has been made available to assist users to identify issues involved in potato production. This information is not to be used or relied upon by users for any purpose which may expose the user or any other person to loss or damage. Users should conduct their own inquiries and rely on their own independent professional advice.

While every care has been taken in preparing this publication, the State of Queensland accepts no responsibility for decisions or actions taken as a result of any data, information, statement or advice, expressed or implied, contained in this publication.



Queensland Government



# Growing **THE CROP**

*This section is our recipe for growing and marketing a commercial crop of potatoes for the fresh market. To keep the section as brief as possible and easy to follow, little explanation is provided with the recommendations. Where more information may help, reference is made to other sections of the kit. Symbols on the left of the page will help you make these links.*

*Our recipe does not cover potatoes grown for processing into crisps and French fries as this is a specialised operation accounting for only 20% of Queensland's production. While many of the growing practices are similar, these potatoes are grown by contract growers using guidelines supplied by the processing companies.*



## Getting the crop started

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*How to get ready for planting, prepare the seed and plant.*



## Looking after the crop (Stage 1)

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*Things to do from planting to just before tuber initiation.*



## Looking after the crop (Stages 2 & 3)

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*Things to do during tuber initiation and bulking up.*



## Looking after the crop (Stage 4)

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*Things to do during tuber maturation.*

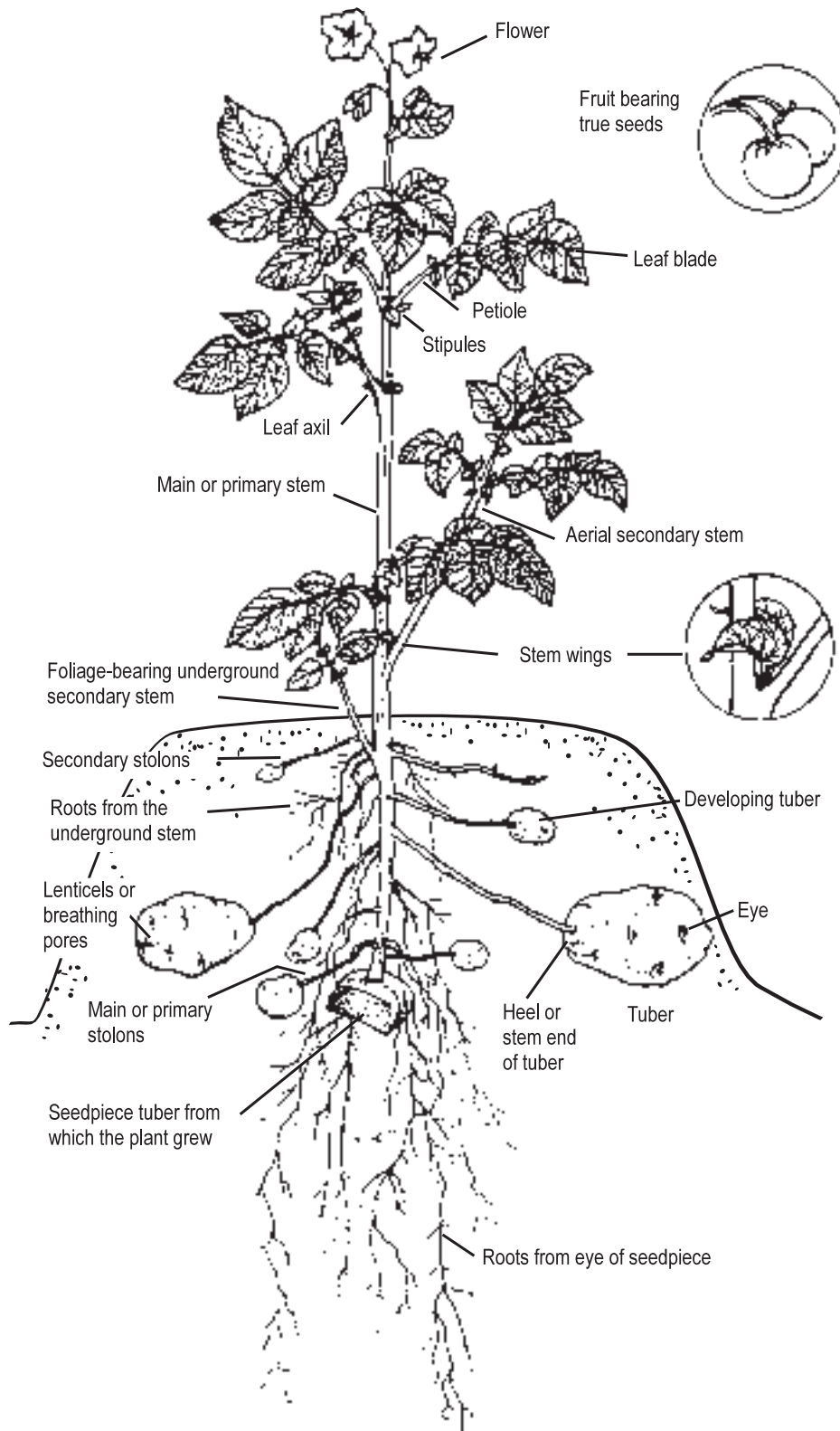


## Harvesting and marketing

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*The steps from harvesting to marketing.*

# The potato plant



**Figure 1.** Parts of the potato plant



## Getting the crop started

Start planning your crop and preparing the land at least six months before planting. This involves nine key steps.



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### Decide when to plant

The major factor influencing planting time is climate, specifically the heat of mid-summer and the extent of frosts in winter and early spring. Little can be done about the mid-summer heat. Solid set irrigation systems fitted with frost alarms will allow growers on farms subject to frost to start planting in late May and early June.

The main planting times for each production district are listed in Table 1.

**Table 1.** *Planting and harvesting times for the main production districts.*

District	Planting	Harvesting
Lockyer Valley	February–March June–July	May–June October–November
Killarney	October–November	February–March
Coastal areas such as Bundaberg, Redland Bay	April	August–September
Atherton Tableland	April–September	August–December

## Figure 2. Getting ready for a June planting

	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun
<b>Seed</b>	Contact certified seed suppliers to find out what is available. Order seed if growing new or uncommon varieties.				Order seed for standard varieties.	Seed arrives. Empty it into 500 kg crates for inspection and storage. Inspect it closely, then cool store or store in a well ventilated shed until 3 weeks before planting.	Make sure seed has sprouted. Cut seed 1 or 2 days before planting and treat with seed dust.	
<b>Land preparation</b>	Cultivate and/or deep rip. Get a soil analysis done. Apply lime, fertiliser, manure as indicated by soil analysis. Plough in.		Plant green manure crop.	Slash or mow green manure crop when it reaches 1 to 1½ metres in height. Allow crop to regrow if time permits.	Apply urea or nitram after each slashing where green manure crop is being allowed to regrow.	Plough or rotary hoe in green manure crop.	Cultivate 1 or 2 times to assist the breakdown of green manure crop. Re-do soil analysis to fine-tune fertiliser requirements. Apply fertiliser just before or at planting.	<b>PLANT</b>
<b>Other</b>					Develop an irrigation plan and prepare equipment.			



Details on varieties  
Section 4 Page 18

## Select varieties

The main fresh market varieties grown in Queensland are Sebago, Red La Soda, Snow Gem, Pontiac, Exton and Sequoia. Atlantic is the main crisping variety. Minor fresh market varieties include Winlock, Desiree and Bison. The variety grown depends largely on the market which you are supplying—the fresh unwashed market, the fresh washed market or the processing market. Other factors which should be considered include frost or heat tolerance, susceptibility to disease and yield potential. Our current suggestions are shown in Table 2. Use this as a starting point and seek expert local advice before deciding.

**Table 2. Current variety suggestions**

Market	Varieties
Fresh unwashed	Sebago Exton (April/May plantings only)
Fresh washed	Red La Soda Snow Gem
Processing	Atlantic

## Select seed source

These guidelines will help you in selecting seed potatoes.

- Use certified seed. This seed has been grown under Government supervision, is true to type, free from specified diseases and within specified levels for other pests and diseases. Certified seed is produced as either round seed or seed suitable for cutting.
- Certified seed schemes operate in New South Wales, Victoria and Tasmania. The certified seed used should come from an area recognised as producing seed suited for your required planting time. This knowledge only comes from local experience, so seek expert local advice before selecting your certified seed source.
- There is one situation where certified seed probably will not be available. This is for the autumn planting of Sebago in February to March. Seed for this crop is traditionally obtained by growers storing small, round tubers from their spring crop. If you intend to do this, keep the parent crop as free from disease as possible. Alternatively, grow a small area specially for seed tubers and inspect it several times, removing and destroying diseased plants and tubers. Avoid harvesting the seed tubers during hot conditions. Remove the seed as quickly as possible from the field and place it in a cool store or well ventilated shed. Do not leave seed tubers in the hot sun.
- Do not buy uncertified seed because it may be diseased. If you have to for some reason, inspect it carefully and avoid old seed tubers which have numerous well advanced shoots, or which are flabby.



Selecting seed  
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## Work out how much seed you will need

### Row width and plant spacing

The row width chosen depends mainly on the machinery being used. The normal row width is 75 to 90 cm. This range accommodates most specialised potato machinery.

The normal distance between planted seedpieces ranges from 20 to 30 cm depending on row spacing, seedpiece size and seed price.

Provided that the same quantity of seed is planted per hectare, yield will not vary significantly within these ranges.

### Deciding how many seedpieces you need

To determine how many seedpieces you will plant per hectare, use the following formula:

$$\text{Step 1} \quad \frac{10\,000}{\text{distance between rows (m)}} = \text{metres of row/hectare}$$

$$\text{Step 2} \quad \frac{\text{metres of row/hectare}}{\text{distance between plants (m)}} = \text{plants/hectare}$$

*For example: How many seedpieces will you need per hectare for a crop with 80 cm between the rows and 25 cm between the plants?*

$$\text{Step 1} \quad \frac{10\,000}{0.8 \text{ m}} = 12\,500 \text{ metres of row/hectare}$$

$$\text{Step 2} \quad \frac{12\,500}{0.25 \text{ m}} = 50\,000 \text{ plants/hectare}$$

To help you, Table 3 shows our calculations for a number of different row and plant spacings.

**Table 3.** Number of seedpieces at different row and plant spacings

Distance between rows	Distance between plants		
	20 cm	25 cm	30 cm
75 cm	66 670	53 330	44 440
80 cm	62 500	50 000	41 670
90 cm	55 550	44 440	37 030

### Deciding the weight of seedpieces you need

To determine the weight of seed you need per hectare, use the following formula:

$$\frac{\text{plants/hectare} \times \text{seed weight in grams}}{1000} = \text{kg of seedpieces}$$

*For example: What quantity of seed will you need per hectare if there are 50 000 plants per hectare and the average seed weight is 50 g?*

$$\frac{50\,000 \times 50}{1000} = 2500 \text{ kg/ha} = 2.5 \text{ tonnes of seed per hectare}$$

The amount of seed planted normally ranges between 1800 and 2500 kg/ha. The higher rate is generally for machine cut seed for the main spring crop when growing conditions are best. On fertile soils with a variety like Atlantic, also use the higher rate to avoid oversize tubers and possible problems with hollow heart. Your own experience over a few years will allow you to fine-tune your planting rates.

Multiply the 'tonnes of seed per hectare' figure by the number of hectares you intend to plant to determine how much seed you need to order.

## Order seed

Contact the seed suppliers of the certified seed source you have selected and obtain details of the varieties they have available, dates when seed will be available, price and delivery arrangements. Then order your seed.

In south Queensland, many growers do not buy directly from seed growers, but order through their local merchants. In north Queensland, seed may be obtained through the Atherton Tableland Potato Growers Association.

## Prepare the land

### Protect against wind

As potatoes are susceptible to wind damage, a site protected from wind will out-produce an exposed site. Permanent windbreaks are best, but vegetation strips of a tall growing crop such as forage sorghum, will provide some protection.

### Protect against soil erosion

Uncontrolled runoff water removes valuable topsoil while the land is being prepared. Where slopes used are greater than 5%, plan the farm layout to prevent erosion and allow efficient irrigation and use of equipment. Avoid using slopes greater than 10%.

Land conservation extension officers from the Department of Natural Resources provide free on-site advice on farm layout.

Laser levelling is recommended to improve water management and avoid low spots, which increase disease risk.

more info



Certified seed  
suppliers  
Section 6 Page 4



## Soil preparation

Soil preparation for potatoes should aim at producing a deep, loose seedbed at the time of planting. The soil should be finely worked with a minimum of clods.

In recent years, ploughing has been replaced in many instances by a combination of deep tine ripping and harrowing with heavy duty offset disc harrows. The final preparation is frequently carried out by rotary hoe or harrow.

Potatoes do not grow well in compacted soil. Avoid cultivation methods which require a considerable number of passes with heavy machinery. Growing a grass cover or green manure crop (pasture or forage sorghum) before potatoes will improve soil structure.

## Crop rotation

To prevent the buildup of pests and diseases, crop rotation is recommended. This means spelling the land between potato crops for periods of two to five years. During the spelling period, other crops or green manure crops are grown. Lucerne and pasture are the only practical long term crops to use in rotation with potatoes. Grain or forage sorghum is a good short term rotation crop. Avoid using tomatoes, capsicums and eggplant which are alternative hosts of many potato pests and diseases.

## A guide to land preparation

Here is a suggested land preparation schedule for a June planting.

- **Initial cultivation (December).** If the land is under grass, first plough it with a disc or mouldboard plough. If the land has been previously cultivated, deep ripping is also recommended.
- **Initial soil nutrient analysis (December).** Purchase a soil sampling kit from your local farm supply store. Follow the sampling instructions and send the sample away for analysis. Results should be back in about two weeks and will be interpreted by the laboratory analysing your sample.
- **Fertilising and liming for green manure crop (December).** Discuss the results of your soil nutrient analysis with your farm supply agent and work out how much fertiliser and liming material (lime or dolomite) are needed to grow a good green manure crop. Spread these over the land and cultivate them in. Use either disc harrows or a rotary hoe/rotary tined implement.
- **Green manure crop (January to April).** Broadcast over the cultivated land 20 to 30 kg per hectare of hybrid forage sorghum seed. If the seedbed is rough and the seed will not have good soil contact, use a higher rate. Suitable varieties of forage sorghum are Betta-Dan, Cowpow, Jumbo, Lush, Superchow, Superdan and Super Sudax.

For best germination, use harrows or a light tined implement after planting to mix the seed into the soil. Light rolling will improve germination by ensuring that the seed is in closer contact with the soil. Water as required and fertilise with urea (100 to 150 kg/ha) when the green manure crop is about 300 mm high or earlier if growth is slow. Apply the urea before rain, or water immediately after application.

Slash or mow when the green manure crop reaches one and a half metres in height. Do not slash the crop below a height of 150 mm from the ground to avoid damaging the crown. Apply another 100 to 150 kg/ha of urea if the green manure crop has been slashed and is to be allowed to regrow before ploughing in.

In April, turn in the green manure crop using a plough, rotary hoe or rotary tines. If you use other cultivation equipment, first slash the crop close to the ground.

- **Final land preparation (late May to early June).** No green material should be left in the soil when potatoes are planted. This is commonly achieved by using a rotary hoe or plough and subsequent working with a power harrow.
- If nutgrass is a problem, apply Eptam at 5.5 L/ha and cultivate in to a depth of 5 to 10 cm.

### **Develop an irrigation plan and choose equipment**

Consult a supplier of irrigation equipment or a designer in your area to help you develop an irrigation plan. Overhead sprinkler irrigation is the main system used. Where required, sprinklers also can be used to protect plants against frost damage. Use solid set or hand shift lines, with impact sprinklers on short risers to allow spray machinery to pass overhead. The sprinkler jet size recommended for solid set is 2 mm, while hand shift lines use a 4.8 mm main jet and a 3 mm tail jet. Travelling irrigators are an alternative to solid set or hand shift lines.

Trickle irrigation, although not widely used, is an alternative way to water the plants where frost protection is not important.

### **Water quality**

Also test the quality of your water and make sure it is suitable for irrigating potatoes. Reduced yields can be expected if the conductivity (salt content) of your water is above 1800  $\mu\text{S}/\text{cm}$  (microSiemens per cm).

### **Prepare the seed**

#### **Inspection**

When the seed arrives, inspect it immediately for any defects. The best way to do this is to empty it into 500 kg crates. This also allows the seed



to then be monitored for any problems during storage. Check for obvious defects such as bruising, rots, powdery scab and potato tuber moth. If defects exceed the levels specified for certified seed, contact the certified seed supplier immediately.

## Storage

There are two options for storage of seed between receipt and planting:

- **Cool storage.** This is often done to speed up sprouting before planting. Cool store at 4° to 5°C until about three weeks before planting and then remove for a warm up period of at least one week. During warm up, keep seed under cover, preferably in 500 kg crates, although bags may be used.
- **Shed storage.** Store in 500 kg crates in a well ventilated shed. Do not store in bags.



Storing seed  
Section 4 Page 13

## Final seed preparation

Make sure the seed has commenced to sprout before cutting or dressing in preparation for planting.

- **Cutting.** Certified seed supplied for planting in winter and spring (April to November) is currently cut to produce seedpieces for planting. In contrast, autumn planted crops (February to March) use whole seed of 50 to 100 g held over from the spring crop in cool store. However, there is a trend towards certified seed producers supplying graded whole seed for winter and spring plantings. This will eliminate the need for seed cutting and its attendant problems.

Seed can be cut and planted on the same day or the next day providing the soil is moist and soil temperatures are around 12° to 15°C. If conditions are not ideal and Sebago is being planted, cut a couple of days before planting and allow the seed to cure or heal. Good curing conditions are 90% humidity, a temperature of 18° to 20°C and good air circulation. This can be achieved by adjusting a cool room to run at these settings.

Many growers own an automatic seed cutter or have access to one. On smaller farms, seed is cut by hand. Hand cutting produces better quality seed but is more expensive.

The size of the seedpiece depends on the size of the tuber and the distribution of eyes. It should range from 40 to 60 g regardless of the number of eyes. Single eye seedpieces can only be produced by hand cutting.

- **Dressing.** Treat all cut seed with a special seed dust to protect it from seedpiece breakdown. Use a chemical from the *Problem Solver Handy Guide*. Follow label directions. Ensure that the cut surfaces are completely covered by the dust. Where *Rhizoctonia* black scurf has been a problem, a second seed treatment may be beneficial. Use a chemical from the *Problem Solver Handy Guide*. Follow label directions.



Selecting seed  
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Where to obtain the brochure  
Section 6 Page 14

The brochure *Make more money by correct handling of potato seed tubers* is a very good reference on handling potato seed and is recommended reading.

## Plant

### Irrigation

Plant seed into moist soil. If required, irrigate before planting to achieve the desired soil moisture.

### Fertiliser

Fertiliser is normally applied at planting using a fertiliser applicator attached to the planter. Place the fertiliser to the side of and below the seed. Direct contact between fertiliser and seed causes seedpiece breakdown. Base the fertiliser rate on soil analysis results. As a guide, in the Lockyer Valley, 600 to 700 kg/ha of a 15:4:11 N:P:K fertiliser is normally applied at planting. In soils with low phosphorus levels, a fertiliser with a higher phosphorus content is required.



### Pest and disease control

Where wireworms, common scab, powdery scab or *Rhizoctonia* black scurf have been previous problems, chemicals are sometimes applied at planting using a special applicator attached to the planter. Use chemicals from the *Problem Solver Handy Guide*. Follow label directions.

### Hilling

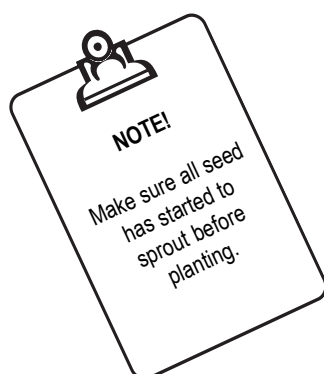
Potatoes are normally grown on hills. The hills help to improve soil drainage and aeration and to facilitate harvesting. Hills also help to maintain a satisfactory soil cover, important under Queensland conditions as it prevents greening and minimises potato tuber moth damage.

Hills can be built at planting using a special planter but are generally built later on during Stage 1. The main advantage of building them at planting is the reduction in soil compaction from later machinery passes up and down the row. It also avoids the risk of hilling not being completed later on because of wet weather. The disadvantage is that weeds cannot be controlled mechanically without breaking down the hills so weed control is entirely dependent on herbicides.

Construct hills 25 to 30 cm high. Sometimes hills are rolled either at, or immediately after planting, to compact the soil around the seedpieces.

### Planting

Seedpieces are planted using cup or needle planting machines. The most common is a double row cup planter. The newer planters are fully



automatic. Cup planters are preferred as there is a risk of spreading disease from one seedpiece to another when using needle planters.

Use the row width (the normal range is 75 to 90 cm) and plant spacing (the normal range is 20 to 30 cm) worked out on page 6.

The normal depth of planting is 10 to 15 cm. Where hills are being built at planting, plant above the bottom of the hill. A general rule of thumb is to plant small seedpieces at the shallower end of the range and large seedpieces at the deeper end of the range. Shallow planting achieves more rapid emergence. Deeper planting is more desirable for rain-grown crops to ensure they have ample moisture.



## Looking after the crop from planting to just before tuber initiation (Stage 1)

The time from planting to emergence takes from two to five weeks depending on soil temperature, age of seed, variety and whether round or cut seed is used. The time from plant emergence to just before tuber initiation takes another two to four weeks, depending on variety and planting time. Stage 1 is illustrated in Figure 3. There are five important things to do in Stage 1.

more info



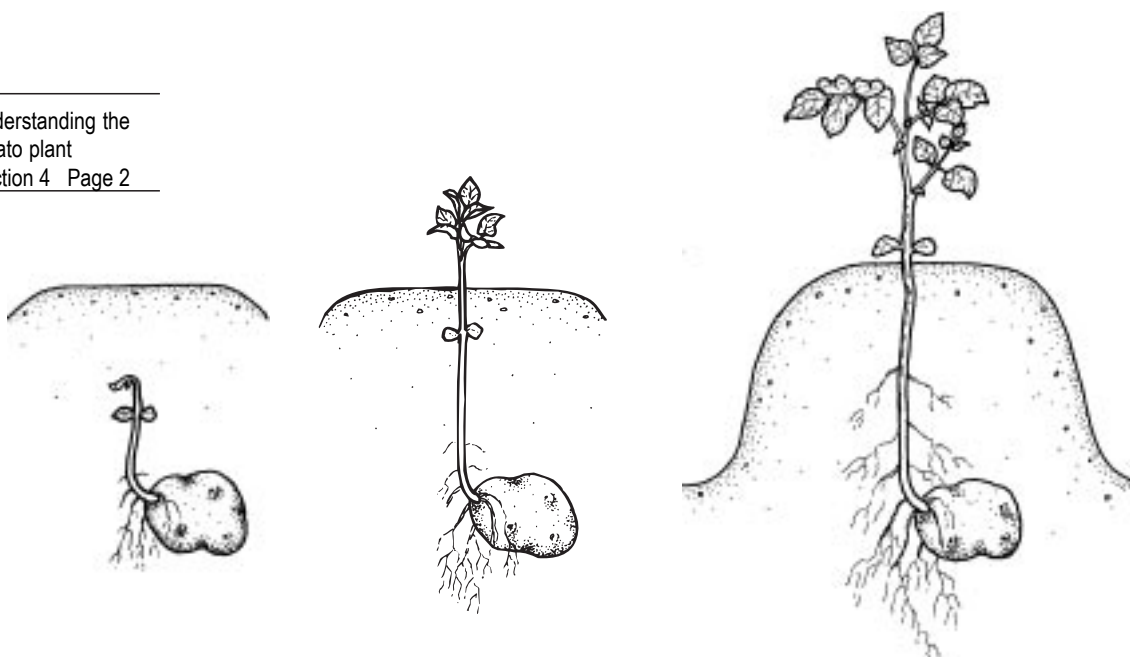
Calendar of things to do  
is in *Crop Production  
Handy Guide*

Roll, cultivate, hill and control weeds .....	3
Monitor soil moisture and irrigate .....	5
Manage pests and diseases .....	5
Prevent frost damage .....	6
Fertilise.....	7

a key issue



Understanding the  
potato plant  
Section 4 Page 2



**Figure 3.** Stage 1 (planting to just before tuber initiation)

Planting to tuber  
initiation  
**Stage 1**

## Roll, cultivate, hill and control weeds

### Rolling, cultivation and hilling (where hills not built at planting)

Roll immediately after planting to conserve moisture in the seedbed. As soon as weeds emerge, cultivate with tickle type harrows, peg tooth harrows or rolling cultivators. This also eliminates any surface crusting which may have developed since planting.

Start hilling soon after plants emerge. Hilling earlier than this can smother young plants. Use hillers or rolling cultivators attached to a three point linkage toolbar. Deeper tines can be used to cultivate the inter-row. This hilling/cultivation operation is generally done a couple of times until plants are 5 to 20 cm high. Complete hilling at this point. Later hilling can considerably reduce yield by damaging the developing tubers.

Stop all cultivation when tubers start to set. This generally occurs close to flowering. Make sure all tractor operations following planting are carried out using narrow tractor tyres. If wide tyres are used, considerable yield reductions can result from soil compaction and damage to developing tubers, as well as damage to foliage.

### Herbicides

Because most crops are hilled after planting, inter-row cultivation is the main form of weed control. However, many potato growers use herbicides to either reduce the number of cultivations or control weeds which are hard to kill. Those that hill at planting use herbicides as their only method of weed control.

The most commonly used herbicides are metribuzin (Lexone, Sencor) and paraquat. Details of these and other registered herbicides are contained in Table 4.



Planting to tuber  
initiation  
**Stage 1**

**Table 4.** *Herbicides for controlling weeds in potatoes*

Chemical and Products	Rate/ha	Notes on use
<b>These chemicals control broadleaf weeds. Some also control grasses.</b>		
<b>chlorthal-dimethyl</b>		
Dacthal	6–15 kg	Apply after planting but before potatoes emerge and water in.
<b>diquat + paraquat</b>		
Sprayseed	3–4 L	Apply after 10 to 25% of potato shoots have emerged. Some marginal leaf burn will occur, but plants will recover.
Sprayseed 250	2.4–3.2 L	
Tryquat 200	3–4 L	
<b>linuron</b>		
Afalon Selective	2.2–4.5 kg	Apply before 10% of potatoes emerge and after last cultivation.
Afalon Flowable	2.4–5 L	
Linuron DF	2.2–4.5 kg	Apply after planting but before emergence and irrigate in. Do not cultivate after application.
Linuron WP	2.2–4.5 kg	
Linurex Flowable	2.4–5 L	
<b>metribuzin</b>		
Lexone	470–950 g	Apply after weeds have emerged and before the largest potato plants are 10 cm high.
Sencor	730 mL–1.45 L	
<b>paraquat</b>		
several brands	1.5–3.5 L	Spray before 25% of crop has emerged. Addition of Reglone recommended for some brands.
<b>These chemicals control grass weeds only.</b>		
<b>fluazifop-p</b>		
Fusilade	0.5–2 L	Safe to spray over potato plants. Note 70 day withholding period.
<b>quizalofop-P-ethyl</b>		
Targa	125 mL–1 L	Safe to spray over potato plants. Note 70 day withholding period.
<b>sethoxydim</b>		
Sertin 186	1 L+1–2 L crop oil.	Safe to spray over potato plants.
Sertin Plus	1.6 L	

## Monitor soil moisture and irrigate

### Water quality

Recheck the quality of your water to make sure it is still suitable for irrigating potatoes. Remember that reduced yields can be expected if the conductivity (salt content) is above 1800 µS/cm (microSiemens per cm).

### After planting

The rolling operation mentioned in the previous section helps to conserve moisture after planting. If the seed is planted into moist soil, there is normally sufficient moisture to achieve plant emergence. If



*Planting to tuber  
initiation  
Stage 1*



Tensiometer use in  
irrigation  
Section 4 Page 26

drying conditions such as strong westerly winds occur, dig around the seedpieces once or twice and check soil moisture. Apply a little extra irrigation if soil around the seedpieces starts to dry. Do not over-irrigate otherwise the seedpieces may decay from a lack of oxygen.

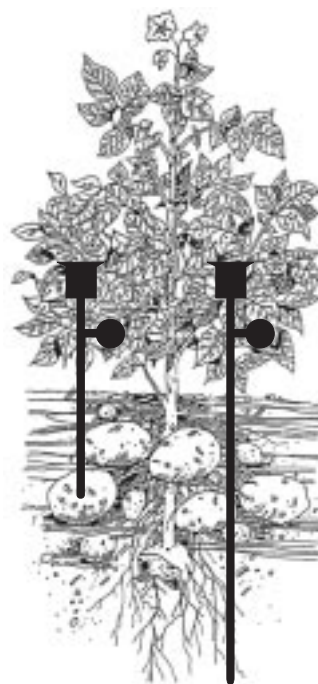
When hilling is completed, install tensiometers.

### Tensiometers

Potatoes are shallow rooted plants and very susceptible to water stress. It is difficult to effectively assess soil moisture levels by observation only. To overcome this problem, irrigation rates and timing from planting should be based on a soil moisture monitoring system. Tensiometers are an economical and effective system for potatoes.

Position the tensiometers in the crop after hilling, and leave them in position until the end of the crop. Select two tensiometer sites within each five hectares of crop and install two tensiometers per site. Place the tip of one 20 cm below the surface of the hill and the other 60 cm below the surface of the hill. Position the tensiometers midway between plants in the row. Figure 4 shows correct placement of tensiometers. Follow the manufacturer's instructions for installation and maintenance.

**Figure 4.** Tensiometer placement in a potato row (section is running the length of the row).



The shallow tensiometer indicates when to irrigate, while the deep one indicates how much water to apply. Commence reading the tensiometers once they are installed. Make the readings between 7 a.m. and 9 a.m. in the morning. Start irrigating when the shallow tensiometer reaches 30 to 40 centibars.

Apply the amount of water indicated in Table 5. Use the lower amount and shorter time interval for sandy soils and the higher rate and longer intervals for clay soils. The table makes no allowance for rainfall or very dry weather. Only the tensiometers can make this allowance.

*Planting to tuber initiation*  
**Stage 1**

**Table 5.** Guide to overhead irrigation from planting to tuber initiation

	Winter	Spring and summer
Amount of water per application	15 – 30 mm	30 – 40 mm
Apply every	6 – 9 days	6 – 9 days

The deep tensiometer gives you an indication of how well you are calculating the amount of water to apply. For example, if the gauge continues to rise after irrigation, apply a little more water next irrigation. If it falls to less than 10 centibars within two days of irrigation, apply a little less water next irrigation. If it remains at the same reading, the root zone has been filled.

From plant emergence until the tubers have filled, irrigation will normally be required every six to nine days with about 30 to 40 mm of water applied at each irrigation. However, on lighter soils and with a solid set irrigation system, frequent, lighter applications are more suitable.

### Manage pests and diseases

Serious pests and diseases are likely to occur at some stage in the life of the crop. As they can have a major impact on yield, your success will be largely determined by how well you deal with these problems. However, provided you have started with certified seed and prepared your land properly, the serious problems are relatively few in number. The main ones you are likely to face are:

Insect pests	Diseases
Cutworms	Target spot
Aphids	Sclerotinia rot
Potato tuber moth	Leaf roll

*more info*  
 Pictures of most pest and disease problems are in Section 5


### Insect pests

The modern approach to insect pest control is to check the crop at least weekly to determine when pests are present. Only when they are present and at threatening levels, are chemicals applied. This approach avoids the use of routine calendar spraying which wastes money if the pests are absent and increases the amount of chemical residue in the produce and in the environment.

You can do the crop checking yourself or employ a professional crop monitor to do it for you. The latter is recommended, particularly if you are new and unfamiliar with the pests and their damage.

The two main pests to check for during Stage 1 are aphids and cutworm. Check the crop every few days during the first few weeks. Look for aphids on the underside of leaves, and cutworms in the soil at the base of plants that have been chewed off.

If detected, spray with an appropriate chemical from the *Problem Solver Handy Guide*. Follow label directions. Spray late in the afternoon after the day's watering has been completed and the plants have dried.

*more info*  
 Names of crop consultants Section 6 Page 5

Planting to tuber  
initiation  
Stage 1

## Diseases

The approach to disease control is different to that for insect pests. As disease organisms are microscopic, they cannot be seen and therefore their arrival and buildup in the crop cannot be as easily monitored. In some cases, this requires routine preventative sprays to protect the crop from possible infection. During Stage 1, the only disease that may require this treatment is target spot, and then only during prolonged wet weather. If these conditions occur, spray every seven to ten days from hilling up.

Use an appropriate chemical from the *Problem Solver Handy Guide*. Follow label directions. Keep aphids under control (see above) to prevent leaf roll virus from spreading.

## Application of chemicals

Most of the chemicals are applied as sprays. Spray machinery includes hydraulic sprayers such as a tractor mounted boom, air blast sprayers, controlled droplet applicators, aeroplanes and helicopters. Before tuber initiation (Stage 2), the general practice is to spray with a ground rig boom spray using a tractor fitted with narrow steel or rubber tyres. From then on, some growers prefer to spray by aeroplane or helicopter to avoid soil compaction, foliage damage and subsequent lower yields.

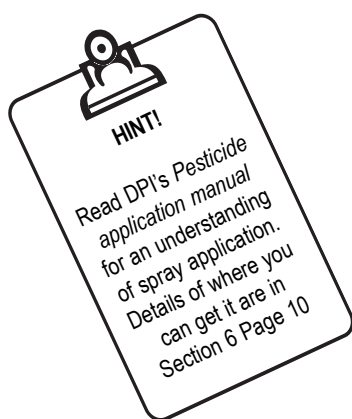
Do not apply herbicides with your main pest and disease sprayer. This avoids the risk of herbicide residues in the sprayer causing damage to the crop.

Ensure all sprays are applied according to label directions. Use sufficient spray volume to achieve adequate coverage of the foliage. The spray volume used depends on the spray equipment and the stage of plant growth. For high volume boom sprayers, it should be at least 375 to 500 L per hectare. Use identical hollow cone nozzles on boom sprayers. Regularly check and calibrate all spray equipment. Always wear recommended protective clothing as directed on the product label.

## Prevent frost damage

Potato leaves are damaged by temperatures below freezing point (0°C). However, provided the leaves are kept covered by a thin film of water, they will not be damaged.

Protect the leaves by continual overhead watering while temperatures stay below 0°C. Your overhead watering system should put out about 2 mm of water per hour with sprinklers rotating at least once every minute. If you have an electric pump, connect it via a thermostat to a temperature sensor in the crop. Set the thermostat to start the pump when the air temperature falls to 1°C. Alternatively, have the temperature sensor connected to an alarm which alerts you to go and start the pump. Continue the overhead watering until the air temperature rises



*Planting to tuber  
initiation  
Stage 1*



Nutrition  
Section 4 Page 23

above 0°C and all the ice formed on the leaves has melted. In some areas, sprinkling will have to be continued until mid-morning.

Seek professional advice from your local electricity authority on designing and operating this equipment.

## **Fertilise**

The yield of potato plants depends directly on the amount of plant food available for tuber storage after the plant's requirements for growth have been met. Fertilising is therefore very important.

Base your fertiliser quantity on the pre-plant soil tests and district experience. As a guide, in the Lockyer Valley, a typical side dressing of fertiliser applied shortly after emergence consists of 80 kg/ha of nitrogen (1.5 kg/20 m of row). This equates to 175 kg/ha of urea (3.3 kg/20 m of row) or 235 kg/ha of nitram (4.4 kg/20 m of row).

There are three options for applying the fertiliser:

- broadcast it over the crop with a spinner and water in
- if the plants are not too big, place it in a band on either side of the hill and water in
- apply it through the irrigation system (for soluble fertilisers such as urea only).



## Looking after the crop during tuber initiation and bulking up (Stages 2 and 3)

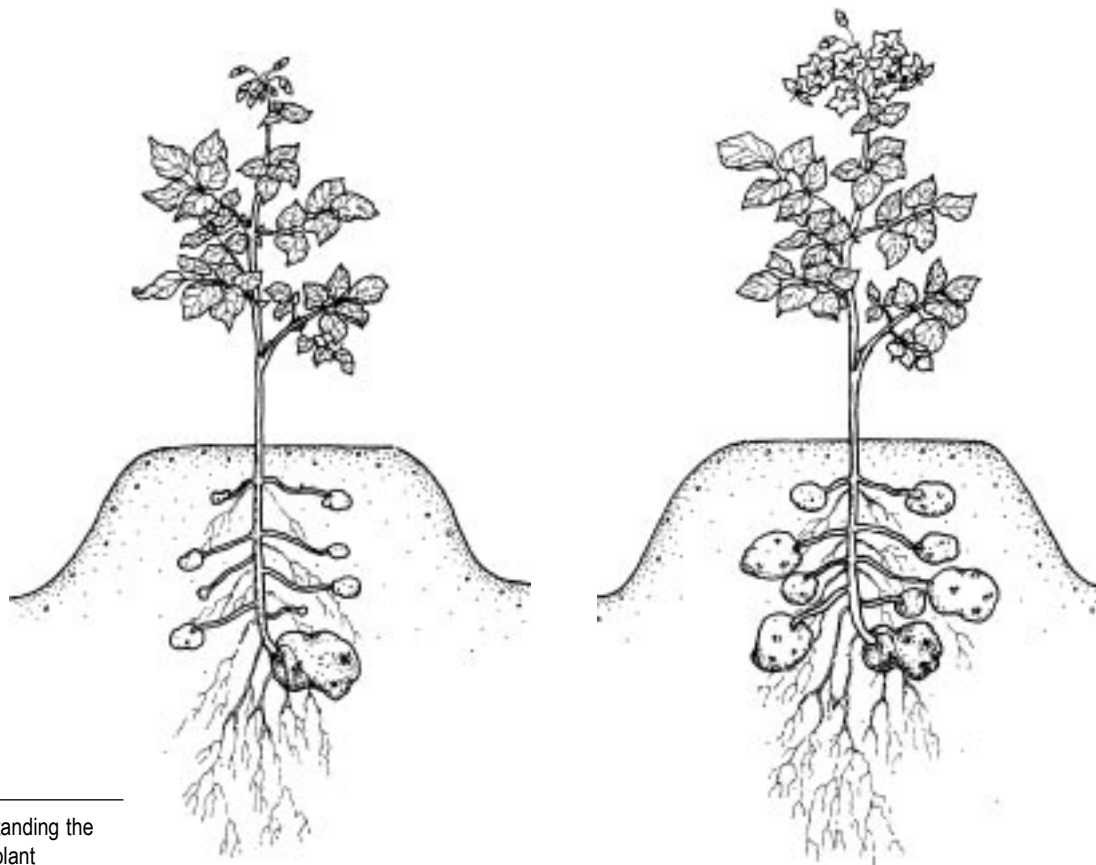
These stages normally last about seven to eight weeks. Flower buds appear at or shortly after tuber initiation. Stages 2 and 3 are illustrated in Figure 4. There are four important things to do in Stages 2 and 3.

more info



Calendar of things to do is in *Crop Production Handy Guide*

Manage pests and diseases .....	21
Irrigate .....	22
Control frost .....	23
Monitor plant nutrients and fertilise .....	23



a key issue



Understanding the potato plant  
Section 4 Page 2

**Figure 4.** Stages 2 and 3 (tuber initiation and bulking up)

Tuber initiation and  
bulking up  
Stages 2,3



## Manage pests and diseases

### Insect pests

During these growth stages, the main insect pests to check for are aphids and potato tuber moth. Continue the weekly monitoring process outlined in Stage 1. The use of professional crop monitors is recommended.

Look for aphids on the underside of leaves and look for signs of leaf damage from the larvae of potato tuber moth. If detected, spray with an appropriate chemical from the *Problem Solver Handy Guide*. Follow label directions.

In these growth stages, it is important to carefully manage potato tuber moth as it can severely damage tubers if it gets out of hand. It can also build up very rapidly in these stages, particularly if tomatoes and other related crops are growing nearby.

### Diseases

The main disease problems during these stages are target spot and Sclerotinia rot. For target spot, continue the routine spray schedule mentioned in Stage 1. Spray at seven to ten day intervals. Use the shorter interval during wet weather. While monitoring for insect pests, keep a close eye out for any sign of Sclerotinia rot, particularly from flowering onwards. If detected, spray with an appropriate chemical from the *Problem Solver Handy Guide*. Follow label directions.

### Integrated pest management

Integrated pest management (IPM) is a new strategy for pest control which aims to reduce the reliance on chemicals by using a range of complementary pest management techniques such as biological control (beneficial parasites and predators of the pests) and cultural control (crop hygiene, crop rotation etc). Preference is given to chemicals which are compatible with beneficial insects and 'softer' on the environment.

IPM works by firstly determining economic injury levels - pest populations at which damage is roughly equivalent to the cost of control. Pest populations are then accurately monitored and control measures applied only when pest populations approach or reach this threshold level. Monitoring then continues to allow pest populations to be managed at or below this threshold level. As well as the pests, the beneficial insects, mites and diseases which naturally attack the pests are also monitored. This is done because in some cases, they alone will be sufficient to keep the pest populations in check. For example, spiders have been found to be very effective in controlling some pests in unsprayed crops.

*Tuber initiation and  
bulking up  
Stages 2,3*

more info



Names of crop  
consultants  
Section 6 Page 5

a key issue



Irrigation  
Section 4 Page 26

Although IPM will undoubtedly be the pest management approach of the future, it is still being developed for potatoes. For example, the economic injury levels have not yet been determined with accuracy for most situations. However, you are encouraged to adopt as much as you can of the available IPM system. The best and easiest way of doing this is to engage one of the professional crop monitoring consultants to work with you in developing an IPM approach for your farm.

## Irrigate

Continue monitoring soil moisture using the tensiometers installed during Stage 1. Remember to make the readings between 7 a.m. and 9 a.m. in the morning. Start irrigating when the shallow tensiometer reaches 30 to 40 centibars. Apply approximately the amount of water indicated in Table 6. Use the lower amount and shorter time interval for sandy soils and the higher rate and longer intervals for clay soils. The table makes no allowance for rainfall or very dry weather. Only the tensiometers can make this allowance.

**Table 6.** Guide to overhead irrigation during tuber initiation and bulking up

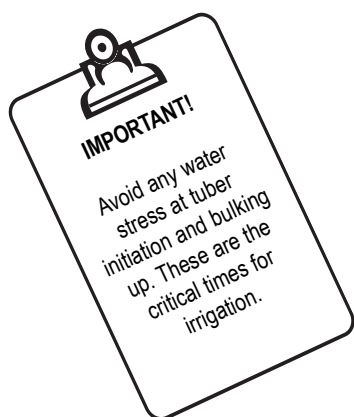
	Winter	Spring and summer
Amount of water per application	15 – 30 mm	30 – 40 mm
Apply every	6 – 9 days	4 – 6 days

The deep tensiometer gives you an indication of how well you are calculating the amount of water to apply. For example, if the gauge continues to rise after irrigation, apply a little more water next irrigation. If it falls to less than 10 centibars within two days of irrigation, apply a little less water next irrigation. If the deep tensiometer remains at the same reading, the root zone has been filled up.

This is a critical time for irrigation as adequate moisture is required to maintain the rapid growth necessary for setting and filling the tubers. Water stress in these growth stages reduces yields, and causes misshapen, cracked and internally discoloured tubers. Moisture requirements taper off towards maturity.

Avoid excessive irrigation as this favours diseases such as blackleg, scab and wilt. It may also cause skin blemishes and enlarged lenticels (breathing pores), which spoil the appearance of the tubers and reduce their marketability.

During Stages 2 and 3, irrigation will normally be required every four to six days with about 30 to 40 mm of water applied at each irrigation. However, on lighter soils and with a solid set irrigation system, frequent, lighter applications are more suitable.



*Tuber initiation and  
bulking up  
Stages 2,3*



Nutrition  
Section 4 Page 23

## Control frost

Maintain the frost control system of overhead watering outlined during Stage 1.

## Monitor plant nutrients and fertilise

Do a leaf analysis just as the plants start to flower. Buy a tissue sampling kit from your local farm supply store and follow its sampling instructions. The correct leaves to sample are shown in Figure 6. Sample 20 to 25 leaves at random throughout the crop.



*Sample petiole (leaf stem) and leaf blade of the fourth leaf from the growing tip*

**Figure 6.** Leaves to sample at the early flowering stage.

Your results will be interpreted by the laboratory analysing your sample. The optimum leaf nutrient levels are listed in Table 7. The aim is to apply fertilisers to get your nutrient levels within these ranges.

Some growers do their leaf analysis at late flowering, three to four weeks after the plants start to flower. Although this sampling is used mainly to guide the fertiliser program for the next crop, it is still useful in determining fertiliser needs for the existing crop. However, sampling at early flowering is the preferred option.



*Tuber initiation and  
bulking up  
Stages 2,3*

**Table 7.** Normal leaf nutrient levels (based on dry weight)

Nutrient	Normal level	
	Early flowering	Late flowering
Nitrogen (N)	5.0 – 6.5%	4.5 – 5.5%
Phosphorus (P)	0.3 – 0.55%	0.25 – 0.45%
Potassium (K)	4.0 – 6.5%	3.5 – 5.5%
Calcium (Ca)	0.8 – 2.0%	1.0 – 2.5%
Magnesium (Mg)	0.25 – 0.5%	0.25 – 0.5%
Sulphur (S)	0.3 – 0.5%	0.3 – 0.5%
Sodium (Na)	0.0 – 0.4%	0.0 – 0.5%
Chloride (Cl)	0.0 – 3.0%	0.0 – 3.5%
Copper (Cu)	5 – 20 ppm	5 – 20 ppm
Zinc (Zn)	20 – 50 ppm	20 – 50 ppm
Manganese (Mn)	50 – 300 ppm	50 – 300 ppm
Iron (Fe)	50 – 150 ppm	50 – 150 ppm
Boron (B)	30 – 60 ppm	30 – 60 ppm

Source: R. G. Weir and G. C. Cresswell, NSW Agriculture.

### Applying fertiliser

The required fertiliser can be either broadcast over the crop with a spinner or applied through the irrigation system (fertigation). Fertigation is preferred as it uses less labour, the fertiliser can conveniently be applied more regularly and it avoids the soil compaction from machinery use. With fertigation, fertiliser is dissolved in water in a drum or tank and sucked or injected through the watering system. Fertilisers used must be highly soluble to avoid pump damage and pipe blockages. Suitable fertilisers are listed in Table 8.

You can fertigate every time you water but once a week is sufficient and most practical. Seek professional advice from both an irrigation designer and a fertiliser representative before buying, constructing or using a fertigation system.

**Table 8.** Soluble fertilisers for fertigation

Fertiliser	Main nutrient supplied
Urea	Nitrogen (N)
Calcium nitrate	Nitrogen (N), Calcium (Ca)
Potassium nitrate	Potassium (K), Nitrogen (N)
Potassium chloride	Potassium (K)
MAP (technical grade)	Phosphorus (P), Nitrogen (N)



## Looking after the crop during tuber maturation (Stage 4)

*This stage normally lasts about two to three weeks. It is the stage when the plant tops start to yellow and die back and the skin sets firmly on the tubers. The development of skin setting is often used to determine maturity. Stage 4 is illustrated in Figure 7. There are three important things to do during this stage.*

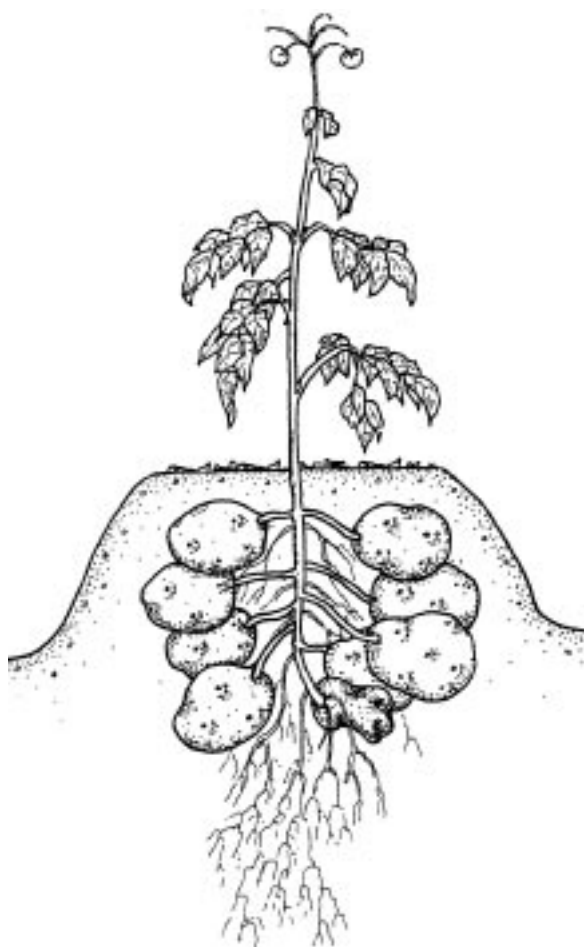


Calendar of things to do in the *Crop Production Handy Guide*

Manage pests and diseases .....	26
Irrigate .....	26
Prepare for harvest .....	26



Understanding the potato plant  
Section 4 Page 2



**Figure 7.** Stage 4 (tuber maturation)

Tuber maturation  
Stage 4

## Manage pests and diseases

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### Insect pests

The main problem to manage during this growth stage is potato tuber moth. Continue to monitor the crop for signs of leaf damage and if detected, spray with an appropriate chemical from the *Problem Solver Handy Guide*. Follow label directions. It is advisable to spray just before the plants collapse at maturity, to prevent the insect larvae infesting the tubers. Cracks in the soil allow the larvae easy access to the tubers. A light irrigation will prevent soil cracking. Harvest promptly if you have a tuber moth problem.

### Diseases

Continue the routine spray schedule for target spot commenced in Stage 1. However, for the last two weeks before harvest, spraying may be suspended provided target spot has been adequately controlled to that point. A slight yield reduction may result, but this may offset the need to defoliate plants before harvesting.

### Irrigate

---

Irrigation can be tapered off as crops approach maturity. Irrigate to prevent soil cracking as recommended above. Also maintain enough moisture to facilitate easy harvesting. This will reduce tuber bruising from dry soil clods. About 15 to 30 mm of water is normally what is required depending on season and soil type.

Don't over-irrigate as this favours diseases such as blackleg, scab and wilt, and increases the risk of skin blemishes and enlarged lenticels (breathing pores).

### Prepare for harvest

---

As the crop nears maturity, the tops or haulms of the plants often yellow and die back with target spot. It may be necessary to reduce the amount of plant material above the ground to make harvesting easier. This process is referred to as 'de-vining'.

De-vining is particularly necessary in the spring crop where weeds have been allowed to establish late in the crop to remove excess soil moisture from storm rains. It may also be necessary where there has been excessive top growth.

There are two different de-vining situations requiring different approaches:

- **where tubers are mature and the skin has set.** Pulverise the tops and weeds using a mechanical pulveriser. Harvest immediately, preferably de-vining and harvesting on the same day. Where a pulverising machine is not available, use an ordinary slasher.

*Tuber maturation  
Stage 4*

- where tubers are not mature but crop growth needs to be stopped to prevent oversized tubers. Either mechanically pulverize or spray with a desiccant herbicide as shown in Table 9. Leave for 10 to 14 days for the skins to set before harvesting.

**Table 9.** Desiccant herbicides to kill tops and weeds

Chemical	Products	Rate /ha	Notes on use
diquat	Reglone	3 – 4 L	Apply about 7 days before harvest.
diquat + paraquat	Tryquat	4 L	Spray 3 to 7 days before digging, after tops have died down.
paraquat	several brands	3.5 L	Spray about one week before digging, after tops have died down.



Make sure you apply the correct rate of herbicide otherwise tuber damage may result. Do not use under hot conditions or where the soil is dry.



## Harvesting and marketing

*As the price received depends largely on appearance and quality, potatoes must be harvested, handled and marketed with care. There are seven important steps in this process.*

Harvest .....	28
Grade .....	29
Bag .....	30
Mark the bags .....	30
Market .....	30
Transport .....	31
Store .....	31

### Harvest

The crop is ready to harvest when the skin on the tubers is not easily rubbed off with the thumb. This is when the crop is approaching full maturity with maximum yield potential. However, some crops are harvested up to two weeks before full maturity, when prices are often higher. This results in much lower yields as the smaller tubers do not have time to fill properly.

Very immature potatoes are easily bruised and can blacken where the skin has been removed. Ensure that these tubers are dug from moderately moist soil, as hard clods in dry soil cause a high level of injury to the tubers. Operate the digger or harvester at a slow speed to minimise damage. Also ensure that a good flow of soil passes over the digging chains and that the speed is regulated to stop tubers bouncing during harvest.

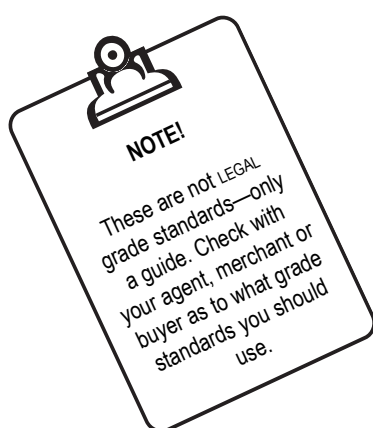
Most potato crops in south Queensland are harvested into bins and conveyed to sheds for grading and bagging. Most growers have forklift facilities for both paddock and shed use.

Yields vary from 15 to 40 tonnes per hectare, depending on time of planting, variety, level of management, weather conditions and disease. Tubers for the fresh washed market are generally washed before grading.

### Grade

Standard grading regulations are no longer in force. The grading standards you use should be negotiated with your agent, merchant or buyer. However as a guide, the previous grade standards are a good benchmark. These regulations are listed in Table 10.

**Table 10.** A guide to grading potatoes



Class (Grade)	Standard
Class 1. (No 1. Grade)	Free from soft rots, glassy end and any damage not removable by the ordinary process of peeling; practically free from greening due to exposure, damage caused by insects or disease and deterioration from storage; reasonably free from dirt and other foreign matter, second growth, sprouting and any abnormal condition of growth; and to individually weigh not less than 80 g nor more than 350 g, and be sound, of similar varieties and have a mature skin.
Class 1. Large Grade (No 1. Large Grade)	As above; and to individually weigh not less than 250 g, be sound, and of similar varieties.
Class 1. Small Grade (No 1. Small Grade)	As above; and to individually weigh not less than 30 g, nor more than 100 g, be sound and of similar varieties.
Cocktail Grade	As above; and to individually weigh not more than 30 g, be sound, and of similar varieties.
Class 1. New Grade (New Grade)	As above; and to individually weigh not less than 50 g nor more than 350 g, be sound, of similar varieties and with an immature skin.
Class 2. (No 2. Grade)	As above; and to individually weigh not less than 70 g, be sound, of similar varieties; practically free of soft rots, and greening; reasonably free of dirt and other foreign matter, deterioration due to storage, sprouting, glassy end, any abnormal condition of damage or growth and damage from insects and diseases; they may be affected with second growth, scab, growth cracks and mechanical damage any of which may be removed without appreciable loss in the ordinary process of peeling.

The main problems to look for are mechanical injury, rots, greening, dirt, potato tuber moth injury and mole cricket damage. Make sure that packers reject potatoes with these problems. Also make sure that dirt is removed.

## Bag

The graded potatoes are machine weighed before bagging into either 50 kg bags (unwashed), or 20 kg bags (washed). Labels are sown on with a bag sewing machine. The bags most commonly used are the Australian Potato Bags (APB).

Some growers still pick and bag in the field. The bags are stacked on pallets for transport, either to merchants' sheds or direct to market. This system reduces handling damage.

In north Queensland, nearly the whole of the Atherton Tableland potato crop is graded on the harvester and bagged into 50 kg bags. These are placed on pallets which are loaded onto semi-trailers, and normally despatched to market on the same day.

## Mark the bags

Potatoes for sale must have the grower's initials, name and address stencilled on the outside of the bag. If printed, the stencil figures must not be less than 6 mm in height. Alternatively, a label as illustrated in Figure 8 could be used.



*Figure 8. Acceptable label for a potato bag*

## Market

Most potatoes are sold on the farm through local merchants. Freight is paid by the buyer. Price is usually negotiated over the telephone subject to an inspection confirming quality and variety. Prices are determined daily based on Sydney sales at that time.

At times, considerable premiums are paid for Sebago potatoes. During periods of shortage, the price gap between varieties narrows. Conversely, during gluts, poorer quality varieties become virtually unsaleable.

A small percentage of the crop is grown under contract or by private treaty for processing companies and handled in company bulk bins.

There is a growing demand for washed potatoes which are usually marketed in a 20 kg bag. Red La Soda is the favoured variety for this market.



Packers usually cool potatoes before transport to improve market presentation.

### Interstate quarantine requirements

There are no quarantine restrictions on sale of Queensland grown potatoes throughout Queensland, but sales into some other states are restricted. Before selling interstate, check on the quarantine restrictions for that State.

- **New South Wales, Victoria, Northern Territory**

No restrictions.

- **Western Australia**

Stringent conditions apply with respect to freedom from potato spindle tuber viroid, bacterial wilt, Irish blight and potato cyst nematode. Widespread bacterial wilt in Queensland effectively excludes potatoes from shipment to WA.

- **South Australia**

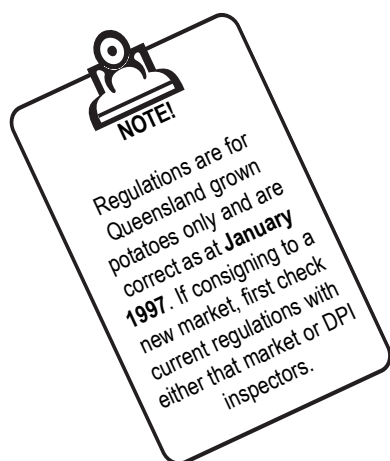
Requires a DPI certificate stating:

1. 'The potatoes have been washed or brushed free of soil.'
2. If from the City of Brisbane local government area, they must have been:  
'grown at least 50 m from any grapevine.'
3. If from elsewhere in the State, they must have been:  
'grown outside the Shire of Bowen and the localities of Bluewater, Brandon, Gumlu, Guthalungra and Farnsfield.'

- **Tasmania**

Requires a DPI certificate stating:

1. 'Freedom from potato spindle tuber virus and PCN (potato cyst nematode)'. (Neither problem is known to exist in Queensland).
2. 'Five years freedom from bacterial wilt and brown rot for the property and within 20 km of the property.'
3. 'Property freedom from TBM (tobacco blue mould ) fungus.'



### Transport

Bags are usually stacked on pallets, 24 bags per pallet, and transported on open semi-trailers or in pantechincons.

### Store

Potatoes grown for the quality fresh market are rarely stored. Sometimes the autumn crop is left in the ground until a sale has been negotiated. Occasionally, potatoes may be cool stored for up to three weeks to meet a special order.