Onion information kit

Reprint – information current in 1997

REPRINT INFORMATION – PLEASE READ!

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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 We advise readers to take particular note of the areas most likely to be out-of-date and so requiring further research: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
- Financial information—costs and returns listed in this publication are out of date.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 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 onion 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.

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Queensland Government

Key ISSUES

This section contains detailed information on some of the important decision-making areas and information needs for onions. The information supplements our growing and marketing recipe in Section 3 and should be used in conjunction with it. The information provided is not designed to be a complete coverage of each issue but instead the key points that need to be known and understood. Where additional information may be useful, reference is made to other parts of the kit. Symbols on the left of the page will help you make these links.

Understanding the onion plant

The growth of onions is highly dependent on daylength and temperature for the formation of bulbs. When daylength reaches a certain critical value the onion plant is induced to start forming a bulb. High temperatures reduce the minimum daylength required for bulbing. If temperatures are too low, a variety may not bulb despite an otherwise suitable daylength. This is why each onion variety requires a specific planting time and, conversely, why each planting time needs a specific variety to produce a successful onion crop.

How the onion grows

more info
Parts of the onion plant
Section 3 page 2

The onion bulb is the key to the plant's survival. It is a resting stage that helps the plant get through dry periods. Once the season improves, growth restarts and the plant flowers and produces seed. Some types of onion also use a multiplying bulb or bulbils to reproduce.

The plant's upright cylindrical leaves help limit rises in leaf temperature on hot days.

Here are three key facts about the onion plant and how they affect crop management.

- The onion plant competes poorly against weeds. Good weed control is essential from sowing or yields will be affected.
- The plant is highly sensitive to moisture stress, though it can survive it well. Sound irrigation management is critical for optimum yields.
- The plant has a limited root system. Correct fertiliser placement and irrigation management are important to ensure the plant's roots get the nutrients and water they need.

What looks like the stem of the onion plant is really a false stem made up of the bases of the leaves (see Figure 1). The true stem, where the leaves are joined, is the woody piece in the base of the onion bulb.

In the onion the bases of the green leaves swell and store food. Some leaf bases also grow and swell in the middle of the bulb, without forming any green blades. In the centre of the bulb, a shoot forms, ready to grow in the next season. On the outside, some leaf bases dry off and form the protective skins (see Figure 2). Thus the onion bulb is formed by swollen leaf bases. Any buds that grow from the leaf axis (that is where the leaf joins the stem) swell in a similar fashion and are the cause of doubles and bulbs with multiple entres.

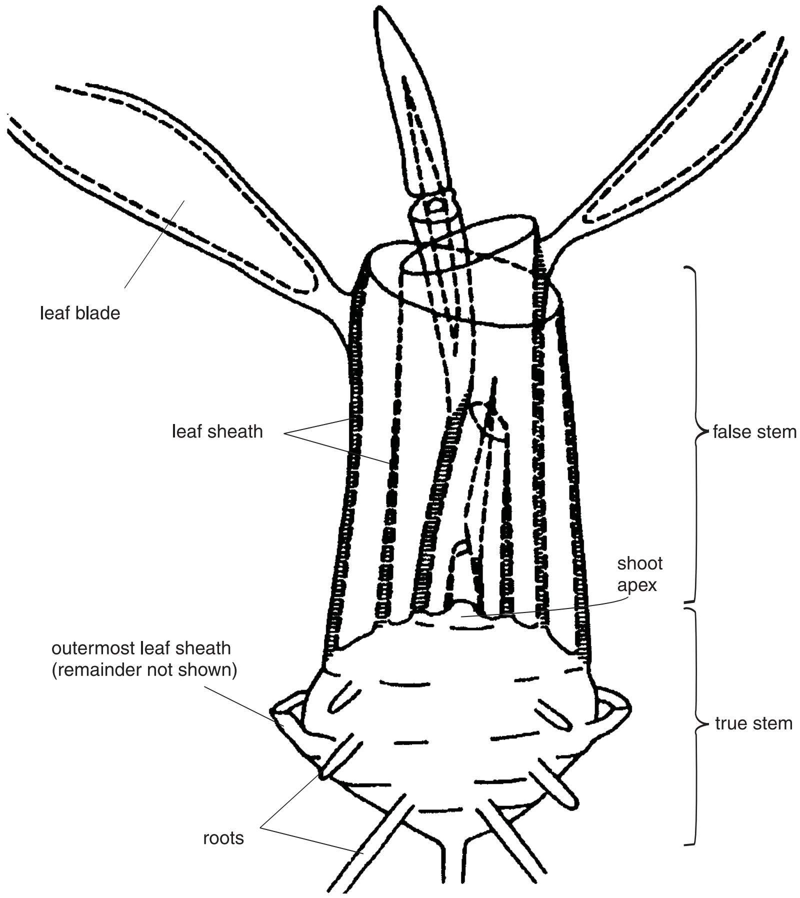

Figure 1. *Diagram of a young onion plant. (Drawing prepared by Lyn Burke and adapted from Jones an Mann.)*

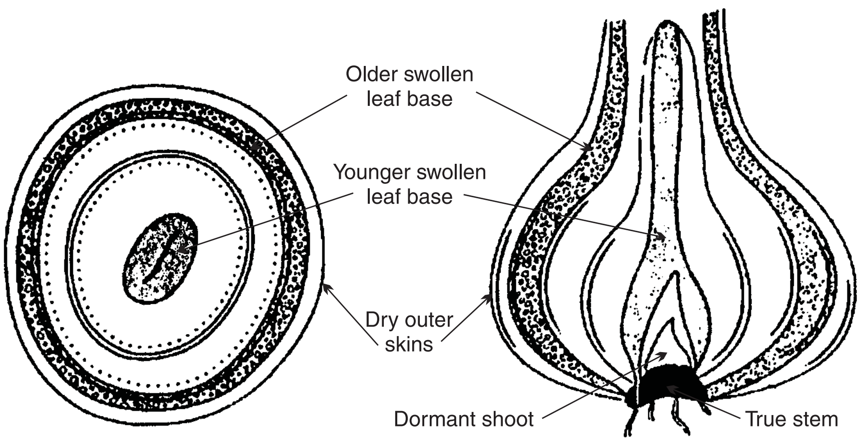

Figure 2. *Diagram of the cross section of an onion bulb. (Drawing prepared by Lyn Burke and adapted from Jones and Mann.)*

The growth cycle

The onion plant forms a bulb so that it can survive very cold or dry periods. In its usual growth cycle, the plant forms a bulb in the first year of growth, becomes dormant for a period, and then goes on to bolt and produce seed in the second year.

The timing of the vegetative, bulbing, dormancy and seed production phases depends on several factors, the most important being variety, sowing date, the farm's latitude (location) and temperature. Crop density and environmental and management issues may also be important. As a result, the plant may do any of the following during the first year of growth:

- bulb normally, the bulb size depends on the timing of bulbing;
- bulb and also bolt;
- bulb, but continue growing without the tops collapsing;
- bolt without bulbing;
- grow vegetatively without bulbing properly or bolting.

Subsidiary shoots (that is from doubles, etc.) may complicate growth further. For example subsidiary shoots may continue to grow after the main shoot has collapsed or bolted.

Bulbing

There are two important changes in the growth of the plant as it starts to bulb. As sugars and water accumulate in the individual leaf bases that make up the bulb, the base of the plant starts to swell. At the same time the green leaf blade on newly formed leaves rapidly becomes shorter on each successive leaf, until leaves form without a proper leaf blade. New blades stop emerging from the neck of the plant.

The date when the maximum diameter of the base of the plant is twice that of the neck is generally regarded as the start of bulbing.

Top collapse marks the end of bulb maturity. The top collapses because there are no more new leaves to replace ageing and dying old leaves. If leaf blades continue to emerge during bulbing, the plants develop 'thick-necks' and do not mature.

What controls bulbing?

Daylength

Daylength, or the number of hours of day light, varies from a minimum in winter (about 22 June in the southern hemisphere) to a maximum in summer (about 22 December).

In onions, daylength is the main signal in the timing of bulbing. When daylength reaches a certain critical value, the onion plant is induced to start forming a bulb. The different minimum daylengths for onion growing areas in Australia range from about 11.5 to 16 hors (see Figure 3).

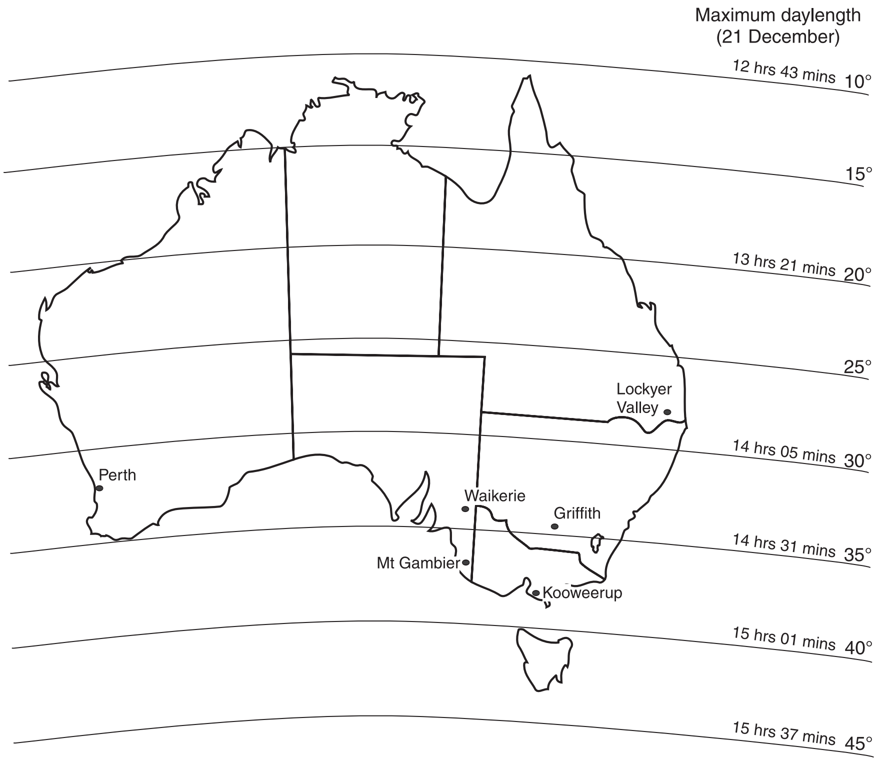

Figure 3. *Maximum daylength at different latitudes in Australia*

Depending on how long a daylength a variety needs it may be termed a short day, intermediate or long day type. Short day onions are best suited to lower latitudes (towards the tropics), whereas long day varieties are better for the higher latitudes (towards the poles).

Although these descriptions are commonly used, all onion varieties are long day plants as they require a daylength period *longer* than a certain minimum. The longer the daylength above the minimum required, the sooner bulbing starts and the sooner the plant matures. The plant continues to require a favourable daylength for normal bulbing to proceed, and it can return to vegetative growth if daylength recedes too far. If a variety requires a longer daylength than that available at the latitude it is planted, it will not bulb properly. Many varieties from northern Europe won't bulb properly in the Murrumbidgee Irrigation Area and Cream Gold won't succeed in Queensland.

If a variety is planted too late for it to bulb and mature before the daylength falls below the critical value, it may resume growth without the bulb maturing. Under marginal conditions, problems such as thick necks and incomplete maturity may develop.

Temperature

Temperature also influences bulbing and varieties differ in how strongly they are influenced. High temperatures reduce the minimum daylength required for bulbing. If temperatures are too low a variety may not bulb, despite an otherwise suitable daylength.

With a suitable daylength, bulbing will start earlier and plants mature sooner under warmer conditions. Given similar sowing dates, temperature is likely to be the major reason for differences in maturity date between seasons and sites at the same latitude. In the tropics, temperature rather than daylength controls the timing of bulbing.

Cold winter and hot summer temperatures are not good for overall plant growth rate.

Planting date

In temperate areas bulb maturity tends to be later with later planting, and earlier if larger planting material or sets are used. Sets are small bulbs used as planting material to produce large bulbs. They are used where conditions are unfavourable for the plant to produce a large bulb in the first growth season. However differences in planting date of several months may make a difference in maturity of one month or less because of the dominant effect of daylength. Sowing date is of little use to spread maturity time, unless one or two weeks difference is important.

Crop density

Higher crop density tends to hasten crop maturity. Low levels of nitrogen, a high potassium to nitrogen ratio, and high phosphate levels in the soil will promote bulbing.

Moisture stress may also hasten bulb development. On the other hand, excessive irrigation or high nitrogen levels can delay maturity. Maturity differences may occur between soil types and are probably caused by differences in soil moisture and temperature.

As well as the minor effects on maturity time crop density, moisture stress and soil type may have major influences on bulb size, as they affect plant vigour and competition between plants.

Bolting

The main stimulus to bolting (flowering) in onions is cold temperatures. Development of the flower head can be divided into three stages.

- Vernalisation, when cold temperatures induce the formation of a floral bud at the growing point in the base of the bulb.
- Suppression of the growth of a floral bud after it has formed, stopping the plant bolting and encouraging bulbing. Warm conditions and long days may suppress this growth.
- The final period, when warm conditions hasten bolting.

Varieties differ in the amount of cold they require for bolting, but temperatures of 9 to 13°C for a while are cold enough. There appears to be a minimum plant size for cold to induce a floral bud. Large plant or set size during cold periods favours bolting.

Exposing sets to cold (5 to 10°C) during storage encourages bolting.

Daylength does not affect budding. However long days just before flowering stimulate more rapid growth of the flower head.

The best way to avoid bolting is to plant the right variety (or strain of a variety) at the correct time for your location. Varieties that require a long exposure to cold should be used if conditions may favour bolting. The chosen sowing date should avoid times when plants receive enough cold to stimulate bolting. Later sowing also reduces the amount of time plants are exposed to the cold. An unusually high incidence of bolting compared to previous experience could be caused by a cold snap or problems with the seed used.

Maximising yield

For maximum yields of the desired bulb size and best timing of bulbing, plant the right variety at the right crop density and at the correct time (daylength) for that location.

Daylength needs to remain above the requirements of the particular variety long enough for bulbs to form and their tops to collapse.

Eighty per cent or more of the final bulb dry weight is added during the first few weeks from the start of bulbing to maturity. However the bulb's final mature size is closely related to the size of the plant (plant growth rate) when it starts to bulb. This is because the time from the start of bulbing to maturity is more or less constant.

Temperature, irrigation, nutrition, weed and pest control and other cultural and environmental factors are also important.

Planting time

Bulb size generally declines from early to late sowing. However, depending on the variety, planting too early can increase the risk of bolting. Optimum yield is likely to result from the earliest planting date that avoids bolting problems.

Later planting may reduce the time the crop is in the ground and assist weed control and overall management.

If the crop is planted very late it may mature successfully, but produce only small bulbs because they form and mature too quickly. Late varieties planted too late could fail to mature properly because the days shorten below the critical daylength. Similarly, a variety may bulb very rapidly because daylength requirements are met too soon. This can lead to problems in getting adequate bulb size. An example is the performance of Early Lockyer varieties in southern Australia.

Economics of production

One way of assessing the economics of onion production is by calculating the gross margin for the crop. A gross margin is the difference between the gross income and the variable or operating costs. The variable or operating costs include the growing, harvesting and marketing costs. The calculation does not consider fixed or overhead costs such as rates, capital, interest, electricity, insurance and living costs. These fixed or overhead costs must be taken into account in calculating a whole farm budget.

The following gross margin is for irrigated white onions in South-East Queensland.

Assumptions

The calculations assume white onions are being grown under irrigation with good management by a family unit. All machinery operations include costs for fuel, oil, repairs and maintenance (F.O.R.M.). No allowance is made for owner operator labour.

Gross margin for irrigated white onions in South-East Queensland

Enterprise unit: 1 hectare

REVENUE	Amount	unit	$	unit	Total $/ha
Price			$400.00	/t	
Less					
Freight (to Brisbane)			$20.00		
Commission	12.5	%	$50.00		
On farm price			$330.00	/t	
TOTAL REVENUE	40	t/ha	$330.00	/t	**$13 200.00**

VARIABLE EXPENSES	/ha	$/ unit		$/ha	
Land preparation					
Machinery usage (F.O.R.M.)					
Ripping	1	$9.00	/ha	$9.00	
Disc harrowing	2	$8.70	/ha	$17.40	
Rotary hoeing	1	$10.50	/ha	$10.50	
Cultivator	4	$6.20	/ha	$24.80	
Harrowing	2	$1.80	/ha	$3.60	
TOTAL LAND PREPARATION EXPENSES					**$65.30**

VARIABLE EXPENSES (cont.)	/ha		$/ unit		$/ha	
Land preparation						
Planting						
Seed	2.2	kg	$134.00	/kg	$294.80	
Planter (F.O.R.M.)	1		$11.20	/ha	$11.20	
TOTAL PLANTING EXPENSES						**$306.00**
Fertiliser						
Basal						
Crop King 88	400	kg	$0.45	/kg	$180.00	
Side dressing:						
Urea (2 applications)	200	kg	$0.50	/kg	$200.00	
Spreader (F.O.R.M.)	2		$1.20	/ha	$2.40	
TOTAL FERTILISER EXPENSES						**$412.40**
Weed control						
Pre-emergent						
Dacthal	8	kg	$30.67	/kg	$245.36	
Sprayer (F.O.R.M.)	1		$1.70	/ha	$1.70	
Post-emergent:						
Totril	2.5	L	$30.60	/L	$76.50	
Fusilade	0.5	L	$60.80	/L	$30.40	
Sprayer (F.O.R.M.)	2		$1.70	/ha	$3.40	
Cultivation (F.O.R.M.)	1		$3.55	/ha	$3.55	
Chipping	9	h	$9.21	/h	$82.89	
TOTAL WEED CONTROL EXPENSES						**$443.80**
Insect control						
Insecticide						
Rogor (5 applications)	0.75	L	$7.40	/L	$27.75	
Folimat	1	L	$61.00		$61.00	
Sprayer (F.O.R.M.)	6		$1.70	/ha	$10.20	
TOTAL INSECT CONTROL EXPENSES						**$98.95**
Disease control						
Fungicide						
Kocide (2 applications)	2.2	kg	$7.00	/kg	$30.80	
Ridomil MZ (3 applications)	1	kg	$31.20	/kg	$93.60	
Mancozeb (7 applications)	2.2	kg	$6.00	/kg	$92.40	
Aerial applications	2		$20.00	/ha	$40.00	
Sprayer (F.O.R.M.)	2		$1.70		$3.40	
Note: Balance of applications with insecticide						
TOTAL DISEASE CONTROL EXPENSES						**$260.20**
Irrigation						
Water charges	4	ML/ha	$9.15	/ML	$36.60	
Electricity—double pumped						
3.7 kW pump	4	L/sec	$0.10	/kWh	$102.78	
30 kW pump	40	L/sec	$0.10	/kWh	$83.33	
TOTAL IRRIGATION EXPENSES						**$222.71**
TOTAL GROWING EXPENSES						**$1 809.36**

HARVESTING	/ha		$/ unit		$/ha	
Casual labour	$23.00	/bin	2	bin/t	$46.00	
Bags & tags	$0.40	/bag	50	bag/t	$20.00	
Freight local	$10.00	/t			$10.00	
Drying, grading, etc.	$0.50	/bag	50	bag/t	$25.00	
Total harvesting expenses					$101.00	
TOTAL HARVESTING EXPENSES			40	t/ha		**$4 040.00**
TOTAL VARIABLE EXPENSES						**$5 849.36**

Gross margin = Total revenue – Total variable expenses:	
Total revenue	$13 200.00
Total variable expenses	$5 849.36
GROSS MARGIN	**$7 350.64**
BREAK EVEN YIELD	**15 t/ha**
BREAK EVEN PRICE	**$146.23/t**
GROSS per MEGALITRE of IRRIGATION WATER	**$1838.00/ML**

Actual gross margin when price or yield changes

		Price per tonne		
		Low	Medium	High
Yield	**t/ha**	**$200**	**$400**	**$600**
Low	32	$–81	$5 519	$11 119
Medium	40	$351	$7 351	$14 351
High	48	$783	$9 183	$17 583

Enterprise characteristics	
1. Growing risk	Medium – High
2. Price fluctuations	High
3. Working capital requirement	Medium
4. Harvest timeliness	Medium
5. Management skills	Medium
6. Quality premium	No
7. Spray requirements	Moderate – High
8. Labour requirements – growing	Low
9. Labour requirements – harvesting	High

Last update: May 1997

Varieties

The variety of onion you plant at a particular time is critical to your chance of producing a quality, marketable crop. The section will give you more information to help you select varieties.

Early strains of Early Lockyer White onions

When to plant

The Early Lockyer White onion (ELW) is grown for early production in the Lockyer Valley. Strains of this variety have been developed for early season production. Figure 4 shows growth cycles at six planting dates for an early season selecton of Early Lockyer White onions. Dates are for planting and maturity of each growth cycle.

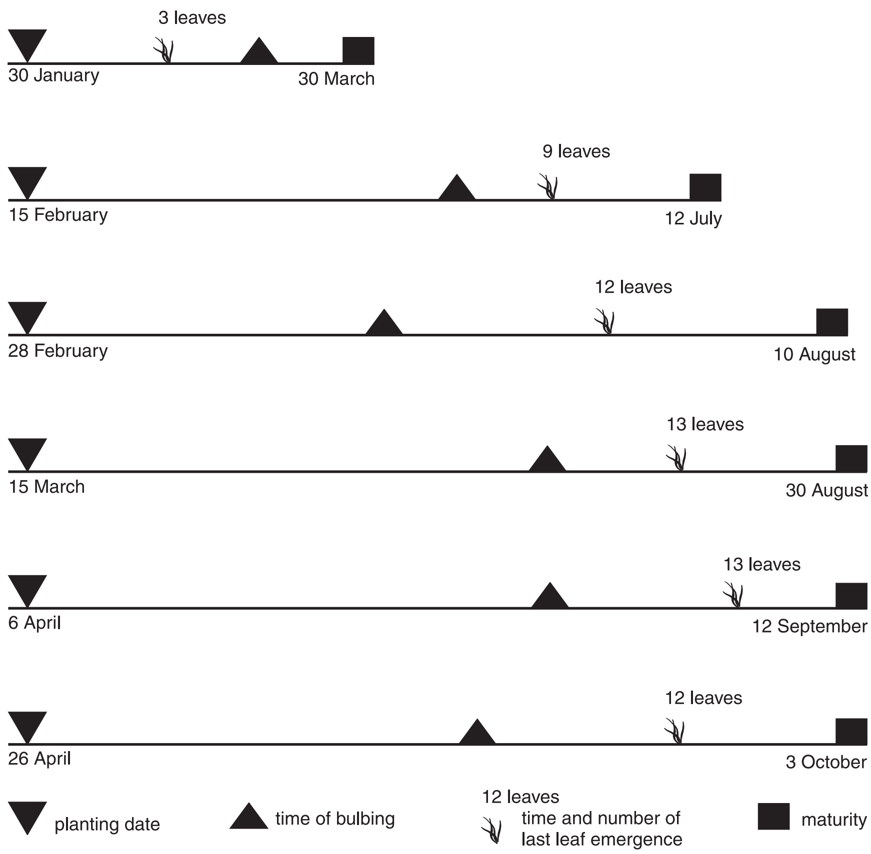

Figure 4. *Growth cycles for an early season selection of Early Lockyer White onion*

Bulb formation

Plantings from mid February to early April are considered commercially viable. Onions from the first of these successful plantings were mature in early July, indicating that new season white onions should be available to markets by this time. Bulb diameters ranged from 50 mm (15 February) to 74 mm (6 April). Bulb diameters did not exceed 15 mm in the 30 January planting and 47 mm in the 26 April planting. Seed stems developed in the last three plantings, increasing to an unacceptable level (50%) in the 26 April planting.

Leaf development

Plantings other than the first two produced 12 to 13 true leaves. The 30 January planting produced three true leaves and the 15 February planting nine true leaves. Leaf number at bulbing (when bulb diameter equals twice stem diameter) varied with planting date and ranged between six and nine leaves at the successful planting times. Leaf development of Early Lockyer White at the 28 February planting is shown in Figure 5. Bulbing occurred at the emergence of the seventh leaf in this planting. Bulb diameter increased by half as much after the emergence of the last leaf. There was no constant period for the time between emergence of the last leaf and maturity across plantings.

Best time to plant

Mid February is the earliest that Early Lockyer White strains can be planted to be commercially successful. Plantings earlier than this do not produce enough leaves to develop bulbs to commercial size. Excessive seed stem production in plantings later than 6 April suggests the early strains selected within Early Lockyer White should not be planted after this time.

Performance of onion varieties in Queensland

more info
Onion varieties
Section 3 page 5

Testing program

A two-year project on different planting times for onions at Gatton Research Station from 1994 assessed the commercial value of current onion varieties and advanced lines for the domestic and export market. Fortnightly plantings started in February and ended in June. Seed came from seven seed companies, four local seed growers and Gatton Research Station.

Seasonal conditions

A very dry season resulted in excellent quality onions being produced. This also restricted the incidence of downy mildew. The most serious outbreak was in the fourth planting and limited mainly to varieties that produced excessive seed heads.

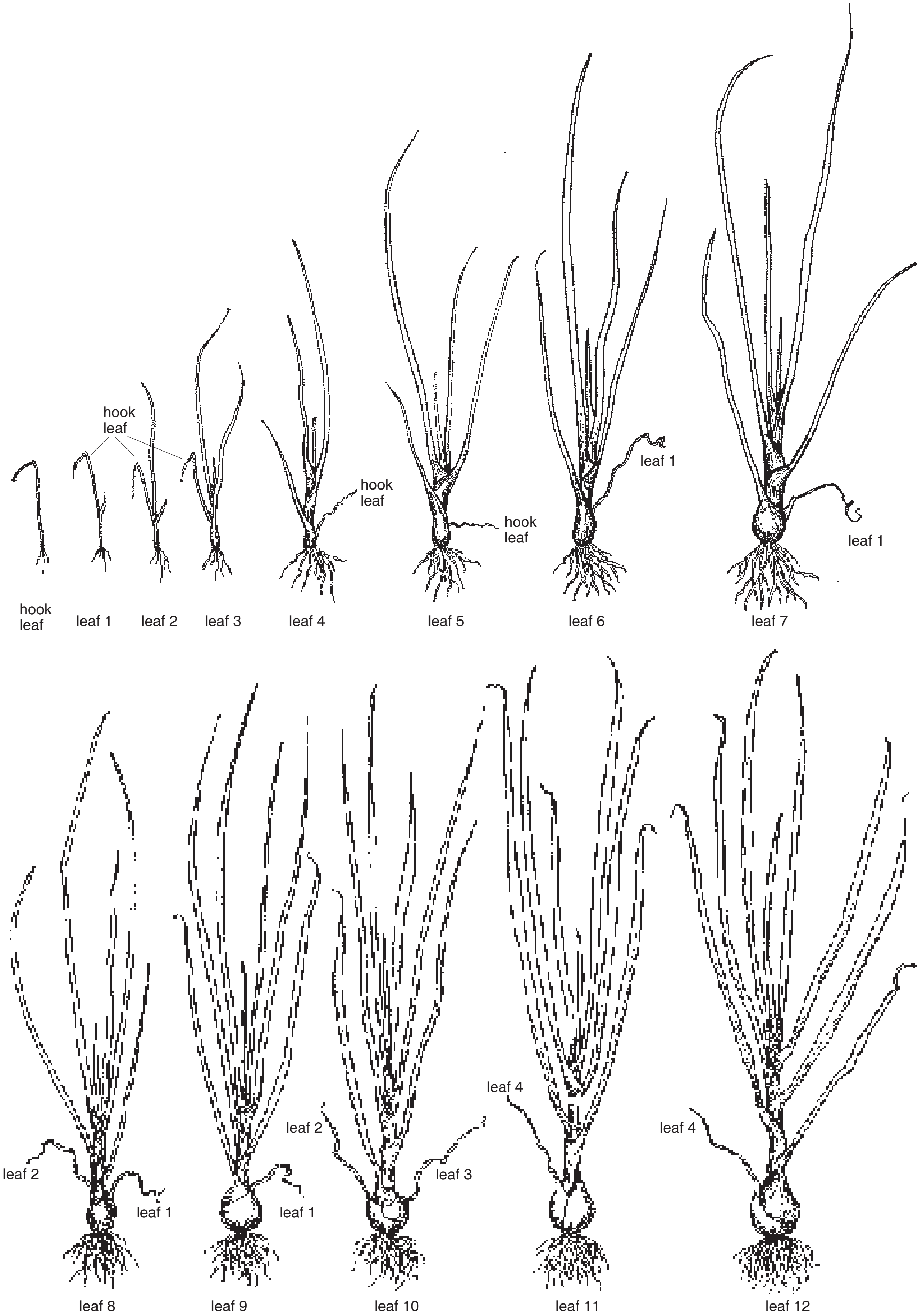

Figure 5. *Leaf emergence stages in onions*

Lower than average minimum temperatures probably accentuated the production of seed heads in some varieties. In milder seasons these varieties may not have been so susceptible. Varieties that produced more than 80% seed heads or those that did not bulb were not harvested.

Early to mid-season (February to March plantings)

Early Lockyer White onions (ELW)

The Neuendorf and Else strains produced the highest yields. This demonstrated the superiority of the locally produced Brooking strain, which is the source of the Neuendorf and Else strains. All Early Lockyer White strains were subject to greening. Lower yields in the Schulz line were mainly due to low germination. This strain also produced the round flat shape present in the other lines. The South Pacific Seeds (SPS) strain produced many smaller onions than the other strains.

Brown onions

Barton Brown, the Gatton Research Station strain of Early Lockyer Brown, produced medium to high yields of good quality onions. They had reasonable skin development and were a medium brown. An experienced exporter selected this variety as having excellent potential for the Korean market.

The performance of the various Golden Brown strains was similar. All yielded well and there was little difference in the number of skins developed. Their appearance after grading was also similar, with most skins being removed.

This lack of skin cover and the resultant bright appearance of the onion has met with buyer resistance in the domestic market. Prolonged curing should achieve a better skin retention with this variety. However an exporting firm has selected Golden Brown as having potential for the Japanese market.

Of the experimental lines, SPS strain 778 produced high yields with a high proportion of large onions, a desirable characteristic for domestic and export markets. However in the early planting (planting 3) it produced 17.8% of doubles. This line appeared more suited to mid season plantings. The Yates strain Z516 performed well in the fourth planting and again in the mid-season plantings 5 and 6. The early Gladalan Brown strain (Wallon Brown) yielded well in the fourth planting, though 8% of plants produced some seed heads. This variety produced high yields of firm brown onions. It shows potential for plantings from mid April to mid May.

Several lines, including Henderson's Red Rojo, Henry's Special and Early Supreme White, Lefroy Valley East experimental lines and Yates A544, were not suited to these earlier plantings dates. More than 80% of plants produced excessive seed heads and were not harvested.

Mid-season (April to mid May plantings)

White onions

In the fifth planting, SPS Lockrose White was the highest yielding variety. It appears similar to the Early Lockyer White strains but was superior to the SPS Early Lockyer White strain in this planting. Wallon White also performed reasonably. All three white onion varieties in this planting were susceptible to greening.

Several high yielding white onions were harvested in the sixth planting. SPS Snowball and Yates A544 were the highest yielding varieties. The Lefroy Valley East lines produced high yields and had the best resistance to greening of all white onions tested. These lines generally tended to produce top shaped rather than globe onions.

Red onions

Henderson's Red Rojo planted in the fifth planting was still too late for this planting time, with more than 80% producing seed heads.

Golden Brown onions

The Neuendorf and Else strains were superior in the mid-season planting. The Schulz strain was more suited to earlier plantings.

Brown onions

The New World Early Lockyer Brown strain in the fifth planting was low yielding, with 56% of plants producing purpled onions. Several high yielding brown onions were harvested in the fifth planting. Poor shape (Northrup King Brown) or uneven colour and shape (Henderson's Henry's Special, Bronco and Grand Prix) detracted from the high yields. Wallon Brown, SPS 778 and Yates Z516 had better shape and more even colour.

In the sixth planting, the Yates selections Z512, Z516 and Centurion produced good quality, globe shaped onions. Yields were not as high as other brown strains evaluated.

Omega (SPS) had a more uniform shape and colour than the higher yielding experimental line SPS 791, which varied substantially in shape. The Lefroy Valley East brown onions tended to be uneven in colour and top rather than globe shape. The New World Lockyer Gold variety appeared very similar to the Golden Brown strains tested in earlier plantings.

Late season varieties (late May to mid June plantings)

White onions

In the seventh planting, Snowball and Yates B501 were the only white varieties planted. Ten per cent of Yates B501 plants continued to produce a proportion of seed stems. Snowball was a softer onion with a poorer keeping quality than Yates B501. In the eighth planting all the white onions produced similar yields, and all had a tendency to break down in storage. The Lefroy Valley East line 94518 was the least susceptible.

Red onions

Henderson's Red Rojo yielded well in the seventh planting, indicating its suitability to late rather than early and mid season plantings.

Brown onions

Daylength requirements for bulbing in the Magnus Kahl Cream Gold strains were not met in the seventh and eighth plantings as only a few plants had bulbed by December. This was three to four weeks after the other varieties in these plantings had been harvested. Omega (SPS) produced high yields in both plantings and had many larger grade size onions.

The Yates varieties Centurion and Gladiator produced similar yields (mainly No. 1 Grade). The onions were of excellent quality, colour and shape and showed potential for long term storage. The SPS experimental lines 767 and 791 tended to be uneven in shape while the Lockyer Valley East lines were uneven in skin colour.

Seed production

Some larger onion producers in Queensland grow their seed, particularly for early plantings (Early Lockyer White, Early Lockyer Brown and Golden Brown). There are also specialist seed producers within the farming community in the Lockyer Valley who grow a full range of varieties. Many mid-season and late onion crops are planted with 'tinned seed' produced by commercial seed companies. Many of these 'tinned seeds', especially late season varieties, are hybrids.

Growing a crop for seed

Select bulbs

Seed production is spread over two seasons. In the first season, bulbs are selected from commercial crops of the appropriate variety. Bulbs are selected for early maturity; trueness to type, colour and shape; and without faults such as doubles and bottle necks.

Bulbs are selected from August through to October. Selected bulbs are spread out and stored in a cool, dry place, preferably in wire netting racks, which allow air to circulate.

Production methods

Two methods are used to produce seed during the following year.

- The first is to plant the bulbs in the field in January or February and allow them to grow into a number of split bulbs. These split bulbs are harvested before they send up seed stems. They are allowed to dry in a cool place for a few weeks, separated and replanted in May or June. This system was popular when very early onions were being produced and bulbs were being selected in June and July.
- The second and more common system is to plant whole bulbs from late April to June. The resulting split bulbs remain in the soil and produce several seed stems per planted bulb.

A well prepared seedbed is used and bulbs are planted into furrows in rows 1 to 1.5 m apart. The bulbs, planted 40 to 60 cm apart, are pushed well into the furrows, which can be lightly cultivated to put some soil around them. The 1 to 1.5 m wide row spacings enable the crop to be cultivated for weeds and also allow a good spray coverage for insect and disease control.

Problem solver handy guide

The main disease problem is downy mildew, which attacks the seed stems and causes elongated diseased areas. These become weak points at which the stems snap, leaving the seed head on the ground. Botrytis or flower blight can also cause severe losses if it is wet during flowering and seed set.

The main insect pests are onion thrips and Rutherglen bugs.

Harvesting seed

The seed turns black when mature. Heads are cut off the stem when most of the seed has matured. Harvesting usually takes place in November and December and must be done as soon as possible to avoid storm damage. The seed stem is cut with a sharp knife or secateurs 30 cm below the head, and put into chaff bags or open mesh bags which allow air to circulate. The bags are tied and hung from racks in a cool, dry shed to cure.

The dried seed heads are threshed using modified corn threshers, hammer mills or farm-made threshers. Onion seed is difficult to thresh and prior drying of the seed heads is essential. Clean the threshed seed by placing it in water for two to three minutes and skimming rubbish and light seed from the surface.

The seed is then spread out to dry thoroughly in the shade, placed in dry containers and stored in a cool dry place. For long term storage, dry to 6.5% moisture content. Onion seed can be stored satisfactorily in household refrigerators but vacuum packing into tins is the best method.

The germination rate of onion seed can decrease rapidly and seed should not be kept for more than 12 months. If kept from one season to the next, obtain a germination test before planting.

Seed yields are quoted at 200 to 300 kg/ha, but such yields are rarely obtained. Yields can fluctuate widely from season to season.

Nutrition

The onion crop has a high requirement for nutrients and this requirement must be met to produce a good quality, high yielding crop. Soil and leaf analysis will help you meet the crop's requirements.

Extent of nutrient need

The onion crop has a high nitrogen and potassium requirement and a moderate phosphorus requirement. Table 5 shows the amount of these elements removed from the soil by a crop yielding 30 t/ha.

more info
Fertiliser rates
Section 3 page

***Table 5.** Amount of element removed from the soil by a 30 t/ha crop*

Nitrogen N	Phosphorus P	Potassium K
80 kg	18 kg	100 kg

Nitrogen

Nitrogen is the major nutrient requirement of most soils in the Lockyer Valley. It is normally broadcast over the crop in several applications after plant emergence. These are usually at the first true leaf stage, third to fourth leaf stage, and at the beginning of bulbing. The amount and timing of nitrogen applications depends on the preceding crop. If potatoes or a salad vegetable were grown immediately before onions, there would often be a fair carry over of residual nitrogen. A preceding cereal crop such as sorghum would often leave the soil low in nitrogen.

The amount of nitrogen required varies from 30 to 130 kg/ha. In a healthy crop, late applications of nitrogen can be detrimental, promoting too much top growth and abnormal bulbs. Nitrogen should not be applied during bulbing unless the crop is affected by diseases such as downy mildew or pink root, or has suffered some other setback, for example heavy leaching rain.

Phosphorus

Most onion growing soils in the Lockyer Valley contain high levels of phosphorus and it is rarely necessary to apply it as a fertiliser. When applied to these soils as a basal dressing at the recommended rate, most low phosphorus fertilisers will supply sufficient phosphorus. On lighter soils in other onion growing areas, do a soil analysis to determine the quantity of phosphorus needed.

Potassium

Most soils where onions are grown in the Lockyer Valley contain enough potassium to produce good crops. As for phosphorus, do a soil test to determine if potassium is necessary and, if so, the quantity to apply.

Trace elements

In the Lockyer Valley onion growth has responded to applications of zinc and manganese on heavy soils with a pH above 7, particularly where pH is high (8 to 9). Some response to sulphur has also occurred on these high pH soils, particularly when applied as sulphate of ammonia.

Boron (Bo). Boron deficiency may occur. Spray two foliar applications of Solubor at 1 to 1.5 kg/ha, or a liquid boron equivalent. Apply early in the life of the crop. Do not apply with a sulphate, for example zinc sulphate.

Manganese (Mn). Manganese can be spread on the soil as manganese sulphate at 70 kg/ha or, alternatively, two foliar applications of manganese sulphate can be made at 1 kg of manganese sulphate per hectare. Ensure the concentration never exceeds 2% manganese sulphate, that is use no more than 2 kg/100 L of water.

Zinc (Zn). Zinc can be spread as a soil application, at least three weeks before planting, at 30 kg/ha of zinc sulphate monohydrate. Alternatively, two to three foliar sprays of zinc sulphate heptahydrate can be used. Apply 1 kg of zinc sulphate heptahydrate plus 1 kg of urea in 470 L of water per hectare. Foliar sprays should be applied early in the life of the crop.

Fertiliser recommendations

On alluvial soils, only nitrogen is normally required. The most common form is urea but sulphate of ammonia and nitram are also used. Apply as one to three applications spun onto the growing crop just before irrigation. The total amount of nitrogen applied varies from 30 to 130 kg/ha, depending on previous cropping and fertiliser practices. Refer to your soil test.

On less fertile soils, nitrogen, phosphorus, potassium (N:P:K) fertiliser mixtures such as 13:2:13 or 15:4:11 may be applied at 250 to 700 kg/ha, preferably spun onto the emerged crop before irrigation. Nitrogen side dressings are often required. If fertiliser is applied before planting, low rates should be used and the fertiliser worked well into the soil.

All fertiliser should be applied before bulbing, except when the crop has been setback due to weather or disease, in which case additional nitrogen may be beneficial. Bulbing is the stage when the bulb is twice the diameter of the stem.

Irrigation management

Irrigation management is one of the keys to producing a high yielding, good quality onion crop. As competition for water increases, and margins between costs and prices narrow, producers must make best use of irrigation water. An efficient irrigation schedule is essential to ensure that the correct quantity of water is applied when the plants need it.

The importance of getting irrigation right

Too little water

If too little water is applied after planting the soil may crust, preventing uniform emergence of the seedlings.

Onions are shallow rooted plants and are highly susceptible to water stress. Too little water during early bulb development will result in a high percentage of small onions or picklers, as well as split bulbs or doubles.

Too much water

Over watering of young plants can result in seedling losses from damping-off.

Too much water applied to older plants will result in waterlogging, a lack of oxygen in the soil, and root diseases. Excess water will also waste nutrients by leaching them beyond the root zone and may pollute the groundwater with excess nutrients.

Irrigation must No. 1—a good irrigation system

more info
Horticultural consultants
Section 6 page 6

The first essential requirement of efficient irrigation is a water supply and irrigation system capable of delivering the required amounts of water when needed. Consult an irrigation equipment supplier or designer in your area and get them to develop an irrigation plan.

Onions require overhead sprinklers for best plant establishment. These can then be used to water the plants throughout the season. Use single knocker, impact sprinklers on short risers to allow spray machinery to pass overhead.

Trickle irrigation is an alternative way to water the plants once they are established. Trickle watering has some advantages over sprinkler watering. It can use less water, reduce leaf diseases and can be used to apply soluble fertilisers directly into the plant root zone. Use a trickle tube with outlets no more than 20 cm apart. Trickle irrigation requires more management and regular maintenance during the growing period.

Irrigation must No. 2—a monitoring system

The second essential requirement of efficient irrigation is a system to tell you when and how much water your crops needs. This is known as a monitoring or scheduling system. The importance of monitoring is confirmed by research which shows that water use can be considerably reduced with monitoring, without affecting yield and bulb quality. It also makes sure you are applying enough water at the critical times.

A range of equipment and techniques is available for monitoring soil moisture and scheduling irrigation. The most common are the soil-based systems using tensiometers, neutron soil moisture probes, or newly developed soil capacitance systems such as the Enviroscan. The other technique sometimes used is a climate-based system that uses estimates of evapotranspiration. The tensiometer or capacitance systems are preferred and recommended. A brief comparison of the main systems is shown in Table 6.

As soil moisture monitoring can be complex, seek expert advice first, particularly when setting up the system.

Table 6. *Comparison of main soil moisture monitoring systems*

System	Advantages	Disadvantages
Tensiometers	· Relatively cheap · Easy to install · Can be read by growers · Continuous monitoring	· Labour intensive to collect and record data · Require regular maintenance · Can be inaccurate in extremely wet or dry soil
Capacitance probe e.g. Enviroscan	· Continuous monitoring · Accurate at all depths and for all soils · Enables rapid reading and recording of results	· Expensive · Need skill in interpreting data
Neutron probe	· Portable, can be moved around sites	· Not suitable for continuous monitoring · Equipment is expensive and radioactive. Use a consultant who owns the equipment. · Less accurate in the top 10 cm of soil · Less accurate in sandy soil because of low sampling frequency
Evaporation pan	· No in-field measurement needed as system uses weather data to predict irrigation need	· Inaccurate as system ignores soil variability

Getting the best from your irrigation

Use a scheduling device, such as tensiometers, to help you make decisions about when to irrigate and how much water to apply.

- For the Lockyer Valley climate and soils, irrigate when the reading of the shallow tensiometer (installed 15 cm below the ground surface) shows 30 to 50 centibars (kPa). Reducing irrigation can adversely affect onion size and yields (Figure 6).
- In sandier soils, critical tensiometer reading may be lower.
- In milder climates, perhaps higher readings could be used without sacrificing yields or quality.
- Remember that pesticide applications, irrigation systems, labour, the availability of water, and disease risk all influence your decision to irrigate.

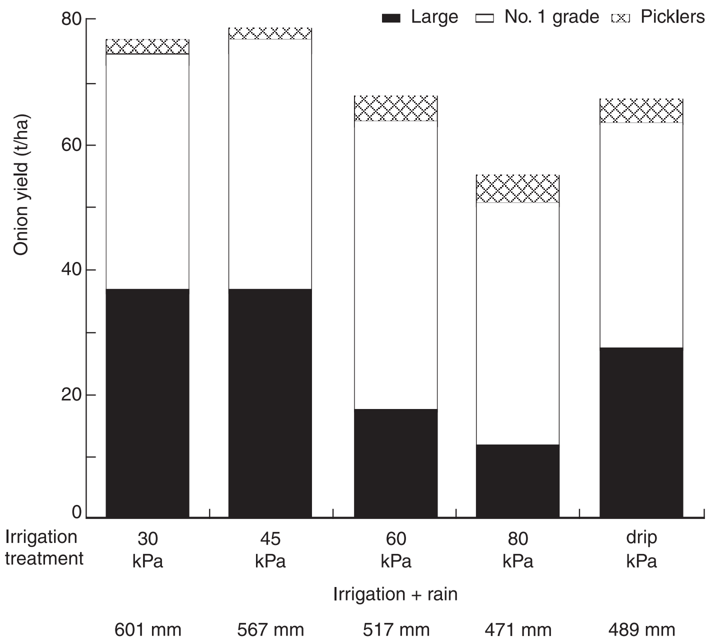

Figure 6. *Reducing irrigation adversely affects onion size and yields*

Tensiometers

A tensiometer consists of four basic parts—a hollow tube filled with water and algaecide, a ceramic tip, a water reservoir and a vacuum gauge which reads water tension on a scale of 0 to 100 kPa (Figure 7). In wet soil, the vacuum gauge displays 0 to 5 units kPa. As the soil dries over several days, water moves from inside the instrument, through the porous ceramic tip, into the soil. The gauge reading steadily increases to a maximum of abot 90 kPa. When the soil is re-wet after rain or irrigation, water moves from the soil back into the tensiometer and gauge readings fall.

The DPI has published a useful booklet *Water it right*, *irrigation using tensiometers* that takes the worry out of scheduling irrigation.

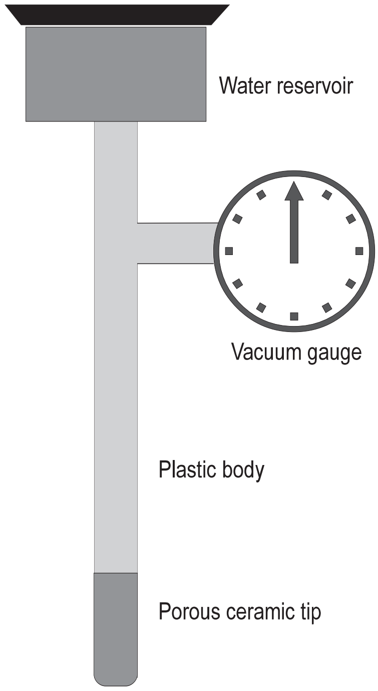

Figure 7. Parts of a standard tensiometer

A monitoring site consists of one shallow tensiometer installed in the major root zone, and one deep tensiometer below most of the roots (Figure 8). A crop planting should have at least two monitoring sites. Shallow tensiometers should be placed within 10 cm of the crop row nd midway between plants, though this can vary slightly. Install the shallow tensiometer with the tip 15 cm below ground and the deep tensiometer 45 cm deep. Install tensiometers after the crop is established, disturbing the plants and surrounding soil as little as possible.

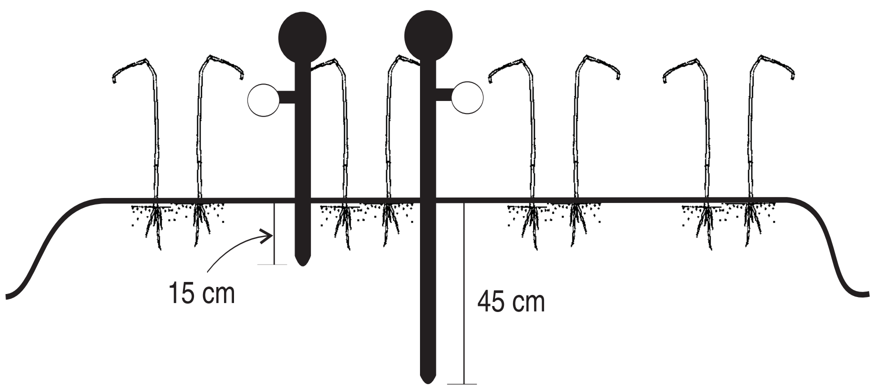

Figure 8. Profile of a typical tensiometer monitoring site in onions

The shallow tensiometer indicates when to water. The deep tensiometer indicates when the right amount of water has been applied. If deep tensiometer readings fall to less than 10 kPa within two days of irrigation, there is more water than the root zone can hold. Constant values after irrigation indicate the root zone is saturated. If readings continue to rise immediately after irrigation not enough water has been added to the root zone.

Installation

Assemble tensiometers and fill with good quality water to which algaecide has been added. Leave them to stand in a bucket of water at least overnight, but preferably for one to two days. The water does not need to be pre-boiled. Tensiometers are more reliable if an appropriate vacuum pump is used to remove any air. Top up the tensiometers with more water if necessary. They are now ready to install.

Carry the tensiometers to the installation site with the tips either in water or wrapped in wet rags. Provided the ground is moist and well cultivated, the shallow tensiometer can be pushed 15 cm into the soil. Don't push too hard. The tips are strong but can crack under excessive pressure. Only experience teaches how hard is too hard. At $30 per tip, this can be an expensive lesson. If you reach a hard soil layer, either take the tensiometer out and try somewhere else, or use the deep tensiometer procedure.

To install the deep tensiometer, dig a hole 45 cm deep, keeping the excavated soil nearby in a pile. We have found a 50 mm (two inch) auger the best tool. Put the tensiometer in the hole, over to one side. The next step is critical.

Good contact between the ceramic tip and the surrounding soil is most important. Take the most crumbly, moist soil from the dirt pile and pack it around the tip at the base of the hole. A piece of 10 to 15 mm diameter dowel is useful for packing. Don't over-compact the soil into plasticine, but remove any large air gaps.

Continue replacing soil until the hole is filled. It doesn't matter which soil you use once you have packed the first 5 cm above the tip. Friable topsoil from a few metres away can be used to create a slight mound around the tensiometer. This minimises water draining down beside the tensiometer, causing false readings. Covers made from silver/blue insulation foil placed over the tensiometers minimise temperature fluctuations and algal growth. The gauge can be left exposed for easier reading.

The tensiometers are now ready to operate. Use the vacuum pump to again remove air bubbles. Tensiometers may take a few irrigation cycles to settle down, so don't take too much notice of the readings for the first few days. During this period, air gaps may appear in the tensiometer. Simply refill with algaecide-treated water. Within a week of installation, readings should rise and fall with irrigation and rainfall.

Clearly mark tensiometer locations, otherwise they may be damaged by tractors, harvesters, rotary hoes and other machinery.

Reading

Read tensiometers at the same time early in the morning, preferably before 8.00 a.m. At that time there is little movement of water in the soil or plants and they are almost in equilibrium. Errors caused by heating of the gauge or water column are also avoided. Read the gauge at least twice a week, but preferably every one to two days. Lightly tap the gauge before reading.

Troubleshooting tensiometer problems

No water in the tensiometer; gauge reads 0

There is either a crack in the ceramic tip or a faulty seal. Fill the tensiometer with water and apply suction with a vacuum pump. A stream of large bubbles will indicate the problem area; usually a cracked tip or a missing o-ring.

Air entering over several days; gauge registering more than 5

There is either a hairline crack in the tip, or a substantial air gap in the soil around the tip. Remove the tensiometer. If there are no obvious tip cracks, then re-install the tensiometer. If the problem persists, replace the tip.

No change in readings over several days

The gauge may be faulty or blocked. Check that the gauge is working.

- Apply suction to the tensiometer with a vacuum pump.

Or

- Remove the gauge, rinse with clean water and suck it. If the needle does not move there is a problem with the gauge.

Tensiometer readings increase beyond 80 then fall to 0, accompanied by air in the tensiometer

The soil has become too dry for the tensiometer to operate. After irrigation, refill the tensiometer and treat as if it had just been installed. If this happens frequently, consider whether you are under-irrigating. If you are happy with your irrigation, try installing the shallow tensiometer slightly deeper. This problem should never occur with the deep tensiometer.

Getting started

A good grower starter pack would include two 30 cm and two 60 cm tensiometers, a suitable vacuum pump, algaecide and a one-metre long 50 mm diameter auger. The total cost should be less than $600. The best tensiometers have replaceable tips, gauges and reservoirs.

Tensiometers should be installed at two monitoring sites in a crop. Continue usual irrigation practices and get a feel for how tensiometers operate. Once you are comfortable with using them, make slight changes to your irrigation and observe what happens. For example, if the reading of the deep tensiometer always fall after irrigation, reduce the amount of water you apply.

Tensiometers are easiest to use in overhead irrigated vegetables; flood, furrow and drip irrigation systems are more complex because positioning of the tensiometer is more critical.

Producers' comments

Producers have commented on the practical use of tensiometers and what influences their irrigation decisions. These include:

1. Tensiometers show a number, which can improve decision-making on when and how much to irrigate.
2. Tensiometers indicate soil moisture status; other factors affect the decision to irrigate. Examples include:
   - timing of pesticide application
   - type of irrigation system used
   - availability of labour
   - availability of water
   - presence of diseases such as downy mildew.

When using tensiometers producers may apply more water during the cropping period; generally smaller amounts are applied more often. A common observation is that slightly higher yields are produced but significantly more large onions and fewer picklers.

Many producers irrigate enough to get some drainage below the root zone. The time between irrigations can be slightly increased because:

- the root zone is saturated
- some water can move up from the subsoil.

In many situations this can be a viable irrigation strategy provided drainage is not excessive.

Pest management

How well you manage pests is critical to your success as an onion grower. The main pests of onions are white rot, downy mildew, onion thrips and weeds.

White rot

more info
White rot symptoms
Section 5
Problem solver

White rot is a serious soil-borne fungal disease of onions in the Lockyer Valley. It has also been found on a few farms on the Darling Downs. Plants can be infected from emergence through to maturity, but in southern Queensland symptoms are rarely seen on seedlings.

Symptoms

The first sign of infection is wilting of the older leaves and later of the entire plant, resulting in death. The most characteristic signs are the presence of white, cottony fungal strands and small (1 to 3 mm in diameter) black spherical bodies (called sclerotia) on the rotting stem bases. White rot usually occurs in patches which are initially only a few metres across but enlarge every year through normal cultivation practices.

Management

Control of onion white rot is limited to hygiene practices and fungicides. No commercial onion varieties are tolerant of white rot, though selections with relatively high levels of tolerance have been identified.

The sclerotia of white rot can survive for at least 15 years in the soil, making rotations impractical for this disease. White rot is difficult to control, so every effort should be made to reduce the chances of introducing it. The fungus can be spread by machinery, vehicles and footwear and on vegetative planting material such as garlic bulbs. Thoroughly wash soil from machinery, boots, etc. suspected of having been in an infested field. Planting material should come from a white rot free area.

Soil fumigation

The results of soil fumigation have been variable, and the high cost of treatment limits its use to heavily infested areas in a field. Treated areas may have to re-treated every one or two years.

Fungicides

Fungicides provide adequate levels of control for onion white rot. Only one fungicide, procymidone (as Sumisclex 275 Flocol), is registered in Queensland for the control of this disease on onions. It is registered to be applied as a seed dressing, a soil surface spray at planting and a plant spray during the season.

In the Lockyer Valley the seed dressing treatment is not very effective but the soil surface spray at planting is vital for disease control. Banding the fungicide is a more cost effective way of applying it than using an overall spray. Irrigate immediately after planting to ensure that the fungicide leaches through the soil to the seed.

The next spray of procymidone must be applied before symptoms of white rot are obvious. In the Lockyer Valley, for onions planted in the main planting window (March to May), an application in mid June will beat the first infections in most years. Apply further sprays at regular intervals, preferably every four weeks.

more info: Managing white rot *Problem solver handy guide*

All of these post-planting sprays must be targeted at the bases of plants and at the surrounding soil, so appropriate nozzle selection, orientation and type is critical. Banding is the best method of application. High water volume or irrigation will ensure that the fungicide reaches the target. Apply at the registered rate.

Despite the careful use of fungicides, control may be poor. The more sclerotia in the soil, the greater the chance of disease. Prolonged periods of cool wet weather increase the likelihood of disease, which fungicides cannot counteract.

Downy mildew

Onion downy mildew occurs each season in the Lockyer Valley. Disease severity depends on the weather, particularly during the critical time from July to mid September. Outbreaks occur during cool, overcast, moist conditions when the relative humidity before dawn is more than 95% and heavy dews persist until 9.00 or 10.00 a.m.

Some strains of downy mildew are resistant to the phenylamide fungicides (metalaxyl, benalaxyl, oxadixyl) but the development of new curative fungicides will allow growers to rotate between the different systemic groups. For this management program to be effective growers must identify the first disease cycle for the season and apply a curative fungicide immediately.

Forecasting for downy mildew

The possibility of using a disease forecasting system for downy mildew was investigated in the Lockyer Valley. The system was based on recording weather patterns in the field and using effective systemic fungicides. The results indicated good potential benefits from a forecasting system. They included:

- effective disease control with fewer sprays;
- increased or comparable yields;
- reduced costs of application, labour and machinery;
- delays in the build-up of resistance to some fungicides.

more info

Downy mildew control strategy Section 6 page 18

Further work started in 1997 to develop a downy mildew forecasting system to cover the whole Lockyer district.

The research

Work at Gatton Research Station has shown the downy mildew weather forecasting system combined with new systemic fungicide mixtures can reduce considerably the incidence of this disease.

The results showed that a new systemic fungicide mixture, Acrobat MZ (mancozeb and dimethomorph), increased yields of Early Lockyer White onions by delaying and suppressing downy mildew infection. It was more effective than Ridomil MZ in reducing disease severity. The presence of phenylamide resistant strains reduced the efficacy of Ridomikl MZ. The number of sprays was halved and control was better when crops were sprayed according to weather forecasting rather than routine calendar sprays.

Trial crops were sprayed within 48 hours of a likely infection event. Subsequent forecasts for seven days were monitored but the crops not sprayed. Six sprays were applied for the forecast-only crops. Mancozeb was sprayed every seven to 10 days, providing the weather was favourable for spraying.

The results of the various sprays on yield, disease severity and the number of sprays is shown in Table 4.

***Table 4.** Effects of forecast spraying for downy mildew on yield, disease severity and number of sprays*

Fungicide treatment	Yield t/ha	Leaf area affected %	No. of sprays
Mancozeb weekly	65.9	81.0	12
Mancozeb weekly + Ridomil MZ 720@ forecast	67.8	78.1	12
Mancozeb weekly + Acrobat MZ @ forecast	70.3	53.6	12
Ridomil MZ 720 @ forecast only	65.8	84.4	6
Acrobat MZ @ forecast only	71.2	50.5	6
Control	47.5	94.5	nil

The forecast spray of Acrobat MZ produced the lowest level of infection compared with the forecast spray of Ridomil MZ 720. This is very important for the Lockyer Valley where resistant strains of downy mildew severely limit the usefulness of phenylamide fungicides.

To delay the resistance of downy mildew to fungicides as long as possible, use the following strategy.

1. Ensure that spray equipment is calibrated and in good working condition.
2. Use a protectant fungicide, for example mancozeb, propineb, etc. at seven to ten day intervals.
3. If the weather is favourable for downy mildew, that is long dew periods or showers, replace the protectant fungicide with a combined systemic/protectant, for example Acrobat MZ, for the next two applications. To get systemic action add an oil adjuvant, for example Synertrol or Codacide.
4. Return to a regular program of protectant sprays.
5. When effective systemic fungicides from different groups are available, alternate the groups in step 3 above.

Onion thrips

Research has started to improve management of onion thrips.

Weeds

Detailed research on weed control in onions has been completed, but new chemical use registrations are needed before recommendations can be made.

Marketing

Marketing is one of the most important issues in onion production and one for which there is little information available. No matter how well you grow a crop, if you do not market the onions the consumers want, you will soon go out of business

What do buyers want?

more info
Market information
Section 6 page 6

Buyers look for the following points when buying onions.

- The amount of mechanical damage, for example cuts and bruising.
- Greening of white onions.
- Immature onions (sprouting).
- Poorly cured onions. These are soft and damp if under cured, are predisposed to break down and have a shorter shelf life.
- Skinned onions.
- Storage rots, for example black mould.
- Insect damage, for example thrips.

Queensland produces a short day, salad-type onion which is sweeter and has lower pungency than onions produced in southern Australia. Unfortunately these differences have not been widely promoted in the market. Queensland onions should complement the southern onions instead of competing against them. Queensland onions can be used fresh in salads or in cooking, particularly barbecuing. Southern onions are used mainly for cooking.

Short day onions have a shorter shelf life. In Queensland this can largely be overcome by serial planting to allow a continuous supply of fresh onions. This avoids premature harvest and allows enough time for curing.

Consumers of fresh onions buy mainly on appearance and usually prefer clean, firm, well cured onions. Onions should be graded, as there are market niches for specific grade sizes.
To avoid mechanical damage, onions should be handled with great care. Avoid drops of greater than 15 cm throughout the harvesting, packing and handling processes to reduce the risk of bruising.

Most white onions 'green' when they are exposed to light in the field. To avoid greening, ensure optimum plant stands and harvest as soon as 80% of the tops collapse.

The temptation to harvest onions before they are mature, to take advantage of high prices, usually results in a market backlash. Immature onions store poorly and are susceptible to break down and sprouting.

Until a marketing plan for salad onions is put in place, prices will remain volatile.

How do you sell your onions?

There are many options for marketing onions. These include:

- Selling to a local merchant.
- Selling to an agent or merchant at the major markets.
- selling to a packer.
- Selling direct to a retailer, for example the major supermarkets or smaller retailers.

Note. Agents sell your produce on your behalf, then receive a commission, usually about 12.5%. **Merchants** buy the produce from you at an agreed price, then sell it for what ever price they can get.