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NSW DEPARTMENT OF
PRIMARY INDUSTRIES

Onion growing

Agfact H8.1.22, 2005
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New South Wales produces about 32,000 tonnes of onions annually. This figure represents 15 per cent of the total Australian production. About 90 per cent of the State's onion crop is grown in the Riverina — the region from Griffith and Whitton in the north to Jerilderie in the south. There is also a small but expanding onion industry in the Central West around Wellington and south to Cowra.

Onion production in the Riverina is based on the Creamgold onion, a long-day variety (also known as 'Pukekohe Longkeeper') that is commonly grown in southern Australia. A feature of Riverina production is the use of furrow irrigation on self-mulching grey clay soils. Production in most other areas of the State uses overhead sprinkler irrigation on sandy loam soils.

The NSW onion crop is planted in May–June and harvested from early November to the end of December. For marketing purposes, the NSW onion crop slots into a consumer window which comes after the southern Queensland crop in the Lockyer Valley/Darling Downs harvest, which finishes in early November, and before the South Australian harvest, which starts in early February. For export markets, including Japan, this is generally also a period of good demand as northern hemisphere stocks begin to run low and the demand for fresh supplies of some varieties, such as mild onions, increases.

VARIETY SELECTION

In NSW, most sowing takes place in early–late May with some late plantings of hybrid types possible until late August. Difficulty with access to irrigation during winter generally dictates planting schedules. Also, May is usually drier and better suited to sowing, with the increased risk of prolonged wet periods in June–July endangering access to paddocks.

Onion bulb formation is dependent upon day-length. Some varieties, including Creamgold, require longer day-lengths to trigger bulb formation than do short–intermediate day-length onions. If you want to plant both Creamgold and a short-day variety on the same date in May, you can expect the short-day type to commence bulb formation in late September for a late November harvest while the Creamgold will not commence bulbing until mid-October for a January harvest. Many of the newer hybrids are intermediate day types and, apart from being suitable for planting in both southern Queensland and NSW, tend to be ready for harvest prior to mid-December.

Although Creamgold remains the predominant variety in NSW, hybrid onions for more specific markets have become common in recent years. Standard Creamgold, as well as extra early and early selections, are open-pollinated types which are still popular among growers and are also favoured by market agents for their brown, solid skins and good shelf-life. More recently, varieties such as Gladiator have filled the gap for harvesting in the late November–early December timeslot.

Use of high quality seed is important because disease, off-types, and poor germination can result if appropriate quality assurance in seed production is not practised. Therefore, check with seed companies to ensure quality tests are carried out.

SOWING

The correct sowing dates for onions are critical. In the Riverina, the new hybrid types can be sown in early May while Creamgolds should be

sown after 15 May. Earlier sowings of Creamgold can result in bolting while late plantings (July–August) may result in smaller bulb potential because of the shorter time before the onset of bulbing. If late plantings cannot be avoided, good plant establishment should be encouraged by the use of higher rates of pre-plant fertiliser. Take care not to set the crop back through the excessive use of herbicides. Sowing density can also be increased to compensate for the anticipated smaller bulb size.

Early sowings are more likely to be exposed to warm conditions which can promote quick germination and growth which in turn can induce bolting later in the crop. However, earlier sowing can enhance good plant stands as crops emerge and establish prior to the onset of cold soil temperatures and frosts. On poorer soils, earlier sowings are less risky but, in this situation, only minimal pre-plant fertiliser should be used to minimise the risk of bolting.

Early Creamgold remains a popular variety as it is a storage onion and is relatively early maturing (mid-December) before the risk of the extreme January–February temperatures. The ideal plant population for Creamgold onions is between 60–70 bulbs per square metre. Normally, 6–7 rows are planted on a 1.8 metre bed, with an approximate spacing of 70 mm between plants. This planting configuration should give a good, marketable bulb diameter of 55–70 mm for Creamgold types. The use of precision air seeders to sow the seed at the correct spacing to achieve an ideal plant population is recommended.

SUMMARY OF THE AUSTRALIAN ONION INDUSTRY

Production by State (tonnes)

Year	SA	TAS	QLD	WA	VIC	NSW	TOTAL
1996*	71,100	80,000	15,000	25,000	20,300	37,500	248,900
1997*	65,274	59,677	21,789	20,321	15,615	32,000	214,676
1998**	65,000	55,000	24,000	19,000	31,000	31,200	225,200
1999**	65,000	70,000	25,000	18,000	25,000	32,500	235,500
1999/00**	70,000	60,000	26,000	18,000	30,000	30,000	234,000
2000/2001**	85,000	68,000	23,000	15,000	20,000	34,000	245,000

* Australian Bureau of Statistics figures
** Australian Onion Industry Association (AOIA) figures

PER CAPITA CONSUMPTION — AUSTRALIA

	1994	1995	1996
Estimated per capita consumption (kg)	7.5	10.1	9.3

MAJOR EXPORT MARKETS (tonnage and value)

Importing country	1996/97 (tonnes)	1996/97 ($'000)	1997/98 (tonnes)	1997/98 ($'000)
Singapore	2185	521	2628	1840
Hong Kong	2157	649	2472	1723
Japan	3708	1295	6517	4562
Germany	9376	2496	9878	6915
United Kingdom	2887	1357	6598	4619
France	1168	547	4247	2973
Other countries	15,512	4613	18,345	12,858

Source — Australian Bureau of Statistics

SITE SELECTION

Site selection is also critical to a successful onion crop. A minimum of a four-year rotation should be established to avoid the build-up of soil-borne diseases. Planting onions immediately after pasture should, however, be avoided, as wireworm populations tend to be high.

In selecting sites, consider soil type, irrigation, bed width, and production system, that is, whether the crop will be hand or machine-harvested. Sandy loam soils should be irrigated with overhead sprays, while laser-levelling is essential for furrow-irrigated crops. Avoid growing white onions on grey clays, as skin discolouration may result.

In the Griffith area, in particular, watertables within 1.5 m of the surface can reduce yields. Soil in this area should therefore be tested for salinity prior to planting, with irrigation water also monitored during the season to prevent salt accumulation around crop roots.

Land preparation should commence 6–9 months prior to sowing with beds formed up prior to the onset of autumn rains. Pre-irrigations should also be used to germinate residual weed seeds for cultivation or planting prior to sowing. A full soil test should be conducted prior to planting. Some of the soils currently used for onion production are sodic and, therefore, respond well to gypsum applications. Rates of up to 5 tonnes/ha are commonly used to help overcome crusting problems on these soils and reduce clods at harvest.

If using furrow irrigation, paddocks should be laser graded at 1 in 800 for heavy clays and up to 1 in 1500 for lighter clay soils. The optimum level is to minimise runs to 400 metres on a slope of 1 in 800 m. Access to irrigation water during winter provides more options for the grower in terms of varieties and sowing schedules. Consideration should also be given to the installation of an on-farm storage both for re-circulation of drainage water and for storage during winter.

IRRIGATION

Onion growers in NSW are facing increasing limitations on water availability and, in some locations, rising watertables and salinity. This, combined with the demand from markets to produce a top-quality product, increases the importance of precise water management, regardless of the irrigation type used.

Onion crops in the Riverina are traditionally grown under furrow irrigation. A grower survey in 1999 showed that average water use for growers on furrow irrigation is about 5 ML/ha applied over 5–6 irrigations with spray irrigation water use of around 4 ML/ha.

TABLE 2 — ONION VARIETIES COMMONLY GROWN IN NSW

Browns
Early types: Early harvest (late November–early December), similar timeslot to Gladalan Brown now replaced by hybrids such as HA 890, Predator, Cavalier, Centurion, Nautilus, Rio Xena, and Gladiator. Mid–Early: Mid-season types (harvest, late December–January), Early Globe, Extra Early Creamgold, Early Creamgold. Late season: Late types (February onwards), Regular Creamgold varieties.
Mild Browns
Early: Predator, Cavalier, Rio Xena, Sombrero, Sirius, Mellow Yellow, HA890, Nautilus. Mid: Houston, Matilda, Sweet Sensation, Terminator.
Reds
Early–Mid: Red Rock, Redback, Red Rojo, Red Shine. Mid: Red Vein. Late: Tango, Scarletta.
Whites
Early: Gladalan White, White Diamond. Mid: Contessa, White Globe, Cossack. Late: White Spanish, GP 101.
Dehydrator
Southport White Globe types.

Source — M Quadir, NSW Department of Primary Industries.

Furrow irrigation. This is a proven and relatively cheap form of irrigation but also one that can be inefficient. This is because it is very difficult to achieve a high degree of distribution uniformity throughout the field with, usually, either the top or bottom of the furrow either under or over-irrigated. This can cause problems such as waterlogging, resulting in a yield penalty.

In order to achieve the maximum benefit from furrow irrigation, the following points should be considered:

- Prefer laser-levelled slopes of between 1:800 to 1:1200 for grey, self-mulching soils, with slopes on poorer subbing red soils not exceeding 1:1500.
- Good drainage at the end of the field is essential, as onion crops will stress after just two days of waterlogging.
- High beds (150 mm) may be necessary to improve internal drainage from the rootzone. Where wetting up across the bed is poor, consider using narrow, 1 m beds.
- Use alternate row irrigation, which only partially wets the onion rootzone and leaves a reserve of oxygen in the soil. In addition to keeping the onion plant actively growing following an irrigation, this can be regarded as insurance in the event of heavy rainfall after irrigation.

Overhead irrigation. This is more efficient than furrow irrigation but generally requires a higher level of management. Centre pivots are the more common systems used, although linear move irrigators will do a good job on suitable soil types. Fixed sprinklers are rarely used for onion production in NSW, although this is the most common system used in places such as Gatton and Werribee. Overhead sprinklers offer the following advantages over furrow:

- They can apply crop water requirements more precisely, offering water savings of up to 30 per cent.
- They can help facilitate mechanical harvesting by using light irrigations to soften soil prior to harvest.
- They can be used to cool the crop around harvest, thereby minimising diseases such as black mould (*Aspergillus*).
- Strategic, light irrigations can also be used to reduce the incidence of downy mildew.
- Soil dries quicker to enable field operations.
- Sprinkler irrigation is also essential on sandy soils and where the terrain does not suit furrow.

Drip irrigation. Trials using drip irrigation have been conducted in most onion production regions in Australia. These trials found drip irrigation offers precise control of water, particularly for specific markets such as for mild onions. It is interesting to note that, in the United States, most of the mild onion crop is grown under drip irrigation. In Australia however there has been little commercial adoption of drip irrigation.

NUTRITION

The effective management of fertiliser and crop nutrition is important for several reasons:

- Elements, such as nitrogen, can have a significant influence on bulb quality and make the plant more prone to disease.
- Good nutrition of onion plants makes the crop more resistant to pest and disease attack.
- There are concerns on the fate of fertilisers in the environment.

Fertiliser requirements for bulb onions vary depending on factors such as soil type and climatic zone. In the Riverina, the trend in recent years has been towards reducing nitrogen applications. Excess nitrogen can result in poorer skin retention and softer bulbs, resulting in poor shelf-life and a greater incidence of diseases such as black mould. The total required application

Laser-levelled fields with approximately a 1:1500 slope are recommended for furrow irrigated onions on the grey soils of the Riverina.

of nitrogen (N) for brown onions ranges from 100–150 kg/ha. Approximately one-third of this should be applied as a base dressing with the remainder as split side-dressings, one at about the 4–5 leaf stage, and the last at bulb initiation. Bulb initiation takes place when the bulb is approximately double the diameter of the stem.

Phosphorus (P) applications are dependent on soil tests. Generally, for a soil with low–medium P levels, 60–70 kg/ha of phosphate should be applied. Excessive P levels can induce zinc deficiency, causing stunting of the crop.

Potassium (K) is generally not a limiting nutrient in onions on heavier soils in southern NSW. Again, soil tests should be used to determine if K is required. The K is generally applied as a pre-plant nutrient.

Of the minor elements, zinc (Zn) and calcium (Ca) are the most important. Deficiency of Zn can lead to stunted growth in the plant and poor bulb yield, while good Ca levels in the bulb are essential to prolonging storage life and reducing post-harvest breakdown. Foliar sprays for both Zn and Ca are commonly used in onions. Leaf testing is recommended to find the requirements for minor elements.

In more recent years, there has been a trend towards tissue and sap testing to monitor nutrient levels (particularly nitrogen) in onion crops. Leaf petiole testing should commence at the 5-leaf stage and continue on a fortnightly or weekly basis through to harvest. Providing testing commences at this early stage, corrective measures can be taken for deficiencies. Analysis standards are now well established for the major elements NPK, in addition to the minor elements such as zinc, calcium, boron and molybdenum.

WEED CONTROL

Major weed species in NSW onion crops include wireweed (*Polygonum aviculare*), clovers (*Trifolium* spp.), capeweed (*Arctotheca calendula*), vetch (*Vicia sativa*), fumitory (*Fumaria parviflora*), heliotrope (*Heliotropium europaeum*), variegated thistle (*Silybum marianum*) and loosestrife (*Lythrum hyssopifolia*).

Onion plants are poor competitors in their early growth stages. Late-autumn sown crops generally develop slowly over winter and are, therefore, very prone to weed competition. A comprehensive weed control program is essential to ensure vigorous growth during spring in the lead-up to bulb formation. Correct weed identification is critical to getting the timing right and making the correct herbicide choice. Awareness of any localised problems with herbicide resistance, such as resistant ryegrasses, should also be taken into account when considering herbicides.

Use of mechanical weeding can reduce a reliance on herbicides. However, row spacings need to be appropriate to enable light cultivations without damaging the crop.

A range of pre and post-emergent herbicides are registered for both grass and broadleaf weed control in onions. Timing is critical for application of these products. For instance, problem weeds such as wireweed (*Polygonum aviculare*) should be treated at the pre-emergent or cotyledon leaf stage to be effective. Although grasses are easily controlled at more advanced growth stages, some broadleaf weeds are impossible to eradicate once mature and hand-weeding will need to be employed to reduce problems at harvest.

More details on pesticides available for use in onions can be obtained on the InfoPest CD Rom — contact InfoPest, Animal and Plant Health Service, (07) 3239 3967 or at: *www.dpi.qld.gov.au/aphs/infopest*

HARVESTING AND CURING

Although mechanical harvesting is used to harvest most of the Australian onion crop, more than 70% of the NSW onion crop is still harvested by hand. Rising costs and an increasing insecurity about labour availability has forced some growers to look at mechanical harvesting.

Until recently, onion harvesters were either custom-built or were modified potato harvesters with, typically, great variations in performance. The introduction of purpose-built onion harvesters from the United States, modified to suit local conditions, in the early 1990s has, however, revolutionised the harvesting process and has brought about a marked improvement in the quality of the harvested crop.

While there is an immediate saving in labour costs from using mechanical harvesters, capital costs for both the harvester and other essential equipment is high and bulb damage can be significant if correct harvest procedures aren't followed. Mechanically harvested bins can also contain significant amounts of green onion

tops, weed species, damaged onion bulbs, and other sources of moisture. This makes effective curing difficult and increases the risk of disease developing after harvest.

Soil type also has a significant influence on the suitability of mechanical harvesting. Soil clods are often the biggest problem with harvesting as they can cause bulb damage as they bounce around on the conveyors. Sandy soils of low clay content are the most suitable but, with careful soil conditioning and the use of light irrigations to soften soil close to harvest, bulb damage can be minimised on clay soils.

Curing of onions is essential. Although usually associated with onions intended for long periods of storage, curing is also important for onions which are picked and packed for immediate marketing. Even though most of the NSW onion crop is marketed within six weeks of harvest, curing can still add value to the marketed product and minimise risk of losses at the market place.

Field curing and in-shed forced air curing are common in Australia. Field curing is carried out in Tasmania and Victoria. However, in the warmer production regions, the risk of sunburn is too great. In the NSW Riverina, onions are generally harvested when 80 per cent of the plant tops have collapsed. Top-collapse is an indication that the bulb is going into dormancy, respiration is slowing down and, therefore the bulbs' 'in-built cooling' system is shutting down. The high risk of heatwave conditions from December–February in the Riverina prevents large-scale field curing of onions.

Hand-harvesting involves several steps. On heavier soils, crops ready for harvest are generally undercut the evening prior to harvest to make hand-lifting easier. Onion bulbs are picked into buckets and then loaded into half-tonne bins. Pickers should be trained in correct topping and tailing of onions. Care

Forced air tunnel curing systems are a cost-effective method of removing field moisture and curing the outer skins of onions harvested in the Riverina summer.

A purpose-built onion harvester in action.

should be taken when topping to leave at least one centimetre of neck. To ensure the core temperature of onions can be reduced quickly once they are transported to sheds, harvesting operations should cease once temperatures exceed 38˚C.

Onions brought from the field in bins should be stacked in rows with air gaps to enable good airflow. Wooden bins with relatively large gaps allow better passive air movement than plastic bins. However, under forced air curing, plastic bins tend to provide better airflow into the middle of the stack than do wooden bins.

In recent years, in-shed forced-air curing has been increasingly used, particularly for mechanically harvested onions or where there is a high-risk of disease developing after harvest. Research conducted during the 1980s and repeated recently has confirmed the benefits of curing onions destined for the fresh market. Generally, onions in bins are brought from the field and stacked in rows with large exhaust fans at one end. Tarpaulins are used over the stack to direct the air through the bins. For an 80-bin stack, a minimum airflow rate of 800 m^3/min is required. As long as ambient temperatures are high and relative humidity is low, curing can be completed in three days. In Tasmania and South Australia, onions are stored in large sheds in bulk. In-floor air vents are used in these situations to force air up through the stack.

PEST AND DISEASE MANAGEMENT

Effective pest, disease, and weed management are critical for successful onion-growing. Onions grown in the NSW inland, although relatively free of serious pest and disease problems, sporadically suffer from severe outbreaks of particular diseases. Aspergillus black mould and downy mildew can both cause serious economic losses. Broadleaf weeds also rate as a major constraint to crop yields.

The major diseases of onions in NSW are downy mildew, aspergillus black mould, and botrytis.

- Downy mildew *(Peronospora destructor)* infests onion crops in NSW during spring. The critical temperature for infection is between 10 and 15˚C combined with periods of high humidity which can result in free moisture on the leaves. This fungal infection can originate from older disease crops, volunteer onions, or debris from previous crops. It is generally spread by wind-blown spores from infected leaves and in rain splash from infected soil. High density crops tend to be more prone to downy mildew as air movement is usually restricted. Infection commonly commences after furrow irrigations, which often cause high humidity. Spray irrigation, therefore, can be used to minimise infections. Overhead sprinklers can also be utilised to wash fungal spores from leaves.
- Aspergillus black mould *(Aspergillus niger)* is a post-harvest disease which has its origins in the field. Hot temperatures at harvest time, combined with high relative humidity, favour the disease. High plant nitrogen levels and late irrigations, particularly near top collapse, can also contribute to the disease. This fungus can survive for several years in the soil and will readily infect crops when the right temperature and humidity levels are reached. Old crop debris is also a major source of infection. Control is best achieved through forced air curing, which rapidly dries out the outer leaves where the disease develops. Storage at less than 10˚C also inhibits development of Aspergillus.
- Botrytis *(Botrytis allii)*, or neck rot, is a problem in cooler years. It involves softening and rotting of the neck region of the onion while in storage. The source of this infection is usually from seed, volunteer plants, and crop debris. Poor hygiene on the farm is also a major contributor to this disease's development. Excess nitrogen levels can also result in thick necks, making curing more difficult. Injury to bulbs at harvest and grading also increases botrytis infections.

Other diseases of onions in NSW include damping-off (*Pythium* spp. and *Phytophthora* spp.), purple blotch (*Alternaria porri*), pink root (*Pyrenochaeta terrestris*) and Fusarium basal rot (*Fusarium oxysporum*).

Major pests of onions include thrips, cutworm and seedling maggot.

- Onion thrips (*Thrips tabaci*) are small, slender insects about 1.5 mm long which, in large numbers, kill seedlings. In older plants, damage by thrips may cause crops to mature early and, subsequently, reduce yield. Thrips can also act as vectors of virus diseases. If they persist through to harvest, they can also reduce product quality and jeopardise export

opportunities. Plants are most susceptible at early bulb development. Thrip numbers of around 10 a plant can result in significant yield losses. Monitoring of crops from early September is recommended. However, the application of insecticides should only take place once significant numbers of thrips are present.

- Cutworm (*Agrotis* spp.) are soil-borne caterpillars that feed on stem and foliage near ground level, with most feeding occurring at night. By day, caterpillars hide in the soil, at around 1–10 cm deep, with cool, wet conditions favouring infestations. Because of the difficulty in finding grubs in the soil, their presence is often not noticed until substantial crop damage has occurred. Soil-applied insecticides are sometimes used to prevent cutworm damage.
- Onion maggots (*Delia platura)* tunnel into stems of seedlings below ground level, causing wilting and death of plants. The larvae prefer cool, moist conditions and are attracted to decomposing plant material and organic manures and composts. Good ground preparation permitting incorporation of plant material or the use of inorganic fertilisers can lessen the risk of infestation. Insecticides are best applied in a band along the row.

MARKETS

Onions are generally sold in 20 kg net bags for the domestic market. In recent years, more specialised packs for specific markets have been designed by some of the larger packers and grower/packers. One and two kilo pre-packs for direct supply to supermarkets are an example of this.

Onions for the export market are often sold in 10 kg or 15 kg flat packs. Red onions are also sometimes sold in these packs. Cardboard cartons of 10 kg are also used for specialised crops such as mild onions. There is a growing processing market for fresh cut onions for use in restaurants and catering packs. Large globe, low-pungency type onions are generally preferred for this market.

ACKNOWLEDGEMENTS

The assistance of the following people is gratefully acknowledged.

Dr Jenny Ekman, Post-Harvest Laboratory, NSW Department of Primary Industries, Gosford

Dr Mohamad Quadir, Production Research, National Vegetable Industry Centre, NSW Department of Primary Industries, Yanco

Andrew Watson, Vegetable Pathologist, National Vegetable Industry Centre, NSW Department of Primary Industries, Yanco

FURTHER INFORMATION

For more information, see:

Onions 2002, conference proceedings, June 2002, Yanco, NSW.

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InfoPest CD-Rom — contact InfoPest, Animal and Plant Health Service, (07) 3239 3967 or: www.dpi.qld.gov.au/aphs/infopest

and more Agfacts about onions on the Department website.

ISSN 0725-7759

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