

Protected Berry Production: Strawberries and Raspberries[®]

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PROTECTED STRAWBERRY PRODUCTION

Background. The unmet market demand in Japan for strawberries during the Japanese summer period (Months of May—October) is estimated to be approximately 100,000 tonnes per annum. Currently approximately 5,000 tonnes of poorly regarded strawberry cultivars are imported into Japan during the Japanese summer, primarily from the U.S.A. and New Zealand. The production of Japanese strawberry cultivars during the Tasmanian winter (Japanese summer) represented a unique opportunity to supply the Japanese counter seasonal market.

As a result of demand from Japan for out-of-season product, Japanese company New Agri-Network came to Tasmania to explore the possibility of establishing a production site in the state. New Agri-Network established its first greenhouse at Cambridge in 1999, primarily as a model to display the unique style of strawberry production used in Japan. Typically Japanese strawberry production occurs throughout the cooler months of the year in greenhouses. Summer production is limited because of Japans warm humid climate during the summer months.

Later a joint venture company between Strawberry Fresh and New Agri Network was formed in 2001 to produce premium Japanese strawberries for the Japanese export market. New Agri Network was responsible for developing the strawberry production system and marketing the fruit in Japan.

Tasmania's temperate climate and relatively mild winter provide the right conditions to produce greenhouse-grown strawberries for the Japanese counter seasonal market. The states fruit-fly-free quarantine status also enables direct access to this market. Cambridge in the states south was chosen as preferred for its climate and proximity to Hobart airport.

The Production System. The growing system involves propagating strawberry plants in heated elevated growing beds in a greenhouse specifically designed to provide a low humidity climate. Environmental control is achieved through a computer-controlled venting and heating system. The plants are grown in elevated growing beds using a stabilised pine bark/potting medium and nutrients fed via a through a plastic drip system.

Young plug plants are propagated from runner tips and planted into the growing beds in mid-March, with the first fruit ready to harvest in early June. Production period generally ran from June through to early November when local Japanese produced fruit became available. Some production for local sales continued until late December or until warm temperatures made fruit production unviable.

Cultivars. Four Japanese strawberry cultivars were trialled originally including: 'Toyonoka', 'Aiberry', 'Hokowase', and 'Kunawasi'. All these cultivars have low acid, high sugar, and aroma qualities. The Japanese strawberry cultivar Toyonoka was chosen because of its outstanding flavour, texture, and colour. The size of fruit was also a primary consideration as the majority of fruit was destined for the confectionary market, i.e., for cake decoration, a size range of between 12–22 g was required.

Pest and Diseases. The main disease is powdery mildew and effective control is necessary particularly with the 'Toyonoka' which is particularly susceptible in the early growth stages. It is important to commence cover sprays as soon as plants are established. Early applications of sulphur give adequate control. Two spotted mite is generally the only insect pest of commercial significance, and the use of predatory mites provided adequate control, particularly if introduced early in the production cycle. Pest and disease control is centred on integrated pest and disease management (IPM) control measures.

Conclusion. Unfortunately the project has had limited success to date due to high production, packing, and transport costs. 'Toyonoka' was also very difficult to grow because of its susceptibility to a range of pests and diseases, the small berry size impacted on production costs increasing both picking and packing costs. A number of alternative selections were trialled with limited success due mainly to their poor acceptance in the Japanese market place. Unfortunately the Japanese market is extremely traditional and slow to accept change.

PROTECTED RASPBERRY PRODUCTION

Background. In recent years there has been increasing interest shown both in Australia and overseas in protected production of *Rubus* crops, particularly red raspberry cultivars. Greenhouse production has the advantage of guaranteed supply to the market place and alleviating problems associated with disruptions in supply due to adverse weather conditions and the ability to produce very high quality fruit.

Also a key advantage with greenhouse raspberry production is the extension of the season and production period to take advantage of high prices (up to \$45/kg) created by short supply between the months of May and November. Other advantages of greenhouse production include high quality fruit both in terms of colour, flavour, and higher yields with less second-grade fruit, compared with field-grown raspberries.

Trials. Strawberry Fresh Pty Ltd has been trialling greenhouse raspberry production for over 4 years at Cambridge in Southern Tasmania. The trials include varietal and substrate selection as well trialling a number of production systems. Also during this time a number of study tours have been undertaken both domestically and overseas to gain experience in this type of production.

In 2006 I was fortunate enough to be awarded a Churchill Fellowship to study greenhouse production overseas. My travels included the U.S.A., U.K., Belgium, and Holland. Of particular interest was production systems and chilling techniques used in greenhouse raspberry production in Belgium and Holland; these two locations are world leaders in greenhouse raspberry production. The production and chilling techniques used allow for a major extension of the growing period; when translated to our conditions and season in Tasmania, raspberries can be grown in the months of May through to November, when there is little or no fruit available on the Australian domestic market.

The system for forced chilling observed overseas (canes kept in cool store to accumulate chilling hours) has not been used commercially in Australia. Initial trials were conducted at the Strawberry Fresh greenhouse facility at Cambridge and these confirmed the information gained from overseas experience. Techniques observed in Belgium indicated it is possible to force chill raspberry canes by storing

them in cool store for a period of 2 months, it was also observed it is possible to store canes for as long as 4–5 months at temperatures of -2 °C.

Cultivars. A number of cultivars have been trialled to establish their suitability for greenhouse production including: ‘Chilliwack’, ‘Tulameen’, and ‘Joan Squire’. ‘Tulameen’, a florican cultivar, has shown the most promise because of its above average yield, as well as having best flavour and colour. ‘Tulameen’ also performed very well with consumer taste testing and also with shelf-life testing conducted throughout the production period. ‘Tulameen’ is also one of the most widely grown cultivars in Belgium, Holland, and the U.S.A.

Production System. The production system is based on producing fruit in a hydroponic greenhouse environment. Raspberry canes are grown in 10-L plastic pots with two canes per pot, a growing medium consisting of either composted pine bark or coco coir/coco peat mix. Drippers were placed in each pot and plants were fed a balanced nutrient mix to stimulate growth and produce volumes of sweet, high coloured fruit.

To produce winter fruit, the potted canes are introduced into the greenhouse in early March, flowering would initiate after approximately 6 weeks and fruit harvest commence after a total of 12 weeks. The first ripe fruit can be harvested in mid to late June, with the harvest period generally lasting up to 60 days. Bee hives are introduced into the green house just prior to flowering to provide pollination. Generally one beehive needed per 1000 m² of greenhouse space is sufficient for pollination.

Once established in the greenhouse the canes are then trellised onto wires and the subsequent lateral growth is then trellised behind strings. Adequate trellising is vitally important to manage plant growth and to make harvesting fruit more efficient.

In early trials the fruit was harvested into picking buckets, chilled and then packed into punnets. In later trials it was found to be much more efficient to pick the fruit directly into punnets on trolleys. The fruit was then chilled, weighed, and held in cool store until delivery to market. Fruit sales included local premium Tasmanian outlets, with the majority of fruit sold in Melbourne, Sydney, Adelaide, and Perth. Fruit is generally road-freighted to local and Melbourne destinations and air freighted to outlets in Sydney, Adelaide, and Perth.

Once the fruiting canes had finished producing they were removed, leaving two new replacement primacanemes for the next season’s production. The pots were then removed from the greenhouse and placed outside for a brief period and then stacked in storage bins and placed back into cool store to force chilling until ready to be returned to the greenhouse to produce fruit. Generally plants will last for 3 years in the pot, but our trials show yields reduce by approximately 25% for each year of production. After 3 years plants are replaced. New plants are continually propagated to replace the old ones.

Although raspberries do not require high light levels, supplemental lighting during the winter months will improve yields by up to 10%. Particularly during the months of June-August, it may be necessary to use supplemental light to improve yields.

There are various techniques to produce canes for greenhouse raspberry production. Bare-rooted long canes can be lifted from the field after natural winter chilling are then re-planted into plastic pots and then transferred to the greenhouse. Alternatively canes can be propagated in pots from root pieces. This technique involves

placing a small amount of root piece directly into a 10-L pot containing the growing medium in the late winter period. The pots are then lined out under irrigation for 6 months to grow at least two canes per pot. The strongest canes are selected in each pot and the balance removed. As the canes grow, bamboo stakes are used to provide stability. Once the canes should reach a height of 1.8 m, by late January, they are then placed in storage bins and cool stored for a minimum 8 weeks to accumulate the necessary chilling hours. This type of propagation gives the grower flexibility to stage fruit production over a greater length of time, having the canes in cool storage enables the canes to be placed in the greenhouse in regular intervals over an extended period of time. Canes propagated from root pieces are also more productive than bare-rooted long canes.

Pest and Disease Control. Raspberries produced in a protected environment are less prone to pest and disease out breaks. Integrated pest management techniques which require minimal use of chemicals are all that is necessary to control pests. Two-spotted mite is the only pest of commercial significance and can be controlled using predatory mites (*Phytoseiulus persimilis*). Greenhouse production can be promoted as attractive alternative from a food safety angle as minimal chemicals are used.

Future. In 2007 Raspberry Holdings was formed to commercialise trials undertaken to produce high quality raspberries for the out-of-season, domestic market. The new company based the production system on recent trials designed to produce superior quality fruit with exceptional colour and flavour.

The trials were conducted in Raspberry Holdings twin-skin poly-covered greenhouses at Cambridge which proved very successful, producing approximately 6000 kg of fruit. These volumes were slightly down on our target yield of 1200 g per pot and indicated that twin-skin plastic does not allow sufficient light penetration throughout the winter/early spring period when light levels are traditionally low. On a positive note, prices achieved for fruit where on average above expectations, fruit quality was excellent, and feedback from customers was very positive.

The company now intends to move production from plastic to a glasshouse facility, the increase in production expected to compensate for the higher capital cost of building glasshouses. Our aim is to gradually scale up production over the next 2 years as new nursery material comes online.