

TRUFFLES



An R&D program managed by the Rural Industries Research and Development Corporation

At a glance

Truffles, specifically *Tuber* species, are a relatively new crop in Australia, where the industry has undergone significant expansion since its beginning in the early 1990s.

Truffles are the fruiting bodies of underground fungi that form symbiotic mycorrhizal relationships with the roots of certain tree species. They naturally occur in the woodlands of France, Italy, Spain, Portugal, Bulgaria and parts of the former Yugoslavia. Research in France in the early 19th century developed the capability to cultivate some species as a semi-domestic crop, and research in New Zealand and Australia has given rise to the industry in Australia, where seedling roots are directly inoculated with truffle spores before planting.

Australian production is focused on the French black or Périgord truffle (*Tuber melanosporum*), which is native to Europe and grows on the roots of oak and hazelnut trees. First harvested in Tasmania in 1999, Périgord truffles are now also grown in Western Australia (where at least 70 per cent of national production takes place), and the highland areas of New South Wales, Victoria, South Australia and south-eastern Queensland. Other species cultivated in Australia are the Burgundy or summer truffle (*T. aestivum*) and the Italian whitish or bianchetto truffle (*T. borchii*).

Land under truffle production in Australia grew from 250 hectares in 2007 to about 600 hectares in 2012, while truffle production increased from 800 to almost 4,500 kilograms over the period. The 2013 crop value was approximately \$9.6 million from a crop of 8,000 kilograms.

Industry growth has been driven primarily by investment but there is potential for increased demand from domestic and northern hemisphere export markets; the latter a response to the decline of wild harvested truffles from Europe.

Australia is the largest supplier in the southern hemisphere. Most of its production is exported into developing markets across Europe and the US during the northern hemisphere's off season, and to the burgeoning South-East Asian markets.

Fresh truffles, harvested from late June to early September, attract the highest prices, while frozen and value-added truffle products offer a significant 'import replacement' opening for Australia.



Image courtesy the Canberra and Capital Region truffle festival

There are more than 200 truffle growers nationally. Many orchards have yet to reach productive stage (about seven years from planting) while several areas are struggling to produce, despite trees having reached maturity.

Truffles develop in areas with wet, cool winters and warm-to-hot summers, but local soil conditions and microclimate appear to have an important influence. Forming in summer and maturing in winter, truffles emit an intense aroma that can be detected by trained dogs or female pigs.

Sources: Australian Truffle Growers Association; Foster, M. 2013, *Emerging industries: their value to Australia*, RIRDC Report 13-062, Canberra

Research and development

Research funded by RIRDC, with contributions from the Australian Truffle Growers Association, has been credited with elevating the industry to a new level of maturity over the last 10 years. RIRDC established a jointly funded truffles sub-program within its New Plant Products program in the 1990s. Between 1999 and 2012, RIRDC invested more than \$360,000 in 23 projects to address areas including:

- Truffle yield
- Diseases
- Biosecurity
- Truffle grading standards
- Audit and certification of inoculated seedlings and trees
- Preserved and value-added products
- Processing and packaging technologies to extend shelf life
- Market analysis and market drivers.

Quantity and consistency of truffle yields has been a priority. This work has included a comparison of genetic diversity between black truffles in Australian orchards and native environments in France to gauge the possibility of genetic drift and its influence on production.

Other research has explored nursery practices in response to observations that some trees had very low levels of inoculum, or were co-inoculated with *Tuber brumale* – a cheaper, inferior quality truffle that may out-compete *T. melanosporum*. Research was also conducted to identify the cause of rot in black truffles and to explore management control options (see case study). Current projects are focused on the development of a nano-sensor to determine key volatile organic compounds that can be used to signify the onset of truffle rot and characterise the truffle proteome (the proteins expressed by the truffle genome), while implementation of a tree certification scheme, development of a grower guide to truffle production, biosecurity planning and optimising truffle shelf life are also R&D priorities for the industry.

The Australian Truffle Growers Association has developed an Australian grading standard to enable the industry to label and brand Australian truffles, and to establish product consistency, differentiation and traceability.

Unearthing the cause of truffle rot



Truffle rot appears to be common to all areas where truffles are harvested worldwide. Since it was documented in Australia in 2008, truffle rot has proven a significant threat to the country's black truffle (*Tuber melanosporum*) industry, resulting in crop losses of up to 50 per cent on some properties.

Manifesting as a soft rot affecting immature and mature truffles, it has been observed in Western Australia, New South Wales, Victoria and Tasmania. Its potential to increase rapidly with the exponential growth in national truffle production prompted research to identify the cause.

A study funded by The Wine & Truffle Company (Australia's largest truffle producer) and the Australian Truffle Growers Association, in partnership with RIRDC, investigated potential microbial pathogens, as well as the influence of soil conditions on rot development.

“When truffles form too close to the surface they become stressed and susceptible to factors including rot-causing fungi,”
– Harry Eslick

Researcher Harry Eslick, who oversees truffle cultivation and processing at The Wine & Truffle Company, found that the development of rot is caused by several factors. The fungal species *Trichothecium crotonigenum* is most commonly isolated from rotting tissue. Truffles exposed at the soil surface were more likely to develop rot than those covered with soil.

“When truffles form too close to the surface they become stressed and susceptible to factors including rot-causing fungi,” Mr Eslick says.

Experiments showed that rot levels were higher with weekly irrigation than monthly irrigation, while weekly irrigation replacing 100 per cent of the estimated water deficit resulted in a higher proportion of truffles above the soil surface and a higher proportion of underground truffle rot.

Mr Eslick found that cultivation significantly reduced truffle rot levels and is confident it will eventually eliminate the need to cover truffles forming at the surface with soil.

“Cultivation reduces soil density, increases soil oxygen and removes surface roots, allowing truffles to form deeper in the soil profile,” he says.

“Growers should also consider reducing the rate and/or frequency of irrigation.”

Mr Eslick says the research indicated 50 per cent replacement of evapotranspiration at monthly intervals provided the best result.

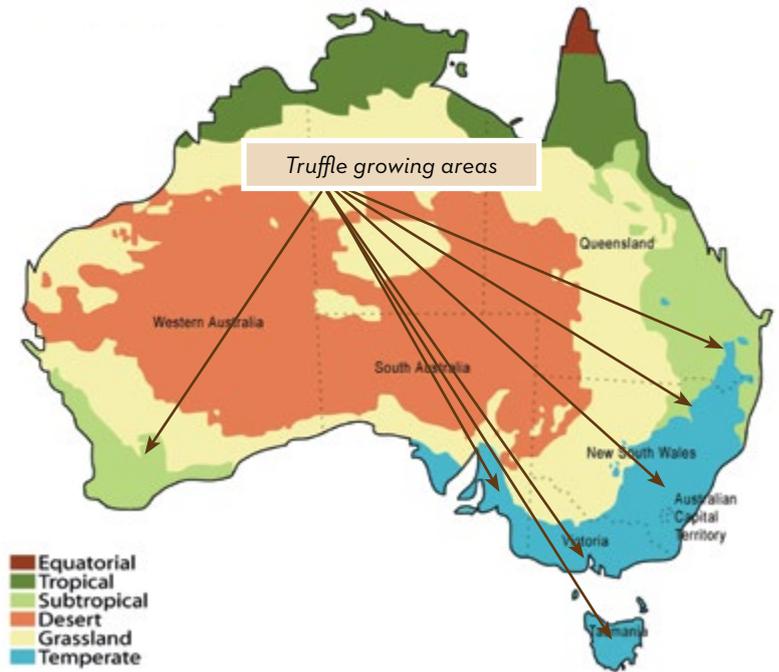
“We recommend somewhere between weekly and monthly; it depends on soil condition and type, the type of trees and their age,” he says.

The study's findings have helped to significantly reduce the level of truffle rot at The Wine & Truffle Company and Mr Eslick predicts management will further reduce rot to between 10 and 20 per cent, a viable level.

Source: Eslick, H. 2012, *Identifying the Cause of Rot in Black Truffles and Management Control Options*, RIRDC Report 12/005, Canberra

Facts and figures

- Truffles have been cultivated in Europe since the early 19th century.
- The Australian industry is dominated by the black Périgord truffle (*Tuber melanosporum*).
- The first Australian truffles were harvested in Tasmania in 1999.
- Land under truffle production in Australia has grown from 250 hectares in 2007 to approximately 600 hectares in 2012.
- The majority of production is exported to Europe, the US and South-East Asia.



Source: Lee, B. 2008, *Taking Stock of the Australian Truffle Industry*, RIRDC Publication No 08/124, Canberra

Truffles: supply, disposal and value in Australia

	Unit	2006	2007	2008	2009	2010	2011	2012
Production								
Truffières	no.	30						>200
Area	hectares							600
Trees	'000							>300
Volume	kg	184	800	na	na	1700	3300	4480
Gross Value	\$'000	377	1640	na	na	2465	3630	5152
Unit Gross Value	\$/kg	2050	2050	na	na	1450	1100	1150

Source: ABS (2013); ABARES.