Enhanced dried grapes types for the Australian industry

Peter Clingeleffer
CSIRO Plant Industry

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ENHANCED DRIED GRAPE TYPES FOR THE AUSTRALIAN INDUSTRY

Report to Horticulture Australia

Project Number: DG09000

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Enhanced dried types for the Australian Industry

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Purpose
This project has built on outputs from previous CSIRO studies supported by HAL (i.e. CSH 17, 24, 54, 60, DG 04003 and DG 01001. It aimed to develop drying varieties that meet market requirements to improve the economic sustainability of dried grape production and enable the industry to meet future challenges associated with production in a variable and changing climate and overcome problems/deficiencies of existing standard varieties. It has evaluated dried grape breeding lines generated in previous projects, particularly in DG04003 (development of rain tolerant drying types). The project has delivered selections for commercial release as varieties; selections for larger scale evaluation under commercial conditions on grower properties and selections for further assessment by industry that have been established in multiplied plots.

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**Media summary**

Production and quality losses associated with rain damage at harvest, the development of mouldy fruit and inconsistent production due to variable fruitfulness and biennial bearing of Sultana are major problems for the dried grape industry. Consequently there is a recognised need to develop rain tolerant sultana types and earlier ripening varieties to extend the growing season to spread production risks.

This project aimed to evaluate new dried grape breeding lines developed in previous projects. New selections, at varying stages of development have been evaluated by harvest, drying and processing in the CSIRO small-scale processing facility. The evaluations included single vine seedling populations, multiplied and top-worked plantings and larger, semi-commercial trials on grower properties.

More than 230 promising seedling types have been identified and established in multiplication plots for future evaluation. Three high yielding, rain tolerant Sultana types, a seedless muscat selection and the low browning, tissue cultured source of Bruce’s Sport have been established in semi-commercial sites on grower properties for future assessment.

Decisions on release of new varieties from the CSIRO dried grape breeding and evaluation program are made by the Unique Dried Grape Varieties Steering Committee which has representatives from growers, processors and marketers, CSIRO and Horticulture Australia Ltd. Two new varieties have been named and released to industry. Commercial mother vine plantings of these varieties have been established to ensure sufficient material is available to industry.

Sunglo, a rain tolerant Sultana type was a joint release with the USDA in 2010. The benefits of Sunglo compared to Sultana are higher and more consistent production, proven rain tolerance, development of a loose bunch structure which minimises risks associated with the development of bunch rots and moulds and facilitates the application of drying emulsion.

The second variety, Black Gem®, was released with PBR protection in 2011. It is an early ripening, disease resistant currant that can be grown without application of sprays for fruit set or of fungicide sprays for disease protection that are required for other currant varieties. Hence it is suited to low chemical or organic production. Fruit of Black Gem® has also been used to produce a high quality grape juice.
Technical Summary

The project was designed to provide a direct benefit to the Australian dried vine fruits industry. It aimed to develop drying varieties that meet market requirements that would improve the economic sustainability of dried grape production and enable the industry to meet future challenges associated with production in a variable and changing climate and overcome problems/deficiencies of existing standard varieties.

Nature of the problem

Production and quality losses associated with rain damage at harvest, the development of mouldy fruit and inconsistent production due to variable fruitfulness and biennial bearing of Sultana are major problems for the dried grape industry. Key markets have introduced stringent minimum standards for Ochratoxin A that could render a significant proportion of Sultana production unmarketable in future wet seasons. Consequently there is a recognised need to develop rain tolerant sultana types and earlier ripening varieties to extend the growing season to spread production risks. Other desired attributes for a new dried grape variety include types with high water use efficiency based on short seasonality, high fruit to leaf ratios and high productivity; types suited to new product development, differentiation and niche marketing; and disease resistance types to reduce the use of chemicals for fungal control and suited to other market categories, e.g. organics.

Science undertaken

New selections, at varying stages of development established in previous studies (DG 04003), have been evaluated at harvest and by drying and processing in the CSIRO small-scale processing facility. These stages include single vine seedling populations, multiplied and top-worked plantings and larger, semi-commercial trials on grower properties. Promising seedling selections have been identified, propagated and established in multiplied blocks or on semi-commercial sites on grower properties.

Major research findings and industry outcomes

A total of 238 seedling genotypes were identified in seedling populations at CSIRO Merbein and established in multiplication plots at the CSIRO Sunraysia site for future evaluation. A further 250 selections of interest, including material that may be required for future Plant Breeders Rights (PBR) purposes, were also propagated and planted as single vines at the site. Current plantings established at the CSIRO Sunraysia site include 1400 single vine seedlings, 336 multiplied, grafted and top-worked selections and the 250 selections of interest retained as single plants. Three rain tolerant Sultana types, an unnamed USDA muscat selection and the low browning, tissue cultured Bruce’s Sport have been established in semi-commercial sites on grower properties for future assessment under commercial conditions.

Two new varieties have been named and released for industry adoption from the project. Sunglo, a joint release with the USDA in 2010, is a high yielding, rain tolerant Sultana type. In the semi-commercial trial conducted over a period of six years, Sunglo consistently produced more (53%) higher quality dried fruit than Sultana, displayed high rain tolerance and developed a loose bunch structure which minimises risks associated with the
development of mould, bunch rots and Ochratoxin A and facilitates the application of drying emulsion.

The second variety released, with PBR protection, was the early ripening, disease resistant currant selection, M 48-42 (syn. Black Gem®). Black Gem® does not require fruit-setting or fungicide sprays which should enable product development based on low chemical use or organic production. Fruit of Black Gem® has also been used to produce a high quality grape juice indicating significant potential for the production and development of markets for an organic grape juice with high health benefits associated with its high anti-oxidant activity.

**Future work and recommendations**

Dried fruits Australia (DFA) have submitted a project proposal to HAL which aims to complete the evaluation of CSIRO material in the breeding pipeline that is planted on the CSIRO Sunraysia property and also the evaluation of lines established on semi-commercial sites. In consultation with CSIRO it will identify selections for release to industry. It is recommended that as part of the new DFA project the main activities to be undertaken will be to:

- Complete vine training and establishment of selections planted on the CSIRO site and the 3 top-worked selections on the semi-commercial grower site.
- Monitor performance of selections on semi-commercial grower sites (i.e. 7 light coloured selections and tissue cultured Bruce’s Sport).
- Complete the evaluation and culling of remaining seedling material.
- Evaluate multiplied, top-worked and grafted selections planted on the CSIRO Sunraysia site and identify, in consultation with CSIRO, material for further development, retention or culling.

Furthermore it is recommended that CSIRO should:

- Implement discussions with the USDA in regard to release and commercialisation of the promising unnamed seedless, muscat selection.
- Liaise with DPI Victoria, Knoxfield to confirm virus status of the tissue cultured Bruce’s Sport and liaise with industry in regard to finalising release strategies if test results are satisfactory.
**Introduction**

The Australian dried grape industry is faced with new and evolving challenges surrounding production in a changing and variable climate, limited water supply and increasing consumer and regulatory demands with respect to product integrity and environmental responsibility. Hence there is a need for seedless drying types that have high water use efficiency which can be achieved by short seasonality, high fruit to leaf ratios to minimise transpiration and high productivity; types that have rain tolerance to minimise production and quality losses, and address the issue of mould and Ochratoxin A development in wet seasons; types with disease resistance to reduce the use of chemicals for fungal control and suited to other market categories, e.g. organics; and, new types for product differentiation and/or niche marketing.

CSIRO Plant Industry has maintained a vine improvement program to provide the viticultural industries with material suited to Australian conditions and industry needs. CSIRO’s dried grape breeding and evaluation program has been overseen by the ‘Unique Dried Grape Varieties Steering Committee’ to ensure that the program is consistent with industry needs, to identify selections with most potential and to facilitate their commercial adoption. Members of this committee include representatives from all industry sectors (production, processors and marketers), HA Ltd and researchers. This project will complete the evaluation of material generated in previous projects, particularly in DG04003 (development of rain tolerant drying types) with the aim to identify selections for commercial release to industry with PBR protection; selections for larger scale evaluation under commercial conditions on grower properties or for further assessment by industry.

In the CSIRO dried grape breeding and evaluation program, new seedless drying varieties have been developed by hybridisation or have been imported and maintained in the CSIRO germplasm collection. Varieties released for dried fruit production from the breeding program include Carina (1975), Merbein Seedless (1981), Marroo Seedless (1988) and Sunmuscat (1997). Two new selections, an early ripening disease resistant currant type and a high yielding rain tolerant sultana type, established on grower properties for evaluation under commercial conditions have been identified as having potential for commercial development. A propagation strategy, to ensure sufficient material is available if either of these selections is released to industry was implemented in the previous project (DG04003).

Previous studies evaluated the range of seedless varieties in the germplasm collection (Newman and Clingeleffer 1987) and identified large berried types as potential alternatives to seedless raisin varieties or for specialty lines. The best of the large berried types were included in CSH17 (‘integration of alternative drying varieties with low input, production systems of management’). Ongoing support has been provided by DFRDC/HAL since 1992 for trial establishment and evaluation of small and large berried Sultana types, new currant types, specialty lines, new raisin selections and disease resistant lines or breeding lines from in-ovulo embryo rescue (CSH24 and 54), development of unique Australian dried grapes varieties (DG01001) and development of rain tolerant sultana types (DG04003).

Key trials established in the previous project (DG04003) for yield and quality assessment included:

1. Seedling populations developed from seedless by seedless crosses or crosses aimed at introduction of disease resistance genes.
2. Selections of promising types identified in seedling populations which were established in multiplication plots in the field.
3. Selections identified for rapid assessment by top-working on established vines.
4. Selections established for semi-commercial evaluation on 3 grower sites.

The current project (DG 09000) was designed to provide a direct benefit to the Australian dried vine fruits industry. It aimed to develop improved drying varieties which meet production, processing and marketing characteristics with potential to enable the industry to meet future challenges associated with production in a variable and changing climate and overcome problems/deficiencies of existing standard varieties. At the completion of the project it was anticipated that new seedless drying types would be made available to the industry for further development and adoption.
Method and activities

Activities

The main activities undertaken in the project were:-

1. The field establishment of new seedling populations produced by in-ovulo embryo rescue techniques and disease resistant crosses in DG04003.

2. The evaluation of fruit from seedlings, multiplied selections and semi-commercial sites which included monitoring of maturity and conduct of harvest, drying and processing.

3. The identification, multiplication and establishment of promising selections from seedling populations under modern management practices.

4. Facilitation of the adoption and extension of results to industry.

Methods

The project aimed to complete the evaluation of material generated from breeding studies conducted in previous projects, in particular genotypes generated from seedless x seedless crosses using in-ovulo embryo rescue techniques in the previous project (DG 04003). This involved land preparation, trellis installation, collection of cuttings and propagation in winter, vine planting and training of seedlings in spring and annual maintenance of established plantings (i.e. fungicide and herbicide application, irrigation, cultivation). In addition, poor performing selections established in a semi-commercial site on a grower property were top-worked with promising selections.

Material for evaluation in this project included:-

1. Seedling populations developed in the previous project, from seedless by seedless crosses or crosses planted at the CSIRO Merbein and Sunraysia sites that aimed at introduction of disease resistance genes.

2. Selections of promising types identified in seedling populations established in multiplication plots in the field at the CSIRO Merbein and Sunraysia sites. At the commencement of the project there were about 100 multiplied selections established in the field. A further 20 were identified for establishment in season 2008. Further promising types were propagated and established in the field each spring.

3. Selections identified for rapid assessment by top-working on established vines planted at the CSIRO Sunraysia site. At the commencement of the project there were about 30 selections in this category with 8 new selections grafted onto established rootstock material (i.e. Ramsey and 1103 Paulsen) in spring 2008.

4. Selections established for semi-commercial evaluation on grower sites. These included a one hectare planting of an early ripening, disease resistant currant selection; a site with 7 light coloured selections grafted on 1103 Paulsen and Ramsey (i.e. 50 vines of each) and a one hectare site of a light coloured, rain tolerant sultana type which has been top-worked on existing Sultana vines grafted on Ramsey.

5. Unnamed imported material in the germplasm, e.g. the Muscat type, C88-89.
Routine drying assessments of the material identified above involved:

1. Pre-harvest sampling for berry weight, determination of total soluble sugars using a refractometer and titratable acidity and pH using an auto-titrator.
2. Measurements of yield, and if appropriate bunch number.
3. Drying as naturals and or after treatment with drying emulsion on racks, by trellis drying (in semi-commercial site) or by artificial dehydration.
4. Processing in the small-scale, CSIRO processing plant.
5. Product evaluation, including colour and its uniformity, moisture, berry size, flavour etc., processing and storage characteristics.
6. Samples of the best selections were submitted to the 'Unique Dried Grape Varieties Steering Committee' and where appropriate to processors and marketers for preliminary market testing.

Furthermore, for one selection (M 48-42), a PBR application was prepared and submitted to the Plant Breeders Rights Office. A US Plant Patent application was also prepared and submitted for this selection. Both applications required collection of detailed information of ampelographic characteristics and other descriptor information as required in the documentation. In the case of the PBR application, a replicated comparator trial to demonstrate distinctness, uniformity and stability (DUS) of the selections was established and maintained under shade-house conditions.

Industry oversight and commercialisation

CSIRO’s dried grape breeding and development has been overseen by the 'Unique Dried Grape Varieties Steering Committee' to ensure that the program is consistent with industry needs, to identify selections with most potential and to facilitate their commercial adoption. Members of this committee include representatives from all industry sectors (production, processors and marketers), HA Ltd and researchers.

The project aimed to develop new drying varieties for adoption and or, further evaluation by the Australian dried fruits industry. The release of new drying varieties has been dependent on development of a commercial path with PBR protection. This has involved establishment of mother vine plantings, propagation and grafting of material through licensed propagators to deliver material for vineyard planting. The dried products have and will be delivered only to registered processors for marketing purposes. Varietal leaflets have been developed to support introduction of released varieties.

The selections F64-74 (released as Sunglo) and C88-89 which were evaluated in this project were originally unnamed USDA selections which were released to CSIRO for testing. At the commencement of the project it was anticipated that a joint release between the USDA and CSIRO would be undertaken if recommendations were made to release to industry.
Evaluation

1. Climatic conditions

The evaluation of the dried grape material occurred over 3 harvest seasons (2010, 2011 and 2012) with very contrasting climatic conditions. The 2010 harvest season suffered from hot, dry (drought) conditions during the growth period, although a number of rainfall events over the harvest drying period caused darkening of many fruit samples. In that season approximately 3.5 ML/ha of irrigation water was applied at both the CSIRO Merbein and Sunraysia sites. The 2011 season was the most difficult season ever experienced by dried fruit growers due to a number of record breaking rain events, high humidity and cool conditions during spring, summer and early autumn. For example, over the season from budburst to harvest, more than 767 mm of rain was recorded at one of the semi-commercial sites. Consequently, there were major problems with disease (i.e. downy mildew, powdery mildew, botrytis and other bunch rots) and slow sugar accumulation during berry development. Significant rain damage to the sultana and currant crops was experienced due to berry splitting and berry drop following major thunderstorm activity accompanied by high rainfall (approx. 200 mm on 4th February) and flooding across the Sunraysia district. Growers implemented trellis drying processes in early February, in an attempt to salvage some crop despite the fruit being immature. Drying conditions continued to be unfavourable for the rest of the season due to further rainfall events, high humidity and occurrences of fog leading to delayed drying and harvest, darkening of all varieties and development of mouldy fruit. Drying conditions in season 2012 were very favourable for most of February with maximum temperatures up to 38°C. However a number of rainfall events occurred in late February and early March which led to severe darkening of Sultana fruit during the latter stages of drying and significant problems with Botrytis development in Sunmuscat, which is later maturing than Sultana.

2. Evaluation of seedling populations

Seedling populations containing approximately 5000 hybrid plants established at CSIRO Merbein were evaluated in seasons 2010 and 2011. Fruit from 3 seedlings was also dried from new populations established at the CSIRO Sunraysia site in season 2012. All grapevine material was removed from the Merbein site in September 2011. Each season individual seedlings (i.e. 200 in 2010 and 90 in 2011) were harvested and racked dried after treatment with drying emulsion, except for selections with black berry colour which were dried naturally without treatment. Berry samples were also collected to determine berry weight, total soluble solids and titratable acidity. Dried grape samples were evaluated against a range of criteria, i.e. berry size, colour, uniformity and flavour. The seasonal conditions provided an opportunity to assess potential drying selections for rain tolerance. Each winter, cutting material from the most promising selections was collected and propagated to establish multiplication blocks as own rooted vines or for top-working onto existing rootstock material to speed up the evaluation process.

During the project a total of 238 promising selections (100 identified in the previous project, DG 04003 in 2009, 108 identified in 2010 and 30 identified in 2011) have been planted and established in multiplication blocks at the CSIRO Sunraysia site. In addition, a further 250 selections have been propagated and planted as single vines at the CSIRO Sunraysia site. The latter includes material that may be required for future Plant Breeders Rights (PBR) purposes. Training of all vines to establish the plantings was ongoing during the project.
Current plantings established at the CSIRO Sunraysia site, following culling in winter 2012, include 1400 single vine seedling selections which include the final plants from crosses between seedless parents made in spring 2007 and produced using in-ovulo embryo rescue techniques which were planted spring 2009, 336 multiplied, grafted and top-worked selections and the 250 selections of interest retained as single plants. The seedling populations include approximately 500 produced from seedless x seedless crosses which were developed using in-vitro, embryo rescue techniques.

3. Evaluation of multiplied selections

Over the period of the project, a portfolio of more than 60 multiplied and top-worked selections which was established in the previous project (DG04003) has been available as mature vines for evaluation. Each year dried fruit was produced from these selections and assessed as described for seedling material described above, although in season 2012 trellis drying was implemented for multiplied selections which were in full bearing on modern hanging cane or swing-arm trellis systems. The portfolio of multiplied selections included 39 light coloured sultana types of which 22 are potentially disease resistant; 16 which produce small berries; 3 which are very early ripening and 5 which produce larger berries. It also included 12 muscat types of which 5 are potentially disease resistant with one very early ripening type and 3 black berried, currant types potentially with disease resistance. The smaller light coloured disease resistant types may also be useful for currant production if dried as naturals. A number of selections were not harvested due to major losses associated with rain damage in season 2011. Most of the multiplied selections, which were identified in seedling populations at Merbein and established as part of this project at the CSIRO Sunraysia site have not produced a crop.

Over the course of the project fruit was harvested and dried from a total of 90, 60 and 100 multiplied and top-worked selections in 2010, 2011 and 2012 respectively. As discussed above, the seasonal conditions provided an opportunity to assess potential drying selections for rain and disease tolerance in season 2011. In season 2012, 42 of the multiplied and top-worked selections established on the CSIRO Sunraysia site and trained on high cordon based trellis systems were trellis dried after application of drying emulsion. The others were either dried on small drying frames at the CSIRO site or rack dried using facilities at DPI Victoria. Samples were ‘finished off’ to achieve acceptable final moisture levels by ground drying or by dehydration using facilities located at DPI Victoria, Irymple. Samples of promising selections dried in season 2010 and 2011 were viewed by the Unique Dried Grape Varieties Steering Committee each year. Drying of the samples from the 2012 season was not completed when the steering committee met in May 2012. Dried grape samples have been retained in cool storage for further assessment as part of a new industry led project.

Over the project period, 4 new selections were identified for establishment in semi-commercial plantings on a grower property. The first selection identified was an unnamed imported muscat selection from the USDA which was top-worked onto a discarded poor performing selection at the semi-commercial site in spring 2009. C88-89 has produced high yields, has a degree of rain tolerance and develops more muscat character than Sunmuscat in the dried fruit product. A further 3 high yielding Sultana types which had good rain tolerance in season 2011 were top-worked onto further discarded selections at the semi-commercial site in spring 2011.
4. Evaluation of selections on semi-commercial grower sites

Three grower sites for evaluation of selections under semi-commercial conditions were established in the previous project (DG04003) and were in full production for assessment in the current project. They included a site with seven light coloured selections grafted on 1103 Paulsen and Ramsey, a one hectare planting of an early ripening, disease resistant currant selection and a one hectare site of a light coloured, rain tolerant Sultana type which had been top-worked on existing Sultana vines grafted on Ramsey. A further semi-commercial site for the low browning Bruce’s Sport clone of Sultana, developed using FSAC (Fragmented Shoot Apex Cultured) to remove viruses, was established during the course of the project.

4.1 Light coloured Sultana types

Seven light coloured selections were established previously in a semi-commercial trial by grafting on two rootstocks, 1103 Paulsen and Ramsey. For most selections, two 60 vine rows were established. The rootstocks were planted in 2004, grafted in spring 2005 and trained on a single bi-lateral cordon with a Shaw swing-arm trellis installed in winter 2009. The planting included: 4 rain tolerant Sultana types, including Canner Seedless, F 64-74 (the selection now released as Sunglo) and two unnamed CSIRO selections; two early ripening, disease resistant small-berried types; and, one selection with an attractive long berry.

Based on feedback from the Unique Dried Grape Varieties Steering Committee one of the early ripening, disease resistant small-berried types was discarded from further evaluation as it produced very tight bunches which were difficult to treat with drying emulsion and the market demand for such a small berried product type was limited. Vines of this selection were top-worked with the promising unnamed USDA muscat selection in spring 2009. These vines produced some crop in 2011 and 2012. Two further selections were discarded from further evaluation after the 2011 harvest based on fruit quality and rain tolerance. These were the remaining disease resistant small berried type which had produced an unacceptable, mottled dried fruit product in both the 2010 and 2011 seasons and the selection with an attractive long berry which proved to be very sensitive to splitting and berry drop in the 2011 season. The discarded vines were top-worked in spring 2011 to give a single row of 3 high yielding, rain tolerant selections identified with high potential in the wet 2011 season.

All retained selections grafted on both Ramsey and 1103 Paulsen have produced good yields (generally in the range of 7.5-10.0 t/ha) and acceptable brown fruit when managed on the Shaw swing-arm trellis in seasons 2011 and 2012. Darkening of all fruit samples was associated with the significant rainfall events during drying in both seasons. In the very wet 2011 season it was noted that Canner Seedless and two of the unnamed selections exhibited some tolerance to downy mildew. The performance of Sunglo at the semi-commercial site confirmed its compatibility with both Ramsey and 1103 Paulsen. However, some sunburn of Sunglo bunches was noted on exposed fruit on the western side of the Shaw swing-arm trellis, which suggests that North-West row orientations should be avoided if possible when establishing new plantings and that high vigour rootstocks be used to optimise production and minimise losses associated with sunburn.
4.2. Early ripening, disease resistant currant type

A one hectare planting of the early ripening, disease resistant currant selection (now named and released as M 48-42, syn. Black Gem, see below) was established in 2004 to assess potential for trellis drying on a tall trellis, mechanical harvesting and to provide sufficient fruit for processing and marketing purposes. This was achieved by top-working onto existing vines of Zante Currant, grafted on Ramsey rootstock. First crops were produced in season 2007. The vineyard has been maintained without application of fungicides in all seasons. Black Gem was selected from progeny of a controlled cross between Seyve-Villard 39-639, a complex multispecies, disease resistant hybrid and Beauty Seedless, a black, early ripening table grape variety. The cross was made in spring 1980 with seeds germinated and seedlings planted in the field in spring 1981. The cross aimed to combine the disease resistant traits of Seyve-Villard 39-639 to fungal infection by downy and powdery mildew with the early ripening, seedless traits of Beauty Seedless.

In the previous project (DG 04003) Black Gem showed considerable promise because of its early ripening, disease resistance, potential health benefits associated with high anti oxidant activity and ‘spicy’ flavour. It was readily suited to ‘low chemical’/ organic production and niche marketing and also juice production. In that study it was also noted that Black Gem was likely to be a very water use efficient selection, combining the benefits of good yield and early ripening with low seasonal water use related to relatively small canopy size. In that study Black Gem was very fruitful and consistently produced dry yields of 5 t/ha, similar to Carina planted on a similar site (Figure 4.2.1). Unlike Carina and Zante Currant it does not require treatment with growth regulators to achieve a good fruit set. The previous study also showed that Black Gem is compatible with a wide range of rootstocks, with best results achieved by grafting on Ramsey, 1103 Paulsen and 140 Ruggeri. Dry yields of around 8t/ha were achieved with cane pruned vines managed on a narrow T-trellis on those rootstocks.

In the previous project (DG 04003) it was noted that management of Black Gem on modern, cordon-based trellis systems with hanging canes to facilitate trellis drying was difficult, because some canes arising from the cordon were too short for attachment to lower wires (Figure 4.2.2). Because of this problem, a number of modified pruning treatments were imposed at the site in winter 2009 with the aim to stimulate shoot growth or facilitate alternative approaches to trellis drying. These treatments included a reduction in cordon length and adoption of a split cordon system where hanging canes were only retained on half of the vine. In this study adequate development of replacement canes has been achieved using shorter cordons (Figure 4.2.2), a result which suggests that closer vine spacing’s should be used to optimise production, i.e. 1.8-2.0 m. Currently, the semi-commercial site is successfully managed using an alternating split cordon system where hanging canes are retained on half of the vine while the other side is pruned very hard, back to the cordon leaving only basal buds to produce canes for the following season. At harvest, the cordon is cut to commence drying of fruit on the hanging canes while fruit on the other side is either hand-picked onto the lower trellis wire for drying or removed chemically prior to flowering, following commercial practices developed for standard drying varieties (Figure 4.2.3).

On the recommendation of the project steering committee, a small rootstock trial has been established for Black Gem on the CSIRO Sunraysia site which includes the high vigour rootstock, Dog Ridge and other standards to assess the potential to increase its vigour to facilitate management on modern trellis systems.
Figure 4.2.1. Views of Black Gem® managed on a high cordon before harvest (left) and after cane cutting and crown bunch removal (right).

Figure 4.2.2. Views of Black Gem® managed with a long high cordon (left) and shortened cordon (right). Note that many of the canes retained with the long cordon (left) were too short to attach to the lower wire in winter compared to the short cordon treatment where all canes were attached to the lower wire.

As reported above, vines of Black Gem® have shown higher levels of resistance to downy and powdery mildews than other drying grape varieties and its Vitis vinifera parent, Beauty Seedless. The disease resistance characteristics have been inherited from its parent, Seyve-Villard 39-639. Its disease resistance was confirmed in the unsprayed semi-commercial site during the very difficult, 2010-11 season which experienced record breaking rain events, high humidity, cool conditions and vineyard flooding during spring, summer and early autumn (Figures 4.2.3). In that season the canopies of Black Gem® appeared to be free of downy mildew infection compared to other drying varieties and its parent, Beauty Seedless, which had all been treated for fungicide protection (Figure 4.2.4). A strong hypersensitive reaction to downy mildew infection with development of small necrotic spots without further progression of the disease was noted on the leaves of Black Gem® compared to the severe development of necrotic tissue of Beauty Seedless (Figure 4.2.5). Furthermore there was no evidence of downy mildew, powdery mildew or botrytis infection of bunches in the 2010-11
season, although some berry splitting occurred following major rain events in both January and early February (i.e. a total of 357 mm), prior to cane cutting for trellis drying.

Figure 4.2.3. View of the Black Gem in the semi-commercial vineyard after cane cutting of the split cordon system and after significant rainfall events in February 2010. Note: The full canopy of half the vine is maintained with the split cordon system.

Figure 4.2.4. Canopy views of Black Gem (left) and Beauty Seedless (right) in February 2011 following periods of severe downy mildew infection in spring and early summer. The canopies of Black Gem show no symptoms of downy mildew whereas there is extensive damage to the canopy of Beauty Seedless.
Figure 4.2.5. Mature leaf views of Black Gem® (top) showing necrotic spots typical of the hypersensitive resistant reaction to downy mildew infection and leaves of Beauty Seedless (bottom) showing leaf chlorosis and advanced tissue necrosis, symptomatic of its susceptibility to downy mildew infection.

**Commercialisation of Black Gem®**

Black Gem®, provides growers with an early ripening, disease tolerant alternative variety to Carina and Zante Currant. It can be grown without the use of fungicides and setting sprays and has higher levels of anti-oxidant activity than Zante Currant and Carina. Hence its adoption should enable the industry to meet the ever increasing consumer expectations for organic products with high health benefits. Black Gem® has also shown potential for niche marketing as a table grape variety and for juice and wine production.

Provisional PBR protection has been granted for M 48-42 (syn. Black Gem®) (PBR no. 2011/18). Final data collection, from the replicated comparator trial, will be completed in spring 2012 for key leaf morphological characteristics to establish distinctness, uniformity and stability. This trial will be maintained, as required by the Australian PBR office, under shade house conditions on the CSIRO Sunraysia site. The comparator varieties used in the study were Zante Currant, Carina Currant and Grant’s Currant. Furthermore, a US Plant
Patent application has been lodged in the USA for M 48-42, as recommended by the steering committee. Further data collection for this purpose will also be undertaken in spring 2012 at the request of the US Plant Patents office.

A Black Gem® fact sheet has also been prepared for grower and industry use (Appendix 1). An industry article was also published (Clingeleffer et al. 2011) and is attached (Appendix 2). Dried Fruits Australia have been appointed as the commercialiser for Black Gem® and will address issues of availability and supply of material, conditions relating to grower production licences and end use. A mother vine planting of Black Gem® has been established by VAMVIA (Victorian and Murray Valley Vine Improvement Association) as an industry source for propagation material. The first sales of grafted Black Gem® vines produced by licensed nurseries, occurred in 2011.

4.3. High yielding, rain tolerant Sultana type

A one hectare site of a light coloured, rain tolerant sultana type (now named and released as Sunglo, see below) was established by top-working on existing Sultana vines grafted on Ramsey rootstock in spring 2005 with misses replaced in spring 2006 (Clingeleffer 2009, DG04003 final report). The vines are trained on a Shaw swing-arm trellis and have been trellis dried with application of drying emulsion and mechanical harvested since 2008 (Figure 4.3.1). Sunglo has a loose bunch structure which facilitates application of drying emulsion for trellis drying (Figure 4.3.2). The selection has proven to be very fruitful with excellent crops produced in all seasons (2008-2012, Table 4.3.1). Compared to Sultana planted in an adjacent site, yields of Sunglo were higher in every season, on average by 53%, and more consistent over the seasons as shown by the smaller standard error of the mean (Table 4.3.1).

The higher yields of Sunglo can be attributed to more consistent fruitfulness and its now proven rain tolerance which was first noted in 2003, leading to minimal losses from berry splitting, berry drop and mould development which devastated the Sultana crop in season 2011, as shown in figure 4.3.2.

Figure 4.3.1. Views of top-worked Sunglo trained on a Shaw swing-arm trellis (left) and prior to harvest after trellis drying (season 2012, right).
Table 4.3.1. Comparative yields of Sunglo and Sultana over 5 seasons (2008-2012). The standard error of the mean is included as an indicator of seasons to season variability.

<table>
<thead>
<tr>
<th>Season</th>
<th>Sunglo (dry t/ha)</th>
<th>Sultana (dry t/ha)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2008</td>
<td>11.0</td>
<td>6.7</td>
</tr>
<tr>
<td>2009</td>
<td>13.0</td>
<td>12.2</td>
</tr>
<tr>
<td>2010</td>
<td>8.0</td>
<td>4.3</td>
</tr>
<tr>
<td>2011</td>
<td>6.3</td>
<td>3.0</td>
</tr>
<tr>
<td>2012</td>
<td>10.3</td>
<td>5.5</td>
</tr>
<tr>
<td>Mean</td>
<td>9.72 ± 1.17</td>
<td>6.34 ± 1.59</td>
</tr>
</tbody>
</table>

Figure 4.3.2. Views of Sunglo (left) and Sultana (right) bunches prior to trellis drying in season 2011 which show the rain tolerance of Sunglo and rain susceptibility of Sultana. (Photographs supplied by John Hawtin, Dried Fruits Australia)
Sunglo ripens about 10 days later than Sultana. Studies over a five year period (2008-2012) demonstrated that optimum maturity levels for drying of 23.0 °Brix were achieved in the second week of March. The dried product of Sunglo is considered a ‘sultana type’ which visually cannot be differentiated from the standard dried product from Sultana, although berries are about 20% larger. In common with Sultana, the dried berries of Sunglo will darken under difficult drying conditions due to rain and high humidity as occurred in season 2011. In this study, the dried fruit quality of Sunglo with the exception of season 2011, has consistently been graded as 4 or 5 crown light fruit whereas the dried Sultana fruit has been lower in quality (3 crown light or 4 crown brown). For example in season 2012 the dried fruit from Sunglo was graded 5 crown light whereas the Sultana fruit darkened, following intermittent rain events in late February prior to harvest, and was graded as brown type fruit. Views of the trellis dried Sunglo showing the light type fruit produced in season 2012 are shown in Figure 4.3.2.
Figure 4.3.4. Views of trellis dried Sunglo in season 2012. The right hand view shows the light colour of the fruit prior to harvest. (Photographs supplied by John Hawtin, Dried Fruits Australia)

Commercialisation of Sunglo

Sunglo was jointly named and released by the USDA and CSIRO as a drying variety in December 2010. It is a seedless, high yielding, rain tolerant variety that produces a dried product similar to Sultana when treated with drying emulsion. Sunglo resulted from the cross of Calmeria x C4-37 (Muscat of Alexandria x Sultania) made by Elmer Snyder between 1943 and 1947 at the USDA, Fresno. It was tested, but discarded, as a late ripening table grape in the USA. A Sunglo fact sheet has also been prepared for grower and industry use (Appendix 3). Dried Fruits Australia have been appointed as the commercializer for Sunglo. A large mother vine planting of Sunglo material has been established by VAMVVIA (Victorian and Murray Valley Vine Improvement Association) as an industry source for propagation material. The first sales of grafted Sunglo vines, produced by licensed nurseries, occurred in 2011.

4.4. Establishment of semi-commercial test site for Bruce’s Sport.

Studies undertaken in the previous project (DG 0403) showed that high productivity could be achieved with the low browning Bruce’s Sport selection of Sultana developed by FSAC (Fragmented Shoot Apex Culture) when managed as grafted vines on a modern tall trellis. The FSAC process removes viral disease agents. The steering committee approved the establishment of a semi-commercial test site and a mother-vine planting for this selection. Propagation material was supplied to a grower collaborator under a testing agreement in 2010, to establish a semi-commercial test site of 150 vines. Own rooted vines (300) were propagated by CSIRO to supply VAMVVIDIA with material to establish a mothervine planting as an industry source of propagating material. The propagated vines were planted at both sites in spring 2011. Material of FSAC Bruce’s Sport has also been sent to DPI-Vic in Knoxfield for biological indexing to verify its virus disease status, prior to a decision being made to release the material for use by industry.
Technology transfer

The Target audience for the project has been the Australian dried grape growers, processors and marketers. The research has been overseen by the 'Unique Dried Grape Varieties Steering Committee' to ensure that the CSIRO program is consistent with industry needs, to identify selections with most potential and to facilitate their commercial adoption. Members of this committee include representatives from all industry sectors (production, processors and marketers), HA Ltd and CSIRO. The final stages of evaluation have been facilitated by evaluation under commercial conditions on grower properties under modern management practices. Technology transfer has been facilitated through regular meetings of the ‘Unique Dried Grape Varieties Steering Committee’. Steering committee members have been provided with updates on the research and commercialisation at each meeting. Dried grape samples of the most promising selections and varieties have been provided for assessment. In addition, each year in January/February, a farm walk has been undertaken prior to the commencement of harvest by the committee to view the performance of selections and varieties in CSIRO trials and at the semi-commercial sites.

At a meeting of the ‘Unique Dried Grape Varieties Steering Committee’ in May 2010, a decision was made to name and release two selections (i.e. a rain-tolerant Sultana type and the early-ripening, disease-resistant currant selection). To facilitate rapid adoption of these selections upon release, mother-vine plantings had been established in 2009 by the Victorian and Murray Valley Vine Improvement Association (VAMVVIA). Consequently, a joint varietal release notice was prepared with the USDA for the rain-tolerant Sultana type, i.e. Sunglo. The name Sunglo was selected with input from industry through the steering committee. Provisional PBR protection was granted for the early-ripening, disease-resistant currant selection, M 48-42 (syn. Black Gem®) (PBR no. 2011/18) in March 2011. The name Black Gem was also selected with input from industry through the steering committee. A US Plant Patent application has also been lodged for M 48-42 as recommended by the Unique Dried Grape Varieties Steering Committee.

Dried Fruits Australia (DFA) has been appointed as the commercialiser to oversee the development of new variety releases from the project. This role will oversee the commercialisation strategy, developed with the ‘Unique Dried Grape Varieties Steering Committee’, which involves supply of mothervine material through VAMVVIA; propagation by licensed nurseries and grafters; licensing of growers; supply of fruit to licensed processors; and, collection of royalties on propagation and production.

Over the course of the project, results have been presented at industry forums conducted by Dried Fruits Australia and Processors. Each year CSIRO has been represented by staff including posters and appropriate fruit samples for viewing or tasting at the Mildura field days in May. Updates on the project have been published in ‘The Vine’ magazine and HAL dried grape annual reports (see bibliography below). Fact sheets for use by growers and industry were developed for Sunglo and M 48-42 (syn. Black Gem®) (Appendixes 1 and 4, respectively). An article describing M 48-42 (syn. Black Gem®) was also published in The Vine (Clingeleffer et al. 2011).
Discussion

The project was designed to provide a direct benefit to the Australian dried vine fruits industry. It aimed to develop drying varieties that meet market requirements that would improve the economic sustainability of dried grape production and enable the industry to meet future challenges associated with production in a variable and changing climate and overcome problems/deficiencies of existing standard varieties. Production and quality losses associated with rain damage at harvest, the development of mouldy fruit and inconsistent production due to variable fruitfulness and biennial bearing of Sultana were identified as major problems to the industry. Desired attributes for a new dried grape variety included types with high water use efficiency based on short seasonality, high fruit to leaf ratios and high productivity; rain tolerance to minimise production and quality losses and address the issue of mould and Ochratoxin A development; types suited to new product development, differentiation and niche marketing; and disease resistance types to reduce the use of chemicals for fungal control and suited to other market categories, eg. organics.

During the project, selections, at varying stages of development established in previous studies (DG 04003), have been evaluated by drying and processing in the CSIRO small-scale processing facility. These stages include single vine seedling populations, multiplied and top-worked plantings and larger, semi-commercial trials on grower properties. Further promising seedling types have been identified and established in multiplication plots for more detailed evaluation. In total 238 promising selections were established in multiplication blocks at the CSIRO Sunraysia site. A further 250 selections of interest, including material that may be required for future Plant Breeders Rights (PBR) purposes, were propagated and planted as single vines at the CSIRO Sunraysia site. Current plantings established at the CSIRO Sunraysia site following culling in winter 2012, include 1400 single vine seedling, 336 multiplied, grafted and top-worked selections and the 250 selections of interest retained as single plants. Furthermore, three rain tolerant Sultana types, an unnamed USDA muscat selection and the low browning, tissue cultured Bruce’s Sport have been established in semi-commercial sites on grower properties for larger scale assessment under commercial conditions. It is anticipated that a number of selections from this range of promising types that overcome deficiencies of existing varieties or that are suited to future industry needs will be named and released for industry adoption once evaluation is completed in future studies undertaken by industry.

The project has named and released two new varieties for adoption by industry. The first is Sunglo, a joint release with the USDA (Appendix 3), which offers significant advantages over Sultana because of its high and more consistent yield, proven rain tolerance and its loose bunch structure which facilitates the application of drying emulsion and minimises risks associated with the development of mould and bunch rots and development of Ochratoxin A. The second new variety released for industry adoption is M 48-42 (syn. Black Gem). It provides significant advantages over Zante Currant and Carina because it can be grown without the use of setting or fungicide sprays for downy and powdery mildew, as it is self fertile and disease resistant. M 48-42 (syn. Black Gem) appears to have inherent low vigour which requires some changes to management practices to enable production on modern trellis systems, i.e. grafting on high vigour rootstock, the use of higher density plantings with short cordon or a split cordon approach. The dried Black Gem product should be suited to new product development, differentiation and niche marketing (e.g. organics), as it can be grown without the use of setting or fungicide sprays and has high antioxidant activity as reported previously (Clingeleffer 2009, Clingeleffer et al. 2011). Fruit of Black Gem has also been
used to produce a high quality grape juice indicating significant potential for the production and development of markets for an organic grape juice with high health benefits (Clingeleffer et al. 2011).

The project has been overseen by the Unique Dried Grape Varieties Steering Committee, with delegates from all sectors of the industry (ie. production, processing and marketing), HA Ltd and CSIRO. This approach has provided the research team with excellent guidance with respect to both the breeding directions and decisions on commercialisation of new drying selections.
Recommendations

Due to the exit of CSIRO Plant Industry from Dried Grape Breeding and Evaluation Research, Dried Fruits Australia (DFA) has expressed intent to continue the evaluation of promising material arising from this project and has submitted a project proposal to HAL that, if successful, will commence in October 2012. The project proposal aims to complete the evaluation of CSIRO material in the breeding pipeline planted on the CSIRO Sunraysia property and monitor the performance of selections established at semi-commercial sites and identify further selections for release to industry. It is recommended that as part of the new DFA project the activities to be undertaken will be to:-

- Complete vine training and establishment of selections planted on the CSIRO site and the 3 top-worked selections on the semi-commercial grower sites.
- Monitor performance of selections on semi-commercial grower sites (i.e. 7 light coloured selections and tissue cultured Bruce’s Sport).
- Complete the evaluation and culling of remaining seedling populations.
- Evaluate multiplied, top-worked and grafted selections planted on the CSIRO Sunraysia site and identify, in consultation with CSIRO, material for further development, retention or culling.

Ongoing issues which must be addressed by CSIRO include:-

- Implement discussions with the USDA in regard to release and commercialisation of the promising unnamed seedless, muscat selection.
- Liaise with DPI Victoria, Knoxfield to confirm virus status of the tissue cultured Bruce’s Sport. If results are satisfactory, liaise with industry in regard to finalising release strategies.

It is recommended that a reference committee, with a similar role to the Unique Dried Grape Varieties Steering Committee represented by all industry sectors be implemented for the new DFA/HAL project to oversee the project and provide guidance and input into decisions on release and commercialisation of new varieties.
Acknowledgements

The input of all listed staff is acknowledged. In particular, David Emanuelli has played a significant technical role in the project. The inputs of the CSIRO farm staff have also been appreciated. Members of the ‘Unique Dried Grape Varieties Steering Committee’ have provided excellent guidance to the project, particularly in developing commercialisation strategies for selection release and adoption. The support of growers for the provision of land and management of the semi-commercial sites is gratefully acknowledged. The inputs of Dried Fruits Australia, the appointed ‘commercialiser’ for the CSIRO dried grape varieties released from this project, is also acknowledged.

Support has been provided through funding of this project by HAL and CSIRO.

Mr. Peter Clingeleffer Project supervisor
Mr. David Emanuelli Technical support
Dr. Steve Sykes PBR officer
Dr. Rob Walker Chair Steering Committee and commercialisation.
Lionel Henderson Commercial issues
Bibliography

Final reports

Clingeleffer, P.R. (1998) Integration of alternative drying varieties with efficient low-input and highly productive management systems. Final report submitted to Dried Fruits Research and Development Council (project CSH17).

Clingeleffer, P.R. (2001) Assessment of improved currants (Muscat types), early ripening, large berried or disease resistant Sultana types and seedless selections from in-ovulo embryo rescue as drying grapes. Final report submitted to Dried Fruits Research and Development Council (project CSH24).


Project outputs

Clingeleffer, P.R., Emanuelli, D., Tarr, C. and Davis, H. 2009. Improving Australian dried grape production through better varieties and rootstocks. The Vine 5(4), 34-35.

A release notice for the new rain tolerant drying variety, Sunglo was completed jointly by the USDA and CSIRO in December 2010.

Sunglo Shines. The Vine 7(2), 11. Sunglo article prepared with Dried Fruits Australia.


Clingeleffer, P.R. 2011. Sunglo fact sheet (Appendix 4)
Appendix

Appendix 1: Black Gem® fact Sheet

Appendix 2: Black Gem® article

Appendix 3: Sunglo fact sheet
Appendix 1: Black Gem® fact Sheet

CSIRO PLANT INDUSTRY
Dried Grape Varieties Fact Sheet

Black Gem® - an early ripening, disease resistant currant variety for drying

A new, early ripening, disease resistant currant variety, M 48-42 (syn. Black Gem®) has recently been released by CSIRO Provisional Plant Breeder Rights (PPR) for M 48-42 (syn. Black Gem®) was granted in March 2011, (PPR no. 2011/13). Black Gem® resulted from the cross of Seyve-Villard 39-639, a complex multispecies, disease resistant hybrid and Beauty Seedless, a black, early ripening table grape variety with the aim of combining disease resistance with early ripening. The cross was made at CSIRO Maribyrnong in 1980 and first assessed between 1985 and 1988.

Black Gem® is a self-setting, early ripening, disease resistant currant type with high fruitfulness, a distinctive flavour and high levels of antioxidants for an added health bonus. It is primarily a dried fruit variety which has also shown potential for juice, wine production and as a table grape variety for niche markets.

Management systems and planting spacings:

Black Gem® has inherently low vigour and requires grafting on high vigour rootstocks to promote a large canopy, achieve adequate yield and develop longer replacement canes, particularly for trellis drying on cordon based systems. Management on modern, cordon based trellis systems with hanging canes to facilitate trellis drying has proven difficult because canes arising from the cordon may be too short for attachment to lower wires. However, adequate development of replacement canes has been achieved using shorter cordon, a result which suggests that closer vine spacings should be used to optimize production, i.e. 1.8-2.0 m. Vine spacings will depend on soil type, trellis type and rootstock used. Black Gem® produces a high number of bunches on the cordon which require removal. This has been achieved by spraying inflorescences prior to flowering, using practices developed for other varieties, or by hand harvest of bunches and placement on the trellis wire for drying.

Suitable rootstocks:

Black Gem® is compatible with a wide range of rootstocks, with best results achieved to date by grafting on Ramsey, 1103 Paulsen and 140 Rugger. Dry yields of around 8t/ha were achieved with cane pruned vines managed on a narrow T-trellis on these rootstocks.

Setting sprays:

Black Gem® is highly fruitful and unlike Carina and Zante Currant does not require treatment with growth regulators to achieve a good fruit set.

Susceptibility to pests and diseases:

Vines of Black Gem® have shown higher levels of resistance to downy and powdery mildews than other drying grape varieties. Consequently it can be managed potentially with no or minimal application of fungicides for mildew control. Its disease resistance was confirmed during the very difficult 2011 season which experienced record breaking rain events, high humidity, cool conditions and vineyard flooding during spring, summer and early autumn.
Rain tolerance:

Black Gem is more tolerant of rain than Zante Currant. However, berry splitting has been observed in wet seasons, particularly of the ripest berries. These split berries usually drop from the bunch or dry rapidly without development of moulds. For example in 2011 the product was of high quality despite some berry splitting occurring following major rain events in both January and early February (i.e. a total of 357 mm prior to cane cutting for trellis drying).

Bunch structure and berry size:

The bunch structure is reasonably loose when compared to Zante Currant, and is suited to trellis drying. Black Gem has fresh berry weight ranging from 0.6 to 0.9 g, which is similar to Carna and Zante Currant.

Maturity:

Black Gem ripens at a similar time to Zante Currant in mid to late January, about 3 weeks earlier than Carna. Optimum maturity levels for drying of 23.0 Brix, were achieved at this time.

Product type and quality:

The dried product of Black Gem is considered a 'currant type' which is similar to the dried product of Carna. However, it has a more attractive spiciness when dried than either Zante Currant or Carna, which could offer an advantage over other currant varieties for some markets.

Storage and processing:

The fruit stores very well prior to processing. Capsules are easily removed during processing, when treated as a currant type, ensuring minimal skin damage and maintenance of product quality.

Health properties:

Dried berries from Black Gem have been shown to have high levels of anti-oxidants (approximately 3-fold higher than Zante Currant and 20% higher than Carna). In a further study, juice of Black Gem had higher levels (20%) of anti-oxidants than found in prune juice.

Grower returns:

Yields of Black Gem will be more consistent than Zante Currant but are likely to be lower than Carna. Management techniques to optimise yield are still being developed. Adoption of Black Gem should provide considerable savings from reduced spray inputs and a reduced requirement for desiccation due to its early harvest. Extra returns may be achieved by targeting alternative markets, e.g. for organic produce, and potentially for juice and prune fruit production.

Further information and material availability:

Dried Fruits Australia has been appointed by CSIRO and Horticulture Australia Ltd as the commercialiser for Black Gem. Growers wanting information or seeking to obtain grafted vines should contact Dried Fruits Australia on: ph: (03) 9023 3174.

Growers will be required to enter a Registered Grower agreement before vines can be supplied.

CSIRO acknowledges the support of the dried grape industry and Horticulture Australia Ltd.

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M 48-42 (syn. Black Gem), a new early ripening, disease resistant currant variety

By Peter Clingeleffer, David Emanuelli, Caroline Tarr, Davinder Singh, Steve Sykes and Rob Walker

A new, early ripening, disease resistant currant variety, M 48-42 (syn. Black Gem) has recently been released by CSIRO. A provisional Plant Breeders Right (PBR) for M 48-42 (syn. Black Gem) was granted in March 2011, (PBR no. 2011/18).

The new variety was identified and trialled in CSIRO dried grape breeding and evaluation studies supported by Horticulture Australia (HAL). Dried fruit production is expected to be the primary use for the variety, although it has also shown potential for juice and wine production and as a table grape variety for niche markets.

Background

Black Gem was selected from progeny of a controlled cross between Seyve-Villard 39-639, a complex multispecies, disease resistant hybrid and Beauty Seedless, a black, early ripening table grape variety. The cross was made in spring 1980 with seedlings planted in the field during spring 1981. The cross aimed to combine the disease resistant traits of Seyve-Villard 39-639 to fungal infection by downy and powdery mildew with the early ripening, seedless traits of Beauty Seedless.

Black Gem was identified as a potential seedless, currant type with 'spicy' flavour when first assessed during the period, 1985-86. It has a fresh berry weight ranging from 0.6 to 0.9 grams, which is similar to Carina and Zante Currant. It's potential as a new dried currant was further assessed in own-rooted, multiplied plantings established by CSIRO at Merbein in 1989 and at Koorlong in 1993.

A rootstock planting of Black Gem which included a comparison of own rooted vines with Ramsey, 1103 Paulsen, 140 Ruggeri and Kober 5BB rootstocks was planted on a grower property in 2003. A one hectare, semi-commercial planting of Black Gem was also established in 2004 by top-working to Zante Currant vines grafted on Ramsey rootstock. This site has been managed using a tall cordon-based hanging cane system without application of fungicides or setting sprays.

Management

Black Gem is highly fruitful and unlike Carina and Zante Currant does not require treatment with growth regulators to achieve a good fruit set. However, it has inherently low vigour and requires grafting on rootstocks that promote a large canopy to achieve adequate levels of production and the development of longer replacement canes, particularly for trellis drying on cordon-based systems.

Black Gem is compatible with a wide range of rootstocks, with best results achieved by grafting on Ramsey, 1103 Paulsen and 140 Ruggeri.

Dry yields of around 8 tonnes per hectare were achieved with cane pruned vines managed on a narrow T-trellis on these rootstocks. Black Gem has produced dry yields of 5 t/ha on the top-worked vines at the semi-commercial site, similar to Carina planted on a similar site.

Management on modern, cordon-based trellis systems with hanging canes to facilitate trellis drying has proven difficult with Black Gem because some canes arising from the cordon are too short for attachment to lower wires. However, adequate development of replacement canes has been achieved using shorter cords, a result which suggests that closer vine spacings (i.e. 1.8-2.0 metres) should be used to optimise production.

Due to its inherently high fruitfulness, Black Gem produces a high number of bunches on the cordon.
which are easily removed using standard practices developed for other varieties. Currently, the semi-commercial site is managed using an alternating split cordon system where hanging canes are retained on half of the vine while the other side is cane pruned. At harvest, the cordons are cut to commence drying of fruit on the hanging canes while fruit on the cane pruned side is hand picked onto the lower trellis wire for drying.

Processing
The dried currants produced from Black Gem have been processed through a commercial processing facility. There were no significant issues with respect to cap-stem removal, skin abrasion or removal of waste (i.e., stalks and stems). The finished product also had a notable spicy flavour which could offer an advantage over other currant varieties in some markets.

Disease resistance
Vines of Black Gem have shown higher levels of resistance to downy and powdery mildews than other drying grape varieties and its Vitis vinifera parent, Beauty Seedless. The disease resistance characteristics have most likely been inherited from its female parent, Seye-Villard 39-639. Consequently it can be managed without application of fungicides for downy and powdery mildew control. Its disease resistance was confirmed in Sunraysia during the very difficult 2011 season when record breaking rain events occurred leading to high humidity, cool conditions and vineyard flooding during spring, summer and early autumn. Some berry splitting occurred following major rain events in both January and early February (i.e. a total of 357 millimetres) prior to cane cutting for trellis drying.

Health properties
Dried berries from Black Gem have been shown to have high levels of antioxidants. The hydrophilic oxiradical scavenging capacity of dried Black Gem berries were approximately 3-fold and 30% higher than that of Zante Currant and Carina, respectively. In a further study, juice of Black Gem had higher (20%) levels of antioxidants than found in prune juice.

Conclusion
The new drying variety, Black Gem, provides growers with an early ripening, disease resistant alternative to Carina and Zante Currant. It can be grown without the use of fungicides and setting sprays and has higher levels of anti-oxidant activity than Zante Currant and Carina. Hence its adoption should enable the industry to meet the ever-increasing consumer expectations for organic products with high health benefits. Black Gem has also shown potential for niche marketing as a table grape variety and for juice and wine production.

Commercial arrangements for supply and distribution
Black Gem is protected by Plant Breeders Rights. CSIRO is currently in negotiations with Dried Fruits Australia with regards to commercialisation of the new variety involving the availability and supply of material, conditions relating to grower production licences and end use.

Acknowledgements
Enhanced dried grape types for the Australian industry (DG090000), Development of rain tolerant drying varieties to meet market specifications (DG04003) and Development of unique Australian dried grape varieties (DG01001) have been facilitated by HAL in partnership with Dried Fruits Australia. The projects have been funded by the national dried grape research and development (R&D) levy with the Australian Government providing matched funding for all HAL’s R&D activities. The support of growers for the provision of land and management of the semi-commercial sites is gratefully acknowledged.

Peter Clingeleffer, Caroline Tarr and Rob Walker are researchers at CSIRO Plant Industry’s Waite Campus, South Australia; David Emanuelli and Steve Sykes are from CSIRO Plant Industry, Merbein; and Davinder Singh was at CSIRO Merbein and is now a researcher at Department of Primary Industries, Victoria.

Canopy views of Black Gem (left) and Beauty Seedless (right) in February 2011 following periods conducive to severe downy mildew infection in spring and early summer. The canopy of Black Gem showed no symptoms of downy mildew whereas there was extensive damage to Beauty Seedless vines.
Appendix 3: Sunglo fact sheet

CSIRO PLANT INDUSTRY
Dried Grape Varieties Fact Sheet

Sunglo — a rain tolerant seedless grape for drying

The Sunglo variety was named and released by the United States Department of Agriculture (USDA) and CSIRO, in December 2010. It is a seedless, high yielding, rain tolerant variety that produces a dried product similar to Sultana when treated with drying emulsions. Sunglo resulted from the cross of Calmera x C4-37 (Muscat of Alexandria x Sultana) made by Elmer Snyder between 1943 and 1947 at the USDA, Fresno. It was tested, but discarded, as a late ripening table grape in the USA.

Sunglo, was imported by CSIRO and released from quarantine in Australia as an unnamed selection, F 64-74 in 1971. F 64-74 was tested as a drying variety by CSIRO in the 1980’s. In those studies, after application of drying emulsion and rock drying it produced light golden-amber coloured dried fruit with a pleasant acidic flavour.

Its potential as a rain tolerant type was particularly evident in season 2003 when significant rain events occurred in mid February causing significant losses to the Sultana crop. The fruit of F 64-74 was undamaged by the rain and subsequently produced an excellent light type, dried product.

Key characteristics of Sunglo
Rain tolerance:

The rain tolerance of Sunglo has been proven in the semi-commercial site in 2010 and 2011 when rain damage to Sultana caused major losses associated with berry splitting, berry abscission and mould development.

Yield:

Sunglo produced modest yields when assessed in the initial trials planted on own roots, i.e. around 5t/ha. However, when grafted on Ramsey rootstock and managed on a Swing-arm trellis in the semi-commercial trial it has been highly fruitful and very productive as shown in the table below, with an average dry yield of 9.6 t/ha compared to 6.6 t/ha of Sultana.

Dried grape yields of Sunglo and Sultana grafted on Ramsey rootstock and managed on a Swing-arm trellis and trellis dried over 4 seasons (2008-2011) are shown below.

<table>
<thead>
<tr>
<th>Season</th>
<th>Sunglo (dry t/ha)</th>
<th>Sultana (dry t/ha)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2008</td>
<td>11.0</td>
<td>6.7</td>
</tr>
<tr>
<td>2009</td>
<td>13.0</td>
<td>12.2</td>
</tr>
<tr>
<td>2010</td>
<td>8.0</td>
<td>4.3</td>
</tr>
<tr>
<td>2011</td>
<td>6.3</td>
<td>3.0</td>
</tr>
<tr>
<td>mean</td>
<td>9.6</td>
<td>6.6</td>
</tr>
</tbody>
</table>

Suitable rootstocks:

High vigour rootstocks are required for Sunglo, to optimise production and minimise losses associated with sunburn. It has performed adequately when grafted on Ramsey and 1103 Paulsen without any signs of incompatibility.

Susceptibility to pests and diseases:

Sunglo is not disease resistant, hence standard applications of fungicides are required.
Planting spacings:

Vine spacings will depend on soil type, trellis type and rootstock used. A 2.5 m spacing is used with the Swing arm trellis at the semi-commercial site.

Pruning systems:

Sunglo can be cane pruned using traditional trellises or cordon based hanging cane systems. The variety is not suited to spur pruning as it is not fruitful in the basal nodes.

Bunch structure and berry size:

The bunch structure is loose and is well suited to trellis drying.

Berries of Sunglo, weighing about 2.1 g are 25% larger than Sultana berries.

Maturity:

Sunglo ripens about 10 days later than Sultana. In the CSIRO studies optimum maturity levels for drying of 23.0 °Brix were achieved in the second week of March.

Drying ratio:

The ratio of fresh to dry weight is estimated to be around 4.0 provided adequate maturity levels are achieved.

Product type and quality:

The dried product of Sunglo is considered a ‘sultana type’ which cannot be differentiated from the standard dried product from Sultana. With the exception of season 2011, dried fruit quality of Sunglo from the semi-commercial site has consistently been graded as 4 crown light fruit. In contrast, the dried product of Sultana was lower in quality in 2009 and 2010, i.e. 3 light and 4 brown, respectively.

In common with Sultana, the dried berries of Sunglo will darken under difficult drying conditions due to rain and high humidity.

Storage and processing:

The fruit stores very well prior to processing with excellent colour retention and good friability. Capteins are easily removed during processing, ensuring minimal skin damage and maintenance of product quality (i.e. light amber colour without sugaring problems).

Grower returns:

Adoption of Sunglo should provide considerable benefits over Sultana associated with its rain tolerance, higher and more consistent yield and quality.

Further information and material availability:

Dried Fruits Australia has been appointed by CSIRO and Horticulture Australia Ltd as the commercializer for Sunglo. Growers wanting information or seeking to obtain grafted vines, either bare rooted or field grown or field nursery grafted onto Ramistay rootstock should contact Dried Fruits Australia on (03) 50235174. Growers will be required to enter a Registered Grower agreement before vines can be supplied.

CSIRO acknowledges the support of the dried grape industry and Horticulture Australia Ltd.

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