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# Traditional cap management techniques

Plunging, pump-overs and ‘rack and returns’ are traditional cap management options performed during a red wine fermentation. How these techniques are performed can vary significantly between wineries and one or all of them may be used throughout a single ferment. There are limited operational instructions within textbooks because cap management is used to achieve different objectives at different times during fermentation. In this column, AWRI Senior Oenologist, Geoff Cowey answers questions about when and how these practices are typically used.

*What are the objectives of cap management?*

## Pre-fermentation

Before fermentation starts, there is no protective layer of fermentation-derived carbon dioxide (CO<sub>2</sub>). Chilling, sulfur dioxide, dry ice and bioprotectants can all be used to protect the must. Mixing the must ensures the surface is kept wet and additives are mixed evenly, preventing surface oxidation reactions, limiting growth of aerobic microorganisms or mould, and minimising accumulation of vinegar flies. Tank covers can also be used. Mixing can also maximise extraction of flavour and colour from grape solids. Colour is extracted early in fermentation, then often decreases due to polymerisation and adsorption.

## During fermentation

Heat generated during fermentation is controlled using cap management and refrigeration. Warmer temperatures aid phenolic extraction; however, excessive temperatures in the cap can affect yeast viability and fermentation performance. Cap management also allows oxygen ingress, an essential nutrient for initial yeast propagation and the first 24-48 hours of fermentation. Oxygen helps build healthy yeast cell walls and can prevent reductive off-odours. The increasing ethanol combined with the physical action of cap management techniques increase extraction of colour, flavour, polysaccharides, potassium and tannin from grape solids.

## End of fermentation

Towards the end of fermentation, or once the cap has sunk, ferment temperature is generally lower and mixing is less frequent, particularly if a winemaker wants to limit extraction of seed

tannins that are more easily extracted at higher ethanol concentrations. Mixing is used to expose the cap/surface to ethanol to prevent growth of aerobic spoilage microbes on the surface, as there is less CO<sub>2</sub> present towards the end of fermentation, particularly during extended maceration.

*How and when should plunging/punch-downs (pigéage) be performed?*

Traditionally done by foot (pigéage à pied), modern plunging techniques use a solid or perforated stainless steel or plastic plate on pole. A small hole or wedge is first created to release the CO<sub>2</sub> and then the cap solids are progressively pushed into the liquid. Plunging can be carried out manually if fermenting in grape bins or in open top fermenters (up to 2-6 tonnes) or using a mechanised pneumatic plunger (up to 10 tonnes).

In the AWRI Vineyard and Winery Practices Survey (Nordestgaard 2019), plunging was the main cap management technique used by very small wineries (<50 tonne), with 85% of these producers using plunging far more than any other technique. Larger wineries reported using plunging for small-batch ferments which do not have sufficient liquid volume for pump-overs. Plunging is also more likely to be used with lighter-coloured red varieties such as Pinot Noir and less likely for tannic varieties such as Shiraz or Cabernet Sauvignon.

One plunge per day may be used as a mixing technique during pre-fermentation steps such as cold soak or after additions. Once a cap has formed, plunging is conducted until the cap is fully broken up and homogenised with the must, which for smaller volumes can be relatively quick (10 minutes). Subject to the variety and style, generally one

to three but up to five plunges are done per day.

*How and when should pump-overs (remontage) be used?*

Pump-overs can be used in both open and closed fermenters. Must is pumped from the ferment by first connecting a hose from the racking or bottom valve of a fermenter. The must is then discharged via hose or fixed-line to the top of the cap where the liquid percolates down through the cap. The return hose can be simply sat on the surface of the cap, secured in position with clamps or ties. Pump types that can handle high-loads of grape solids are required; typically, a progressive cavity pump (Moineau or Mono) or peristaltic pump is used.

Pump-overs can be conducted more aerobically by draining must from the bottom valve through a mesh/sieve/rolling screen and splashing the must into a ‘splash tub’ then pumping the liquid from this container back over the cap. The must can be manually sprayed over the total surface of the cap of skins like a fire hose, which can be physically abrasive and extractive. It is also common to use an irrigator that radially distributes liquids evenly and gently over the cap surface. Pump-overs are less labour intensive and can be automated compared to plunging.

In the survey results, pump-overs were the main cap management technique (90-100%) used by both small (50-1,000 tonne) to large (>10,000 tonne) wineries. Irrigators were particularly used by mid- to large-sized wineries. As the technique transfers liquid back over the cap, the extraction is considered gentler than plunging, with the must extracting colour, tannins and flavours as it percolates back down through

the cap. Typical pump-over durations during peak CO<sub>2</sub> production periods in mid-late fermentation have shown limited impact in terms of aeration and subsequent reactions (Moenne *et al.* 2014). To achieve greater aeration, air can be added using in-line devices such as Venturi injectors or vortex spargers.

One-third to one-half of the liquid in the tank is typically pumped and sprayed over the cap with two to three pump overs, or equivalent to the whole tank volume, per day. Duration is typically 15-30 minutes or up to 1 hour for larger tanks. In the second half of fermentation, often only half the volume of the tank will be pumped over per day. These guides are subject to the grape variety, level of extraction desired, the number of ferments being managed and associated equipment and labour constraints. Larger wineries will automate pump overs using built-in pumps and fixed lines, with remote sensors and programs controlling parameters.

#### *How and when should 'rack and return' (delestage) be used?*

In a 'rack and return', must is drained or pumped from the bottom of the fermenter into another tank and left for 1-2 hours. The cap falls to the bottom of the fermentation vessel. The must is then pumped back into the fermentation tank and sprayed over the collapsed cap. This technique requires an additional tank to be available and takes longer than plunging or pump-overs as the entire liquid volume is pumped out, held, sometimes passed through a heat exchange, then pumped back into the tank.

In the practices survey, 50% of wineries in medium to large wineries (1,000 - >10,000 tonne) reported some use of 'rack and return' during fermentation. This technique achieves the greatest homogeneous mixing between solid and liquid portions of the ferment. It is more extractive, aerative and equilibrates ferment temperature faster than plunging or pump-overs. Variations for higher alcohol wines may include removing a portion of the seeds at the latter stages of fermentation to avoid excessive seed tannin extraction. A 'rack and return' is typically performed in the middle of the fermentation. For winemakers attempting high flavour, colour and tannin extraction, generally one but up to three may be performed.

#### *What other cap management options are used in Australia?*

Between 10 and 20% of producers surveyed detailed some use of header down boards, which are used to keep the cap fully submerged during fermentation. Pulsair systems emit bursts of compressed air bubbles in the bottom of the tank via probe or the racking valve which breaks the cap and then pushes must over the top. This technique is useful at the beginning of a fermentation to break the cap and mix in additives and for rapid redistribution of heat. It is less labour-intensive than plunging or pumping over. Rotary fermenters, Ganimedee, Ducellier and Nectar systems are other closed fermenter options available for automated cap management.

#### **AWRI helpdesk**

*The AWRI helpdesk provides a free-of-charge technical advice service to*

*Australia's grapegrowers and winemakers. For further information about cap management or any other technical matter, contact the helpdesk on (08) 8313 6600 or [helpdesk@awri.com.au](mailto:helpdesk@awri.com.au)*

#### **References**

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