Delteil International Wine Consulting

Exploring Lees Management

Good Practices for International Markets

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www.Delteil-Consultant.com

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Good Practices for International Markets

From 25 year R&D and consulting experience worldwide

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Presentation plan

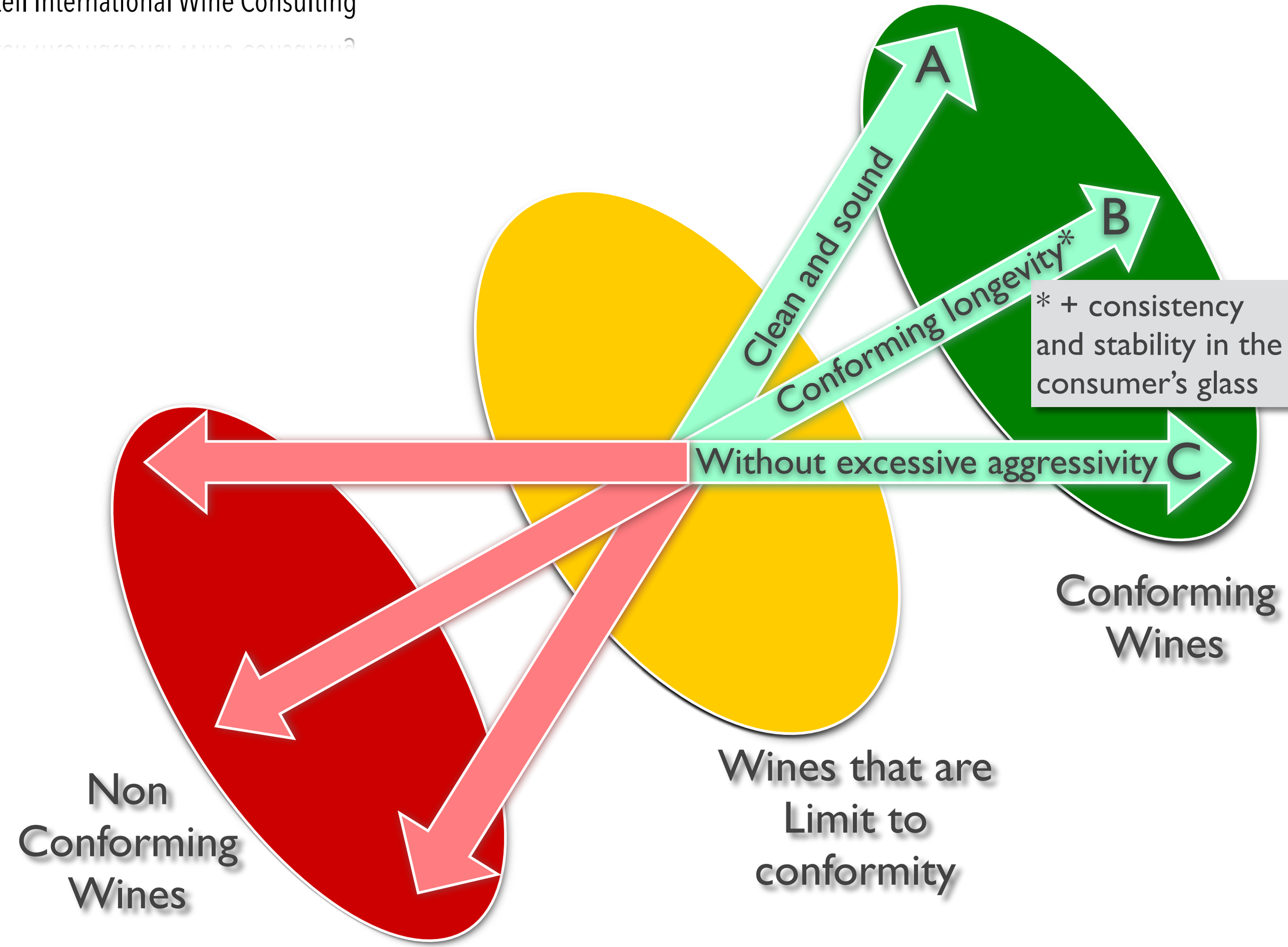
- Good Practices goals. What are we aiming at?
- What are lees? Heavy and light lees
- Preparation of future conforming light lees during winemaking
- Segmentations of lees during aging. Methods, agenda
- Wine management during lees aging
- Lees rebalancing, lees renewing

Step 1

Good Practices Goals

Which are successful wines?

Three key axis to follow at any time during winemaking and aging, including lees management


A
Clean and sound
B
Conforming longevity*
* + consistency and stability in the consumer's glass
Without excessive aggressivity C
Conforming Wines
Wines that are Limit to conformity
Non Conforming Wines

Step 2

What are lees?

Heavy and light lees

Some elements in view of sharing the same language when speaking about the lees,
Some knowledge to pilot the Good Practices

Heavy lees definition

- Heavy lees are the particles that are deposited within 24-48 hours. A wine without pectin
- A wine without pectin (pectin of the cell walls completely hydrolyzed) is obtained by the efficient addition of enzyme to the grapes or juice or to the wine when it's draining or during pressing.

- The size of heavy lees: from 100 microns to a couple of millimeters

Heavy lees in red wines (1)

Just after draining and pressing, the heavy lees are:

- Vegetal particles,
- Agglomerations of tartaric crystals + yeast + coloring matter and precipitated tannins
- Flakes derived from reactions between proteins, polysaccharides and tannins during maceration

Heavy lees in red wines (2)

During aging (at least 2 rackings already carried out) heavy lees are:

- Agglomerations of tartaric crystals + yeast + lactic bacteria + coloring matter and precipitated tannins.
- These agglomerations started forming as of the last racking from reactions of crystallization and polymerization between elements that were soluble in wine.

Heavy lees in whites and rosés (1)

At the end of the alcoholic fermentation, the heavy lees are:

- Vegetal particles, if the juice clarification has left (voluntary or not) over 200 NTU in the juice before fermentation,
- Agglomerations of tartaric crystals + yeast + precipitated colloidal matter,
- Particles of eventual treatments during the fermentation: bentonite, casein, PVVP, etc.

Heavy lees in whites and rosés (1)

During aging (following at least one racking) the heavy lees are:

- Agglomerations of tartaric crystals + yeast + precipitated colloidal matter: formed since the preceding racking

Note: heavy lees continually form in wine

- They are never really interesting.

- At each stage of aging, it's therefore important to evaluate their presence and to regularly eliminate them when needed.

- In view of their formation (see above), the frequency of their elimination diminishes with time

- It's rarely coherent to programme a systematic elimination every three months... as it is done traditionally in some areas.

Light lees definition

- Light lees are particles which remain in suspension 24-48 hours after the wine has been moved

- Movements include: draining, racking, stirring, pumping, etc.

- The size of light lees: from a micron to a couple of dozen microns

Light lees for reds, whites and rosés

- The light lees are constituted of yeast (towards the end of alcoholic fermentation), then by yeast and lactic bacteria (towards the end of malo-lactic fermentation and after malo-lactic fermentation).

Note

- In the case of wines that are still rich in pectin or wines with glucanes produced by *Botrytis cinerea*, this definition of light and heavy lees is no longer valid
- Indeed, these polysaccharides keep all of the particles in suspension.
- The first action is therefore to carry out the hydrolysis of the pectin (classic pectolitic enzymes with a dose acting within 24 hours: in relation to the temperature and the quality of the pectin under hydrolysis) and the glucanes (glucanase enzymes).

Risks associated with heavy lees

Risks associated with vegetal particles and flakes

- Risk of bad smells and grassy flavors.

- Combining SO_2. Blocking of the molecular and free SO_2 on the particles. The blocked SO_2 on the vegetal particles is no longer present in the mass of the wine to play anti-microbial and antioxidant roles

- Adsorbing pigments

Risks associated with agglomerations of coloring matter, tannins, yeast, bacteria and tartrate

- Combining SO2 and protection of certain germs "included" in the agglomerates. They are less affected by the addition of SO2.

- Release of bitter tasting substances in white or rosé wine.

- Preservation or even release of inhibiting substances for the yeast (in the case of a re-inoculated fermentation) or for lactic bacteria. These substances are absorbed on the surface of dead yeast implicated in the agglomerations

Rapidly eliminating heavy lees and rapidly sulfiting the wines (alcoholic and malo-lactic rapidly completed): the best way of preventing *Brettanomyces*

Risks associated with bentonite, casein and PVPP particles in whites and rosés

- Release of undesirable substances absorbed from the fermentation juice

- The ethanol in solution can release elements that were absorbed at the beginning of the alcoholic fermentation, when tere was no ethanol

Risks associated with light lees

Risks associated with yeast (1)

- Risk of the apparition of sulphur off-flavors produced by the *Saccharomyces*. Strain dependent, nutrition dependent
- When the yeast cells are stacked up and compacted, they release sulphur and bad smelling compounds
- The risks are even higher when the juice has shown sulphur off odors during the AF
- The more the yeast had oxygen during AF, the less they are likely to release sulphur flavors during aging

Risks associated with yeast (2)

- The quantity of light lees isn't a factor of risk by itself.
- However after stirring the lees or pumping, the more light lees in suspension the quicker a critical quantity is rapidly stuck at the bottom of the tank
- The more light lees are left to benefit from certain advantages (see further on), the more it is necessary to regularly and completely stir them.
- It is also necessary to more frequently eliminate heavy lees: because of the great mass of reactive light lees, more heavy lees are formed
- The development and the survival of *Brettanomyces* are favored by the presence of a large quantity of light lees

The risk of sulphur off-flavors and animal odors (sweat, rotten meat) produced by contaminating living yeast like *Brettanomyces* and *Pichia*

- These yeast come from insufficiently disinfected harvesting and cellar equipment.
- The causes of their survival are:
  - Active SO_2 is more rapidly combined by the great mass of *Saccharomyces* cells. This is amplified when the light lees are concentrated to work separately with them. (not a Good Practice for me)
  - Dead cells of *Saccharomyces* release nutriments used by these germs of contamination.
- At the beginning of aging, a specific microbiological analysis is recommended to find out if there's an initial risk of *Brettanomyces*

Risks associated with lactic bacteria

- The risk of metabolism of the citric acid and of different amino wine acids with the production of acetic acids and biogenic amines

- Only the living lactic bacteria carry risks.

- Add SO_2 rapidly, just the right dose, homogenous addition to kill **with one shot** the bacteria that produced the MLF

- It's important to properly sulfite even when it comes to selected lactic bacteria that have been directly inoculated.

Advantages associated with heavy lees

- ***Quite simply: None,*** to reach axis A, B and C.

- In the best of cases, they don't compromise working with light lees.

- All of the interesting elements from the solid parts of the grape have been taken and put into the solution during the maceration and during the pressing

The advantages associated with working with light lees (1)

- There are between 30 and 100 grams of yeast per litre of wine at the end of alcoholic fermentation.

- It's a very important source of polysaccharides (mannoproteins and non-filling glucanes) amino acids, nucleic acids and esters.

- All these elements are well known for their strong flavors

The advantages associated with working with light lees (2)

- There is around 2-4 m^2 of ***exchanging surface*** per litre of wine at the end of alcoholic fermentation.

- It's a very important ***sponge surface to adsorb*** reactive compounds from the wine that are instable and altering the wine balance (axis A, B and C)

- ***Sponge effect is immediate*** on light lees surface (electrostatic and tension-active phenomena)

Enough knowledge to start the action!

Good Practices to reach our universal goals (axis A, B and C)

Step 3

Preparation of future light lees during winemaking

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From

★☆☆☆☆

to

★★★★★

= the impact of the winemaking action on the quality of light lees during aging

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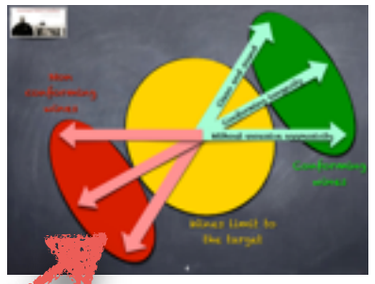


★★★★★ Rhythm of first rackings

★★★☆☆ Addition of press wines

★★★★☆ Duration of maceration

★★★★★ Agitations

★★★★★ Temperature program

★★★★★ Coinoculation yeast - bacteria

★★★★☆ Oak chips

★★★★★ Maceration enzymes

★★★☆☆ Crush

★★★★★ SO2

Destem ★★★☆☆

Adjust pH ★★★★☆

Yeast strain ★★★★★

Yeast protection during rehydration ★★★★★

Inactivated yeast for maceration ★★★★★

Lactic bacteria strain ★★★★★

Type of pumping over ★★★★★

Nutrient for yeast ★★★★★

Macro-oxygenation ★★★★★

Type of pressing ★★★☆☆

Inactivated yeast addition ★★★★★

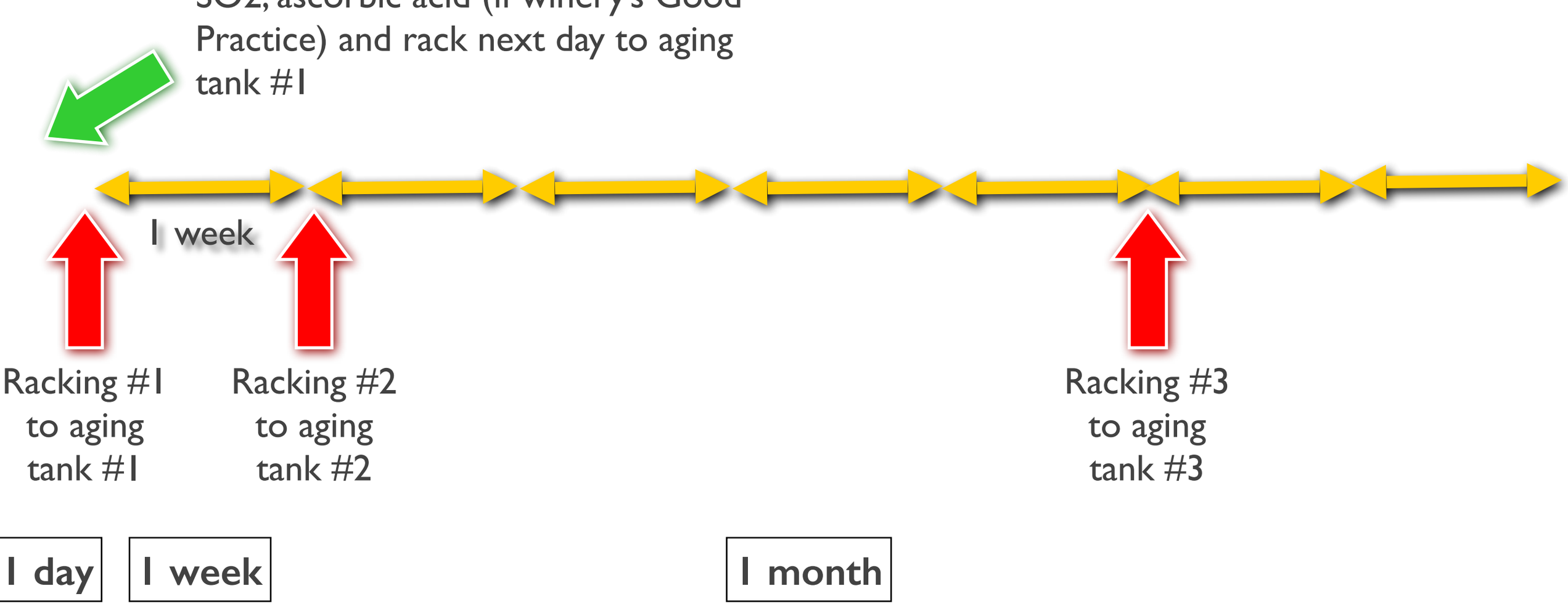
Step 4

Segmentations of lees during aging

Methods, agenda

Racking agenda for a white wine fermented in tank, without malo-lactic fermentation

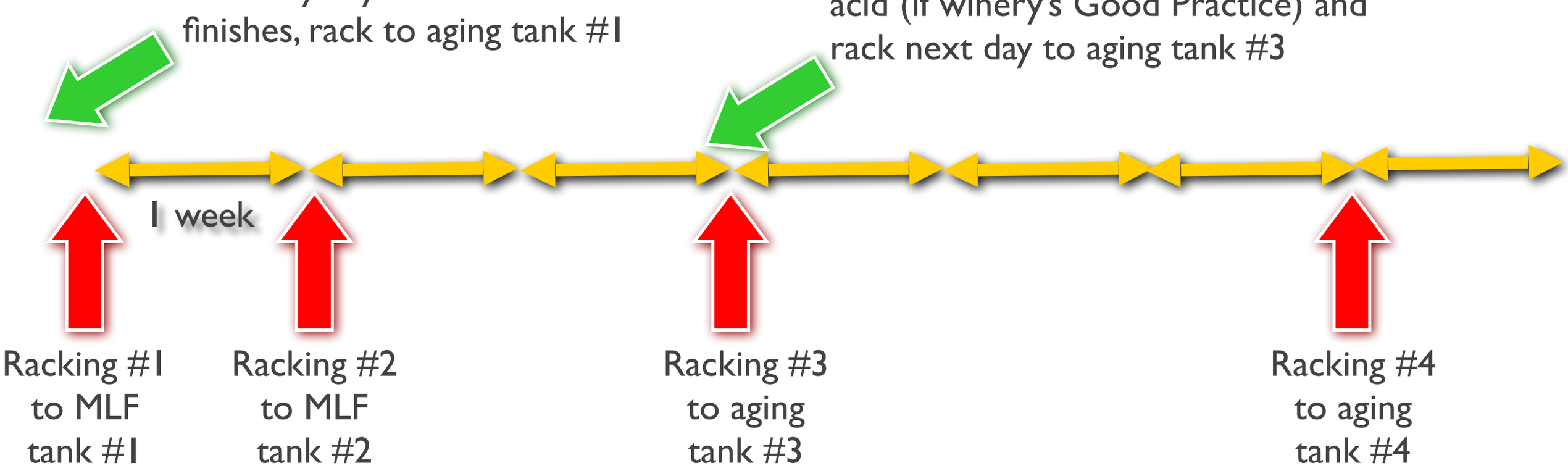
The very day alcoholic fermentation finishes, **in the fermentation tank**, add SO2, ascorbic acid (if winery's Good Practice) and rack next day to aging tank #1



Racking agenda for a white wine fermented in tank, with malo-lactic fermentation with coinoculation yeast-bacteria

The very day alcoholic fermentation finishes, rack to aging tank #1

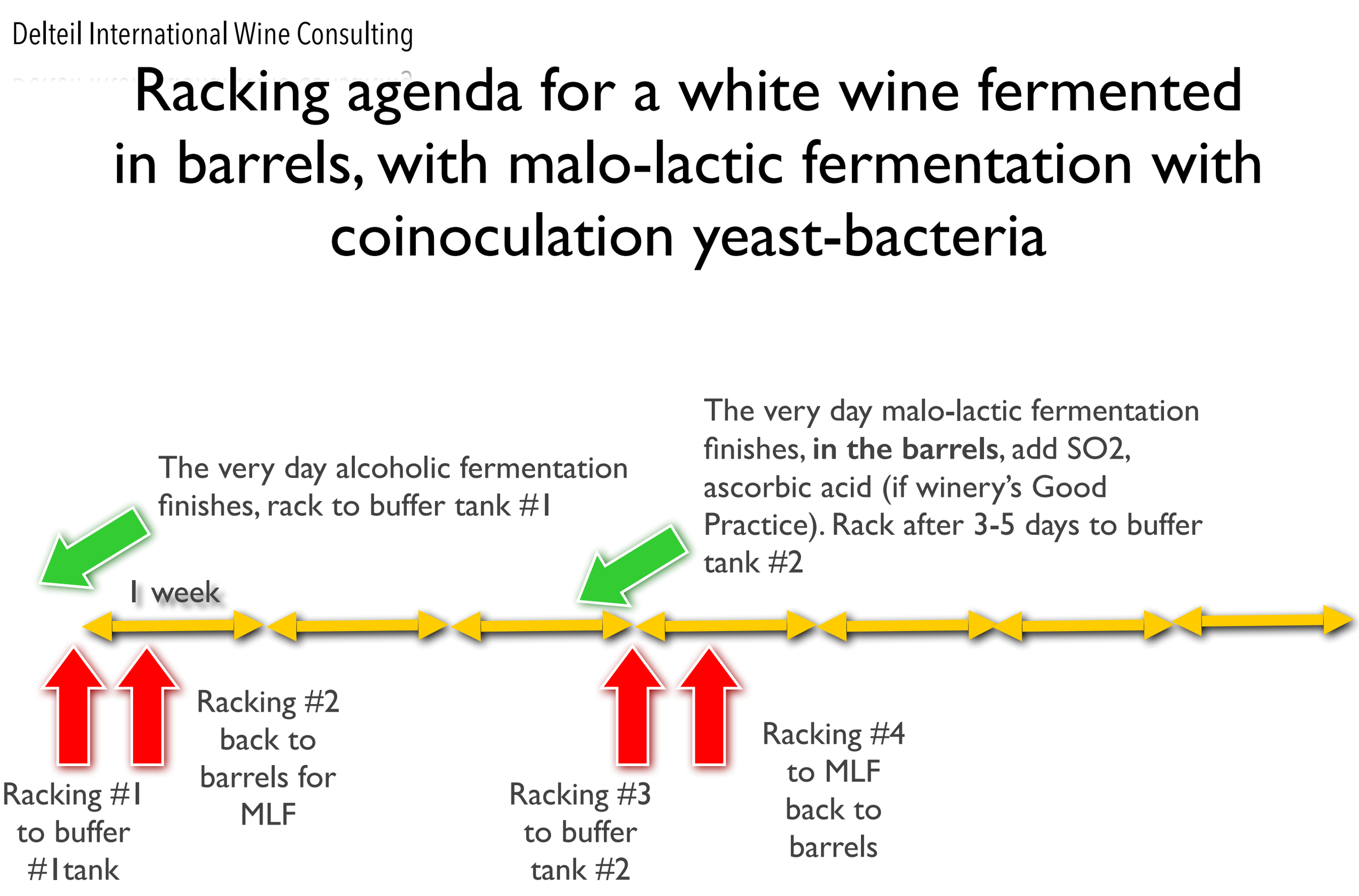
The very day malo-lactic fermentation finishes, **in the malolactic fermentation tank**, add SO2, ascorbic acid (if winery's Good Practice) and rack next day to aging tank #3



Racking agenda for a white wine fermented in barrels, with malo-lactic fermentation with coinoculation yeast-bacteria

The very day alcoholic fermentation finishes, rack to buffer tank #1

The very day malo-lactic fermentation finishes, **in the barrels**, add SO2, ascorbic acid (if winery's Good Practice). Rack after 3-5 days to buffer tank #2

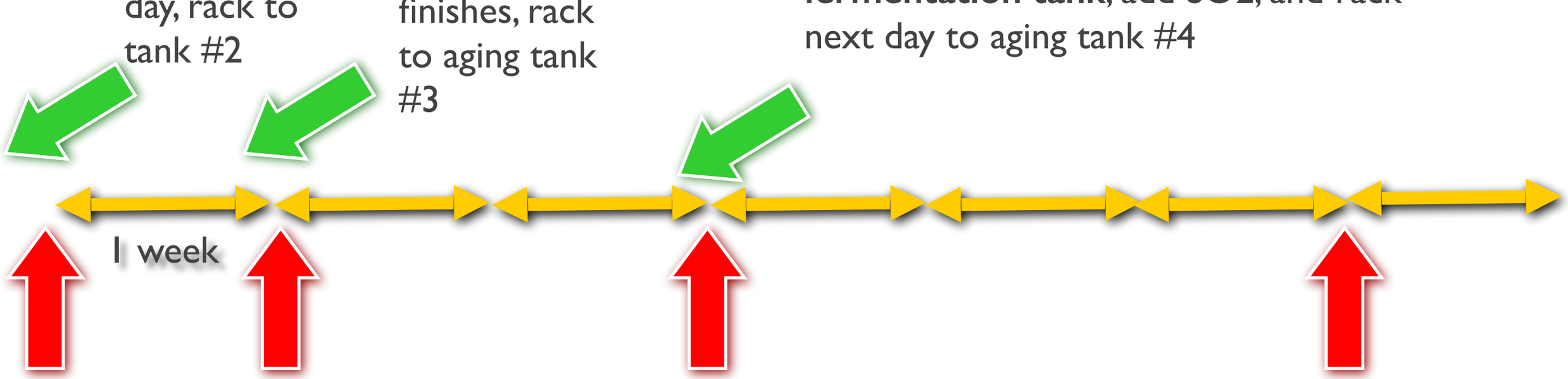


Racking agenda for a red wine fermented in tank, with malo-lactic fermentation with coinoculation yeast-bacteria. Draining and pressing with residual sugars

Draining and pressing to buffer tank #1. The very next day, rack to tank #2

The very day alcoholic fermentation finishes, rack to aging tank #3

The very day malo-lactic fermentation finishes, **in the malolactic fermentation tank**, add SO2, and rack next day to aging tank #4

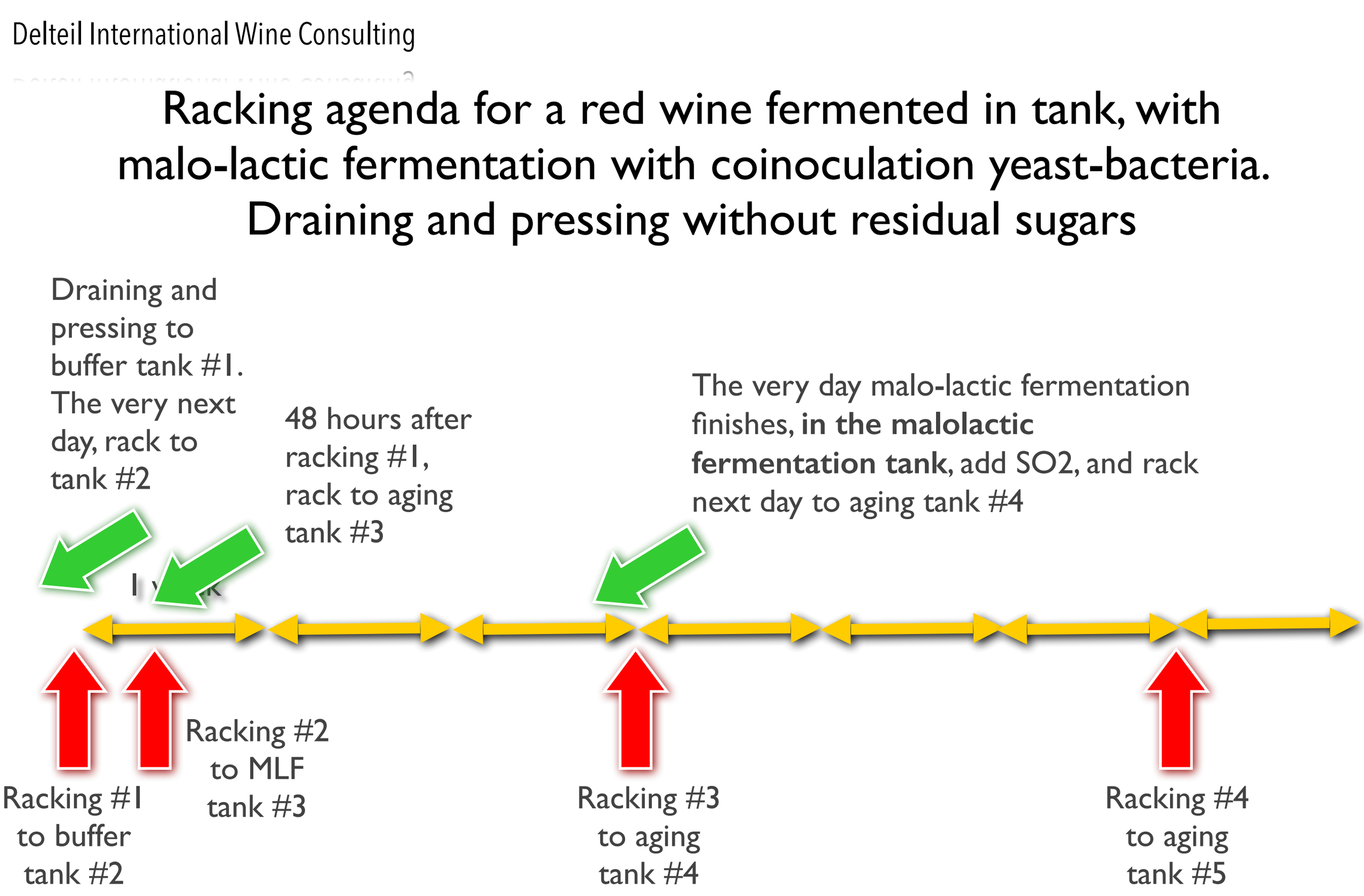


Racking agenda for a red wine fermented in tank, with malo-lactic fermentation with coinoculation yeast-bacteria. Draining and pressing without residual sugars

Draining and pressing to buffer tank #1. The very next day, rack to tank #2

48 hours after racking #1, rack to aging tank #3

The very day malo-lactic fermentation finishes, **in the malolactic fermentation tank**, add SO2, and rack next day to aging tank #4

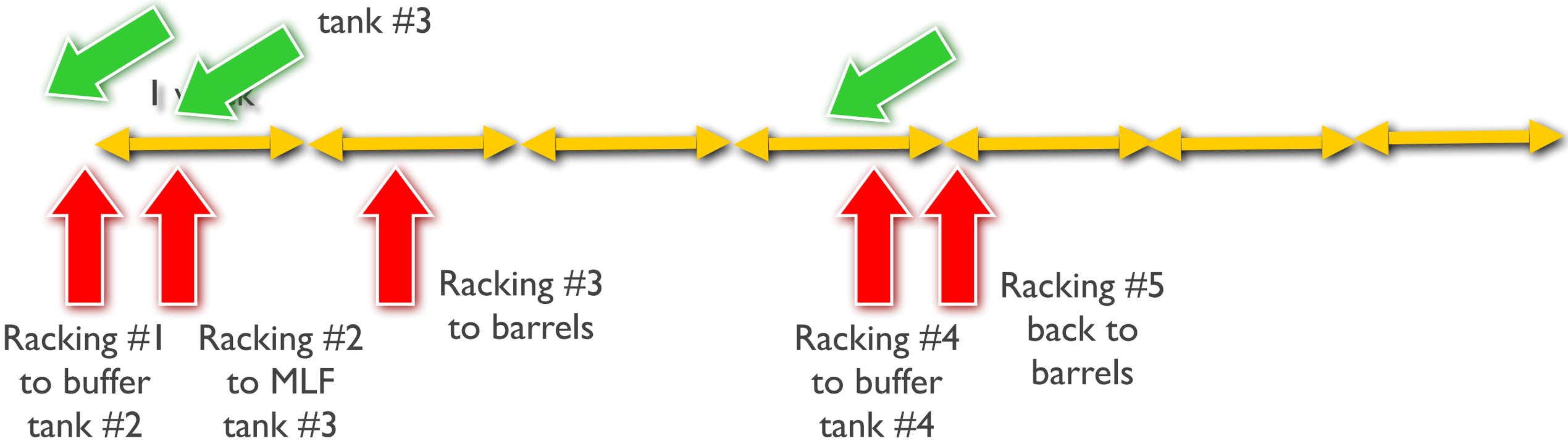


Racking agenda for a red wine fermented in tank, with malo-lactic fermentation in barrels, with coinoculation yeast-bacteria. Draining and pressing without residual sugars

Draining and pressing to buffer tank #1. The very next day, rack to tank #2

48 hours after racking #1, rack to aging tank #3

The very day malo-lactic fermentation finishes, **in the barrels**, add SO2. Rack after 3-5 days to buffer tank #4



Step 5

Wine management during lee aging

Wine management during lee aging

- pH adjustment and frequent control
- Molecular SO_2 (0.6-0.8 mg/L in reds - 0.9-1.1 mg/L in whites) adjustment and frequent control
- *Brettanomyces* & C°: monitoring of living cells starting 10 days after the post-malo sulfiting
- Wine agitation (mixer or stirring). At least 2 times a month until December 31th. Later, once a month. Wine homogeneity is not granted
- Micro-oxygenation

Micro-oxygenation is a style adjustment tool, once you avoid the 4 main mistakes

- Too much oxygen,
- For too long,
- Too late in the season,
- Too contaminated with Brett & C°.

- Often 1 or 2 months micro-oxygenation at 1-2 mg/L/month after MLF is enough when needed from style point of view
- Other key techniques are more efficient than micro-oxygenation for some classical missions that were attached to micro-oxygenation: color stabilization, sulfur off-flavors management, tannin sensation softening
    - Good Practices of macro-oxygenation during winemaking,
    - Early lees segmentation program,
    - Reduless and Noblesse early additions program

Step 6

Light lees rebalancing

Light lees renewing

Reduless

- Reduless is an inactivated yeast product with immobilized organic copper. Copper is monovalent and so has different range of action than classical Cu^{2+}). OMRI approved product

- Developed about 10 years ago by Lallemand to cure strong sulfur off-flavors at high dosage: 10-15 g/hl.

- A fine tuned aging tool I personally developed when I discovered its unique action at very low dosage: 1-2 g/hl

Noblesse

- Noblesse is an inactivated yeast product. OMRI approved product

- Developed about 10 years ago by Lallemand. It is an ICV yeast I selected. Noblesse is a concept I created when I was ICV R&D manager. They are fully respected cells during inactivation to:

  - respect the specific sponge effect of that strain and

  - release immediately some its cell wall mannoproteins and glucanes when put in suspension into the wine.

- Dosage: 10-20 g/hl

Light lees rebalancing and renewing agenda

- Reduless and Noblesse have complementary effect on the wine and on the lees

- They have demonstrated that:

  - an early and frequent addition agenda is more efficient than late high curative doses with long time contact: wine is an emulsion and its colloidal matrix has to be built early, step by step to reach axis A, B and C.

  - the autolysis concept and stirrings are very relative in the building of the fore mouth volume

- Reduless and Noblesse additions are adapted to the basic lees segmentation program of rackings that was developed and validated years before

Reduless and Noblesse agenda for a white wine fermented in tank, without malo-lactic fermentation

Reduless 1-2 g/hl

Reduless 1 g/hl

The very day alcoholic fermentation finishes, in the fermentation tank, **add Reduless (1-2 g/hl)**, SO2, ascorbic acid (if winery's Good Practice) and rack next day to aging tank #1

Reduless 1 g/hl

Noblesse 10 g/hl

1 week

Racking #1 to aging tank #1

Racking #2 to aging tank #2

Racking #3 to aging tank #3

1 day

1 week

1 month

Racking agenda for a white wine fermented in tank, with malo-lactic fermentation with coinoculation yeast-bacteria

Reduless 1-2 g/hl

Reduless 1 g/hl

Reduless 1 g/hl

Noblesse 10 g/hl

The very day alcoholic fermentation finishes, rack to aging tank #1

The very day malo-lactic fermentation finishes, **in the malolactic fermentation tank**, add Reduless, SO2, ascorbic acid (if winery's Good Practice) and rack next day to aging tank #3

1 week

Racking #1 to MLF tank #1

Racking #2 to MLF tank #2

Racking #3 to aging tank #3

Racking #4 to aging tank #4

Racking agenda for a white wine fermented in barrels, with malo-lactic fermentation with coinoculation yeast-bacteria

Reduless 1-2 g/hl

Noblesse 20 g/hl

Reduless 1 g/hl

Noblesse 10 g/hl

The very day alcoholic fermentation finishes, rack to buffer tank #1

The very day malo-lactic fermentation finishes, **in the barrels**, add Reduless, SO2, ascorbic acid (if winery's Good Practice). Rack after 3-5 days to buffer tank #2

1 week

Racking #1 to buffer #1tank

Racking #2 back to barrels for MLF

Racking #3 to buffer tank #2

Racking #4 to MLF back to barrels

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Racking agenda for a red wine fermented in tank, with malo-lactic fermentation with coinoculation yeast-bacteria. Draining and pressing with residual sugars

Reduless 1-2 g/hl

Draining and pressing to buffer tank #1. The very next day, rack to tank #2

Reduless 1 g/hl

The very day alcoholic fermentation finishes, rack to aging tank #3

Reduless 1 g/hl

Noblesse 10 g/hl

The very day malo-lactic fermentation finishes, **in the malolactic fermentation tank**, add Reduless, SO2, and rack next day to aging tank #4

1 week

Racking #1 to tank #2 to finish AF

Racking #2 to MLF tank #3

Racking #3 to aging tank #4

Racking #4 to aging tank #5

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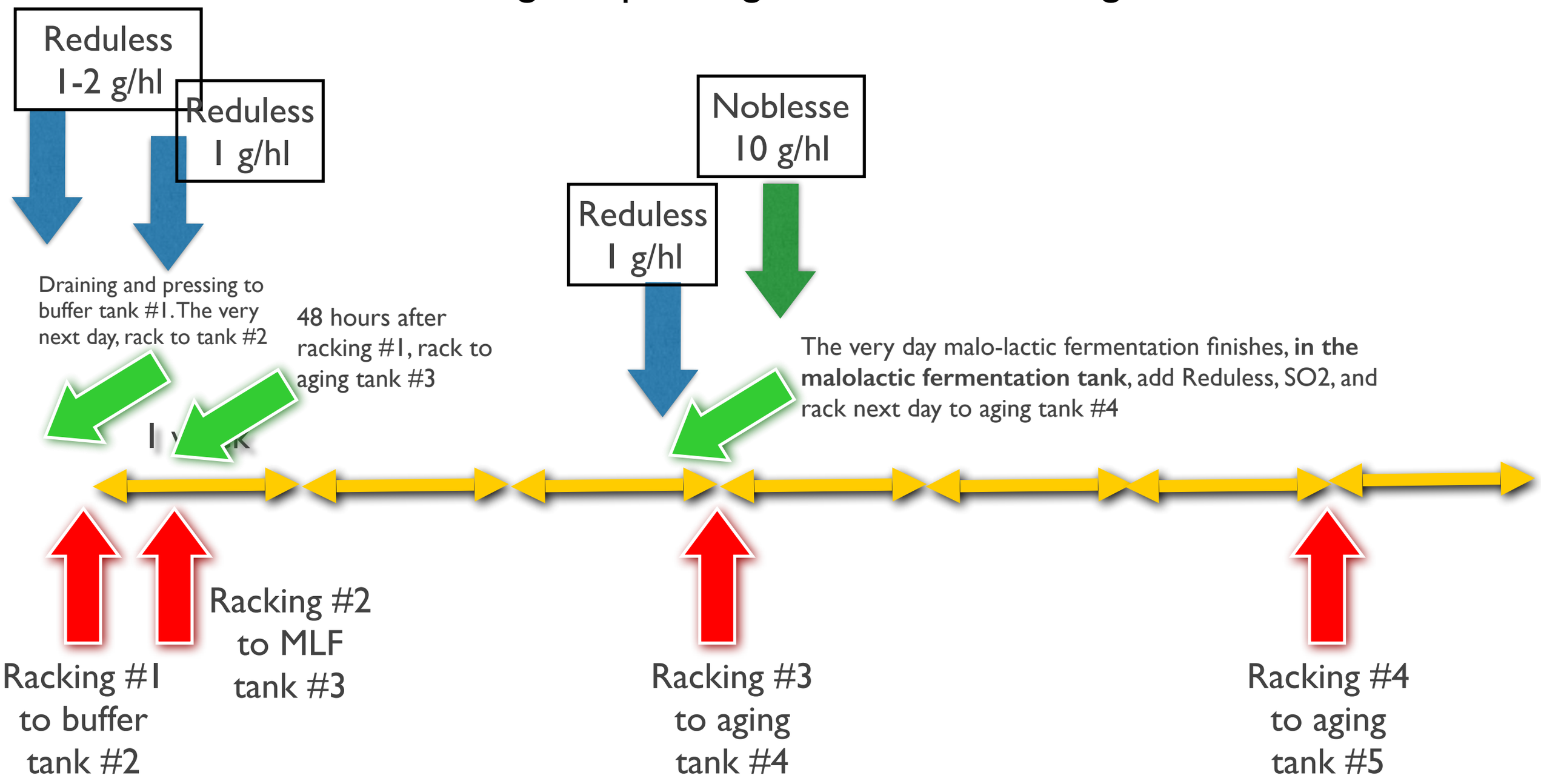
Racking agenda for a red wine fermented in tank, with malo-lactic fermentation with coinoculation yeast-bacteria. Draining and pressing without residual sugars



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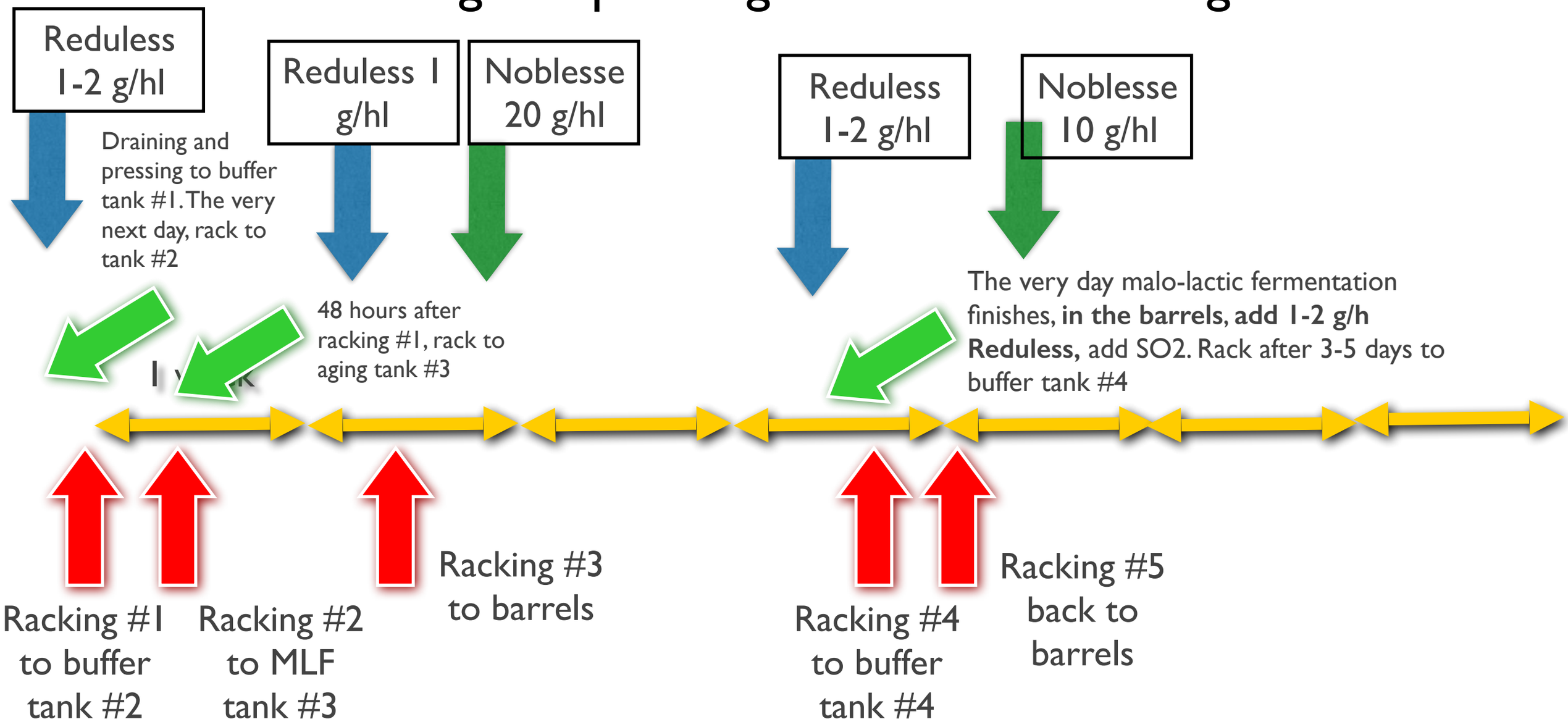
Reduless and Noblesse agenda for a red wine fermented in tank, with malo-lactic fermentation in barrels, with coinoculation yeast-bacteria.
Draining and pressing without residual sugars



Factors influencing lees segmentation and rebalancing programs: more frequent and intense actions after MLF

- **From the fruit:** high alcohol, high pH, potential harsh tasting tannins, potential herbaceous or cooked/pharmaceutical characters

- **From the winery equipment:** high temperature (after MLF, a maximum of 12°C is the recommended temperature for lees management), lack of mixing or stirring, shape of tanks (heigh/width ratio higher than 1)

- **From the winemaking team:** *Brettanomyces* (The presence of *Brettanomyces* is clearly a human responsibility), herbaceous or cooked/ oxidized characters during maceration and fermentation

How to detect on time the necessity of some extra racking or Reduless / Noblesse adjustment or filtration?

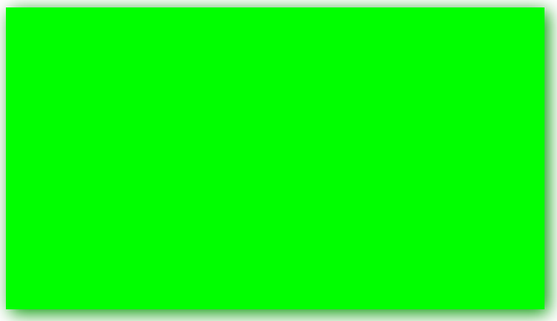
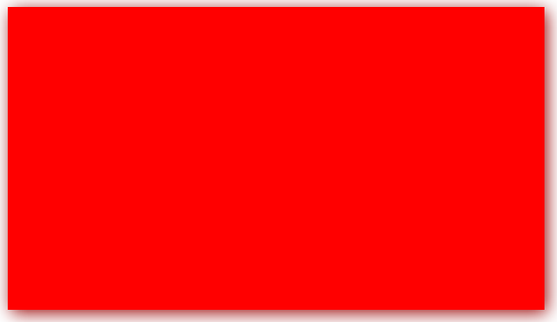
Aging DIWC's test (1)

Once the planned compulsory rackings have been made

- When? Once every 15 days until December 31th. Then, once a month
- How? Take a wine sample, if possible right after a stirring. One 750ml bottle
- Let it settle overnight at lab temperature
- Next day: decant all the wine, eliminating the sedimented lees
- Taste the decanted wine, including the "granularity" of light lees in suspension. Test direct glass additions of Reduless and Noblesse to evaluate the fruit lifting, the mouthfeel balancing.
- Taste the sedimented lees: aspect, aromas and flavors

Aging DIWC's test (2)

Decanted wine

		Conforming	Non Conforming
Heavy lees	Conforming		
	Non Conforming		

Aging DIWC's test (3)

- Go on following the planned agenda. Can think of slowing down stirring rhythm. If some Reduless/Noblesse opens the wine: treat again

- Rack. Urgently if heavy lees are really faulty

- Fix the wine problem. More frequent lees stirring can be one of the tools… if Brett or oxydation like off flavors are not the problem

- Immediate Reduless action before racking (48-72 hours settling). Rack. Noblesse addition after racking. Frequent monitoring

Light lees stirring

A complementary tool

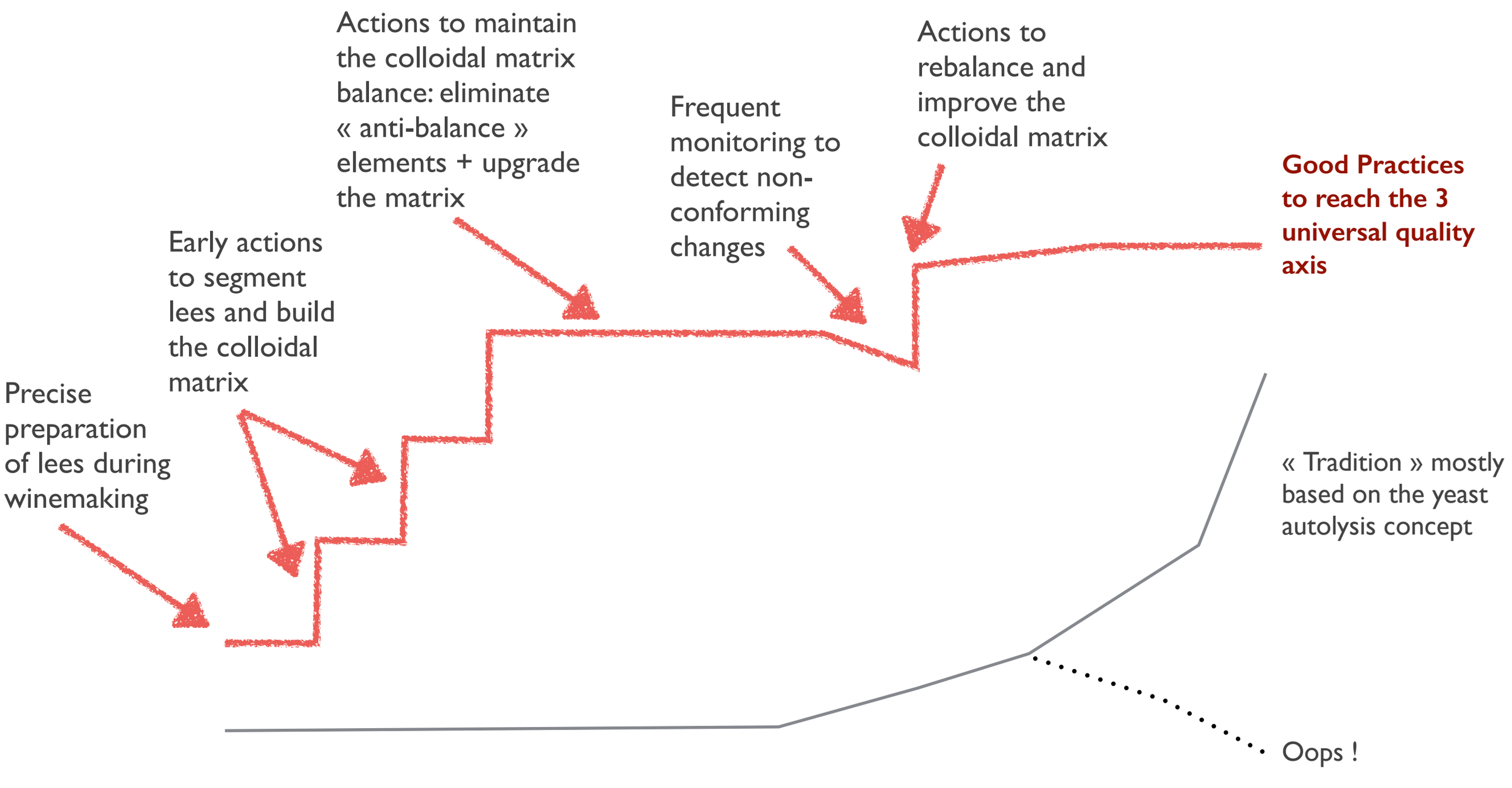
Light lees stirring

Once the planned compulsory rackings have been made

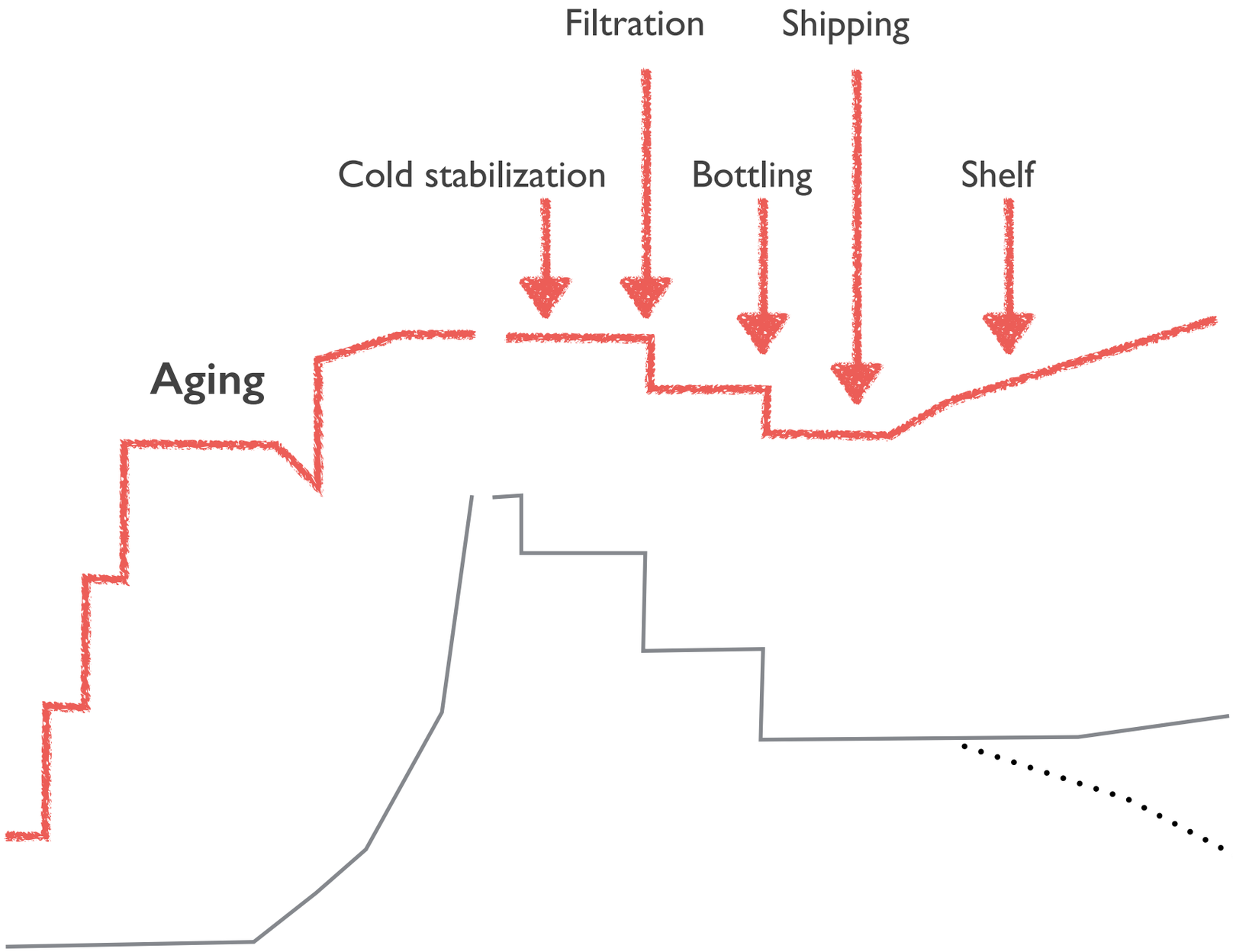
- Stirring comes in third in term of importance in lees management
- It simply follows the rhythm of the compulsory and planned rackings and first Reduless and Noblesse additions.
    - Generally once a week until the third racking and third Reduless addition
    - Two times a month until December 31th
    - Once a month after December 31th at least to make your aging DIWC's test
- It is not sensible to compensate insufficient rackings and insufficient lees rebalancing with more frequent stirrings.

Different lees management strategies

The schematic curves represent the level of « clean and sound » + « conforming longevity and consistency / stability in the consumer's glass » and « without excessive aggressivity » of the wine during aging



Consequences of pre-bottling and bottling actions, shipping and sales on the wine quality



Good Practices to reach the 3 universal quality axis

« Tradition » mostly based on the yeast autolysis concept