Welcome to the Virtual Viticulture Academy Vineyard Management Guide. This Grower Guide provides the management actions and associated tasks needed for each of the 5 phases of a successful vineyard season for mature bearing grapevines. Management actions focus on pests and diseases, fertilization and irrigation, and canopy management. This Grower Guide will also serve as a good record keeping tool for capturing grapevine phenology (growth stages) and major vineyard management activities and will be useful for annual reviews and planning for future growing seasons.

Contents

• Phase 1 – Bud Burst – Bloom
• Phase 2 – Fruit Set – Verasion Start
• Phase 3 – Verasion – Harvest
• Phase 4 – Post-Harvest – Leaf Drop
• Phase 5 – Dormancy
• Annual Vineyard Management Snapshot
• Appendix - Modified Eichhorn – Lorenz Numeric Phenology Scale

Using the Guide

For each phase, you will find a list of management actions followed by task pages aligned to numerical phenology benchmarks from the Modified Eichhorn – Lorenz Numeric Phenology Scale. A Vineyard Management Guide may be used for each distinct management block, or if blocks are small enough to be treated the same, a single guide may suffice. This guide is intended to help growers organize management decisions for their vineyards and does not substitute for record keeping for private, state or governmental agencies and Westover Vineyard Advising, LLC is not responsible for any of the outcomes of grower actions based on information or opinions compiled in this guide.

Do you have questions or a suggestion to improve this guide? Email: support@virtualviticultureacademy.com
## Phase 1 Bud Burst – Bloom

Bud burst marks the start of the growing season. Each vineyard management action will be timed according to the phenology stages that follow. Bud burst through bloom is the phase in which the grower sets the canopy size, density, and potential yield. Proper timing of each management activity is essential to reduce labor costs and to ensure your vines are healthy and ready for a successful fruit set.

### Task Timing

<table>
<thead>
<tr>
<th>Phenology Start</th>
<th>Phenology End</th>
<th>Vineyard Actions</th>
</tr>
</thead>
</table>
| (4) Bud burst   | (7) First leaf separated from shoot tip | (1) Pest & Disease Management  
(2) Fertilization & Irrigation |
| (9) 2-3 cm shoots; 2-3 leaves open | (12) 10 cm shoots; 5 leaves open | (1) Pest & Disease Management  
(2) Fertilization & Irrigation  
(3) Canopy Management  
• Sucker Removal  
• Shoot Thinning |
| (15) 8 leaves separated; flowers compact | (17) 12 leaves separated; single flowers separated | (1) Pest & Disease Management  
(2) Fertilization & Irrigation  
(3) Canopy Management  
• Sucker Removal  
• Shoot Thinning  
• Leaf Removal  
• Wire Raising |
| (19) Flowering begins; about 16 leaves | (23) 50% caps off of flowers; about 17-20 leaves | (1) Pest & Disease Management  
(2) Fertilization & Irrigation  
(3) Canopy Management  
• Shoot Thinning  
• Shoot Positioning  
• Leaf Removal  
• Wire Raising |

### Vineyard Management Actions:

1. Pest & Disease Management
2. Fertilization & Irrigation
   - Tissue Sampling – Nutrition
3. Canopy Management
   - Sucker Removal
   - Shoot Thinning
   - Leaf Removal
   - Wire Raising
   - Shoot Positioning

### Phenology Phases

Bud Burst to Bloom phenological stages:

- **(4) Bud burst**
- **(23) 50% caps off of flowers**
- About 17-20 leaves
## Bud Burst – Bloom

**Phenology**

- **(4) Bud burst**
- **(7) First leaf separated from shoot tip**

### Pests & Diseases

<table>
<thead>
<tr>
<th>Pests</th>
<th>Treatment Methods</th>
<th>Date Applied</th>
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<tbody>
<tr>
<td>Grape flea beetle</td>
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<td>Grape rootworm</td>
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<td>Other</td>
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<thead>
<tr>
<th>Diseases</th>
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<tbody>
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<tr>
<td>Other</td>
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</tbody>
</table>
## Fertilization & Irrigation

### Phase 1

#### Bud Burst – Bloom

- **Bud burst**
- **First leaf separated from shoot tip**

<table>
<thead>
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<th>Block ID</th>
<th>Date</th>
<th>Date</th>
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</table>

#### Fertilization:

- **Ground applied**: First of annual maintenance rates applied at this stage
- **Drip injected**: Early for drip injected fertilizer unless correcting chronic deficiencies
- **Foliar applied**: Foliar application is not typical at this stage

#### Fertilizer Applied:

<table>
<thead>
<tr>
<th>Block</th>
<th>Product</th>
<th>Rate/Acre</th>
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#### Irrigation:

- **Soil profile at full moisture capacity to depth of roots**

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<tr>
<th>Block</th>
<th>Inches/Acre</th>
<th>Gallons/Acre</th>
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### Academy Grower Guides

- Assessing Grapevine Nutrition
- Compost Rate Calculator
- Nutrients Commonly Low in Vineyards
- Understanding Seasonal Nutritional Requirements – Tips & Tricks
- Vineyard Management Preparation Webinar
# Pests & Diseases

## Bud Burst – Bloom

| Block ID: ___________________ | Date: ________________ | Date: ________________ |

### Phenology
- **Phase 1**
  - (9) 2-3cm shoots
  - 2-3 leaves open
  - (12) 10 cm shoots
  - 5 leaves open

### Actions

#### Pests:
- **Grape flea beetle**: __________________________________________________________________________
- **Grape rootworm**: __________________________________________________________________________
- **Climbing cutworms**: _________________________________________________________________________
- **Other**: _________________________________________________________________________________

#### Diseases:
- **Anthracnose**: __________________________________________________________________________
- **Phomopsis**: ______________________________________________________________________________
- **Powdery mildew**: __________________________________________________________________________
- **Downy mildew**: ____________________________________________________________________________
- **Other**: _________________________________________________________________________________

#### Treatment Methods

<table>
<thead>
<tr>
<th>Pests:</th>
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<th>Diseases:</th>
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### Academy Grower Guides

- [Common Fungal Diseases of Winegrapes](#)
- [Effective Vineyard Spraying](#)
- [Grape Spray Record Tool](#)
- [Managing Disease Resistance in the Vineyard Webinar](#)
- [Pre-Bloom Field Course 2018 Video](#)
- [Spray Program Strategies Webinar](#)
Fertilization & Irrigation

Phase 1

Bud Burst – Bloom

Phenology

(9)
2-3cm shoots
2-3 leaves open

(12)
10 cm Shoots
5 leaves open

Fertilization:
- Ground applied
- Drip injected
- Foliar applied

Notes
- First of annual maintenance rates can still be applied if not done yet
- Early for drip injected fertilizer unless correcting chronic deficiencies
- Foliar application is not typical at this stage

Fertilizer Applied:

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<thead>
<tr>
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Irrigation: Soil profile at full moisture capacity to depth of roots

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Academy Grower Guides
- Assesing Grapevine Nutrition
- Compost Rate Calculator
- Nutrients Commonly Low in Vineyards
- Pre-Bloom Vineyard Management Webinar
- Understanding Seasonal Nutritional Requirements – Tips & Tricks
**Sucker Shoot Removal**

Shoots will often grow from areas on the vine that are not desired, such as on trunks or undersides of cordons on non-divided training systems. These non-count shoots or “sucker shoots” need to be removed. There are some machines that can assist with sucker shoot removal from trunks and cordon undersides, however this activity is typically done by hand. Shoots may need to be retained on some vines if new canes or cordons must be produced or old ones replaced, in which case shoots at positions at the head of the trunk, just below the fruiting wire are desired.

**Early Shoot Thinning**

Removal of sucker shoots is also done along fruiting canes or cordons if the grower wishes to reduce the shoot density per linear measure of fruiting wire. Early shoot removal is often faster than shoot removal later in the season. Some growers in frost or hail prone sites may prefer to limit shoot thinning along the fruiting wire until these risks have passed. In this case shoot removal is primarily focused on removal of sucker shoots from trunks and those growing in the wrong direction along the fruiting wire.
## Pests & Diseases

### Phase 1: Bud Burst – Bloom

**Phenology**
- (15) 8 leaves separated
- Flowers compact
- Date: ____________
- (17) 12 leaves separated
- Single flowers separated
- Date: ____________

### Actions

**Pests:**
- Grape berry moth
- Grape flea beetle
- Grape rootworm
- Other

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**Diseases:**
- Anthracnose
- Black rot
- Downy mildew
- Phomopsis
- Powdery mildew
- Other

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- Effective Vineyard Spraying
- Grape Berry Moth Identification
- Grape Spray Record Tool
- Managing Disease Resistance in the Vineyard Webinar
- Pre-Bloom Vineyard Management Webinar
- Phosphorous Acid Products for Controlling Downy Mildew
- Spray Program Strategies Webinar
- Sticky Card Pest Traps – Use Tips
**Phase 1**

**Bud Burst – Bloom**

- **Phenology**
  - (15) 8 leaves separated
  - Flowers compact
  - (17) 12 leaves separated
  - Single flowers separated

**Actions**

- **Fertilization**
  - Ground applied: First of annual maintenance rates can still be applied if not done yet
  - Drip injected: Ideal time for injection of maintenance fertilizers (N, P, K, B, Mo, Zn, Mn)
  - Foliar applied: Foliar application of micronutrients to assist fruit set or foliar nitrogen

| Block ID: ___________________ Date: ________________ Date: ________________ |
|-----------------------------|-----------------------------|

**Fertilizer Applied:**

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**Irrigation:** Soil profile at or above 80% volumetric water holding capacity to depth of roots

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**Academy Grower Guides**

- Assessing Grapevine Nutrition
- Grapevine Petiole Sampling
- Instructions for Grape Leaf Blade Sampling
- Instructions for Grape Petiole Sampling
- Nutrients Commonly Low in Vineyards
- Pre-Bloom Vineyard Management Webinar
- Understanding Seasonal Nutritional Requirements – Tips & Tricks
Canopy Management

Phase 1

Bud Burst – Bloom

Phenology

(15)
8 leaves separated
Flowers compact

(17)
12 leaves separated
Single flowers separated (caps on)

Block ID: ___________________ Date: ________________ Date: ________________

Actions

Sucker Shoot Removal – 2nd pass for clean up if needed
Shoots will often grow from areas on the vine that are not desired. The first pass of sucker removal from trunks and cordon undersides should have been completed earlier. This pass is primarily to clean up any new shoots that may have emerged since the last pass. This action can be done in tandem with shoot thinning described below.

Shoot Thinning
Shoot removal or “shoot thinning” along the fruiting wire should begin at this time. The priority is to set the canopy density to the desired cropping level with a final shoot density resulting in 3 to 6 shoots per linear foot of fruiting wire on a non-divided training system. Uniform shoot distribution is desired and the crew should favor the removal of non-fruit bearing shoots and shoots in positions not desired, such as shoots growing downward on a vertical canopy system. For quick action thinning target areas that appear dense, such as spur or node positions containing numerous shoots (including secondary shoots from non-count buds). Ideally, shoot thinning should be done before shoots reach 12 inch length on average. Later thinning may be more time consuming and costly.

Notes: sometimes shoots that are not fruitful may need to be retained in order to create a spur position or fruiting cane for the following season. If a second trunk or replacement trunk or cordon is desired on some vines, it is important to train the work crew to leave shoots in the appropriate areas on the trunk to create replacement parts for vines as needed.

Leaf Removal
Removal of leaves in the fruit zone is typically not done this early in the season, however research has shown that leaf removal in the fruit zone just prior to bloom results in less compact clusters, fewer berries per cluster, and reduced incidence of bunch rots later in the season. Unless the block has a history of bunch rot problems leaf removal should be delayed until bloom or just after fruit set. Flower necrosis caused by *Botrytis cineria* may be reduced if leaves are removed just before bloom. This reduction is likely due to a combination of increased airflow, increased solar radiation, and improved contact with sprays for bunch rot applied at or near bloom. It may be necessary to remove leaves near flowers on varieties highly susceptible to bunch rots.

Wire Raising
Vertical shoot positioned training systems with movable catch wires may begin raising the first set of catch wires at this time (12-14 inches above the fruiting wire). Wires are typically raised after shoot thinning and before leaf removal (a few days before at least).
**Pests & Diseases**

**Phase 1**

**Bud Burst – Bloom**

**Phenology**

- **(19)** Flowering begins
  - About 16 leaves

- **(23)** 50% caps off of flowers
  - About 17-20 leaves

**Actions**

<table>
<thead>
<tr>
<th>Block ID: ___________________ Date: ________________ Date: ________________</th>
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</thead>
</table>

**Pests:**

- **Grape berry moth**
- **Grape leafhopper**
- **Japanese beetle**
- **PD vectors**
- **Other**

**Treatment Methods**

**Date Applied**

<table>
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<th>Pests:</th>
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<tr>
<td>Other</td>
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**Diseases:**

- **Anthracnose**
- **Black rot**
- **Botrytis bunch rot**
- **Downy mildew**
- **Phomopsis**
- **Powdery mildew**
- **Other**

**Treatment Methods**

**Date Applied**

<table>
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<th>Treatment Methods</th>
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**Academy Grower Guides**

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- Effective Vineyard Spraying
- Grape Berry Moth Identification
- Grape Spray Record Tool
- Phosphorous Acid Products for Controlling Downy Mildew
- Spray Program Strategies Webinar
- Sticky Card Pest Traps – Use Tips
Fertilization & Irrigation

**Phase 1**

**Bud Burst – Bloom**

**Fertilization:**
Early bloom (25-50% cap fall) is the ideal time to sample plant tissue (whole leaf or petiole) for submission to the lab for nutrient analysis. Maintenance fertilization should be complete before this phenological stage and the focus moving forward is to fertilize based on plant tissue results obtained at this time (and again at veraison). Exceptions of nutrients to be applied at this time would include soil applied fertilizers to correct chronic nutritional deficiencies (e.g. magnesium, potassium, iron).

**Fertilizer Applied:**
- Block ID: ___________________
- Date: ________________
- Date: ________________

**Irrigation:** Soil profile at or above 80% volumetric water holding capacity to depth of roots.
- Block ID: ___________________
- Date: ________________
- Date: ________________

**Phenology**

- Flowering begins (19)
  - About 16 leaves
- 50% caps off of flowers (23)
  - About 17-20 leaves

**Actions**

**Academy Grower Guides**
- Assessing Grapevine Nutrition
- Grapevine Petiole Sampling
- Instructions for Grape Leaf Blade Sampling
- Instructions for Grape Petiole Sampling
- Leaf/Petiole Analysis Form – Bloom – [Member | Client]
- Nutrients Commonly Low in Vineyards
- Understanding Seasonal Nutritional Requirements – Tips & Tricks
- Water Analysis Form – [Member | Client]
Canopy Management

Phase 1

Bud Burst – Bloom

(19)
Flowering begins
About 16 leaves

(23)
50% caps off of flowers
About 17-20 leaves

Actions

Shoot Thinning
Shoot removal or “shoot thinning” along the fruiting wire can still be done at this time however it is late to efficiently remove undesired shoots due to hardening of periderm near the base of shoots and tendrils grabbing onto wires or neighboring shoots. Shoot thinning considerations can be reviewed in Canopy Management for Phenology stages 15-17.

Shoot Positioning
Hand positioning of shoots to vertical, divided, or downward training systems should begin at this time to ensure shoots are conforming to the intended training system. Wire raising (see below) can accomplish some degree of shoot positioning, but hand positioning may be needed in addition to wire raising to ensure proper shoot positions.

Leaf Removal
Removal of leaves in the fruit zone typically begins at flowering and into fruit set for bunch rot susceptible varieties. Flower necrosis caused by *Botrytis cinerea* may be reduced if leaves are removed just before bloom. This reduction is likely due to a combination of increased airflow, increased solar radiation, and improved contact with sprays for bunch rot applied at or near bloom. It may be necessary to remove leaves near flowers on varieties highly susceptible to bunch rots and flower necrosis caused by *Botrytis cinerea*.

Notes: The intensity of leaf removal will depend not only on susceptibility to bunch rots but also on the climate in the growing region from fruit set to harvest. Growers in hot climates may opt to pull only leaves on the side of the canopy exposed to early morning sun, and pull less leaves or no leaves on the side of the canopy exposed to direct hot afternoon sun. Local experience will need to be developed in order to achieve the benefits of leaf removal (reduced disease and methoxypyrazines, increased anthocyanins) without negative consequences (heat stressed or sunburned fruit).

Wire Raising
Vertical shoot positioned training systems with movable catch wires may need wires raised at this time or wait until fruit set is complete.

Academy Grower Guides

- Late Shoot Thinning Strategies for a VSP Canopy
- Pre-Bloom Field Course 2018
- Pre-Bloom Vineyard Management Webinar
- Shoot Thinning High Cordon Vines
Phase 2 Fruit Set to Verasion

Fruit set marks the first milestone in achieving a healthy crop for the season. Two weeks before fruit set to 6 weeks after is the critical period for disease and pest prevention. Vineyard management activities in this phase focus on improving fruit quality, maintaining canopy architecture and establishing crop load.

Task Timing

<table>
<thead>
<tr>
<th>Phenology Start</th>
<th>Phenology End</th>
<th>Vineyard Actions</th>
</tr>
</thead>
<tbody>
<tr>
<td>(27) Berries setting; flowers at right angle to stem</td>
<td>(29) Berries peppercorn size (2mm); Bunches tending downward</td>
<td>(1) Pest &amp; Disease Management</td>
</tr>
<tr>
<td>(31) Berries pea size (7mm); Bunches hanging down</td>
<td>(33) Berries touching (bunch closure); Berries hard and green</td>
<td>(2) Fertilization &amp; Irrigation</td>
</tr>
<tr>
<td>(34) Berries begin to soften; Sugar starts increasing</td>
<td>(35) Berries begin to color and enlarge (5-25% color change)</td>
<td>(3) Canopy Management</td>
</tr>
</tbody>
</table>

Vineyard Management Actions:
1. Pest & Disease Management
2. Fertilization & Irrigation
3. Canopy Management
   - Shoot Positioning
   - Leaf Removal
   - Hedging (Topping)
   - Wire Raising
   - Fruit Thinning

We hope you found Phase 1 of the Vineyard Management Guide helpful.

Get the full Vineyard Management Guide and all of the exclusive Virtual Viticulture Academy member-only content when you join now!
## Appendix - Modified Eichhorn – Lorenz Numeric Phenology Scale

<table>
<thead>
<tr>
<th>MAJOR STAGES</th>
<th>E-L number</th>
<th>ALL STAGES</th>
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<tbody>
<tr>
<td></td>
<td>1</td>
<td>Winter bud</td>
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<tr>
<td>4 Budburst</td>
<td>2</td>
<td>Bud scales opening</td>
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<tr>
<td></td>
<td>3</td>
<td>Wooly bud + green showing</td>
</tr>
<tr>
<td></td>
<td>4</td>
<td>Budburst; leaf tips visible</td>
</tr>
<tr>
<td></td>
<td>7</td>
<td>First leaf separated from shoot tip</td>
</tr>
<tr>
<td></td>
<td>9</td>
<td>2 to 3 leaves separated; shoots 2-4 cm long</td>
</tr>
<tr>
<td></td>
<td>11</td>
<td>4 leaves separated</td>
</tr>
<tr>
<td></td>
<td>12</td>
<td>5 leaves separated; shoots about 10 cm long; inflorescence clear</td>
</tr>
<tr>
<td></td>
<td>13</td>
<td>6 leaves separated</td>
</tr>
<tr>
<td></td>
<td>14</td>
<td>7 leaves separated</td>
</tr>
<tr>
<td></td>
<td>15</td>
<td>8 leaves separated; shoot elongating rapidly; single flowers in compact groups</td>
</tr>
<tr>
<td></td>
<td>16</td>
<td>10 leaves separated</td>
</tr>
<tr>
<td></td>
<td>17</td>
<td>12 leaves separated; inflorescence well developed; single flowers separated</td>
</tr>
<tr>
<td></td>
<td>18</td>
<td>14 leaves separated; flower caps still in place, but cap colour fading from green</td>
</tr>
<tr>
<td></td>
<td>19</td>
<td>About 16 leaves separated; beginning of flowering (first flower caps loosening)</td>
</tr>
<tr>
<td></td>
<td>20</td>
<td>10% caps off</td>
</tr>
<tr>
<td></td>
<td>21</td>
<td>30% caps off</td>
</tr>
<tr>
<td></td>
<td>23</td>
<td>17-20 leaves separated; 50% caps off (≈ flowering)</td>
</tr>
<tr>
<td></td>
<td>25</td>
<td>80% caps off</td>
</tr>
<tr>
<td></td>
<td>26</td>
<td>Cap-fall complete</td>
</tr>
<tr>
<td></td>
<td>27</td>
<td>Setting: young berries enlarging (&gt;2 mm diam.), bunch at right angles to stem</td>
</tr>
<tr>
<td></td>
<td>29</td>
<td>Berries pepper-corn size (4 mm diam.); bunches tending downwards</td>
</tr>
<tr>
<td></td>
<td>31</td>
<td>Berries pea-size (7 mm diam.)</td>
</tr>
<tr>
<td></td>
<td>32</td>
<td>Beginning of bunch closure, berries touching (if bunches are tight)</td>
</tr>
<tr>
<td></td>
<td>33</td>
<td>Berries still hard and green</td>
</tr>
<tr>
<td></td>
<td>34</td>
<td>Berries begin to soften; Sugar starts increasing</td>
</tr>
<tr>
<td></td>
<td>35</td>
<td>Berries begin to colour and enlarge</td>
</tr>
<tr>
<td></td>
<td>36</td>
<td>Berries with intermediate sugar values</td>
</tr>
<tr>
<td></td>
<td>37</td>
<td>Berries not quite ripe</td>
</tr>
<tr>
<td></td>
<td>38</td>
<td>Berries harvest-ripe</td>
</tr>
<tr>
<td></td>
<td>39</td>
<td>Berries over-ripe</td>
</tr>
<tr>
<td></td>
<td>41</td>
<td>After harvest; cane maturation complete</td>
</tr>
<tr>
<td></td>
<td>43</td>
<td>Beginning of leaf fall</td>
</tr>
<tr>
<td></td>
<td>47</td>
<td>End of leaf fall</td>
</tr>
</tbody>
</table>

*Figure 7.2. Modified E-L system for identifying major and intermediate grapevine growth stages (revised from Coombe 1995). Note that not all varieties show a woolly bud or a green tip stage (May 2000) hence the five budburst stages in the modified original 1995 system have been changed slightly by removing stage 4 and allocating the definition of budburst to what was formerly stage 5. Revised version of “Grapevine growth stages. – The modified E-L system” Viticulture 1 – Resources. 2nd edition 2004. Eds. Dry, P. and Coombe, B. (Winefiles)*

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