NO. 14
Herbicide Application and Resistance Management
Andrew Weeks and Nicole Pitman, Viticultural Officers, CCW

GENERAL APPLICATION GUIDELINES
Herbicides may be either knock down (broad spectrum which kill a wide range of weeds (eg glyphosate), or selective, where they are effective against only one type of weed (eg fluazifop).

Herbicides commonly work with one of three modes of action either;
- **Fully Systemic** – the herbicide is absorbed into the plant and moves within the tissue and throughout the plant to kill the plant, movement from the leaves to the roots in the phloem tissue
- **Contact** – the herbicide is absorbed into the plant and moves within the tissue in the xylem. These herbicides generally only kill the plant tissue where it contacts the plant.
- **Pre-emergent** – the herbicide is applied directly to bare soil and the herbicide is absorbed by the germinating weed seed.

Examples-
<table>
<thead>
<tr>
<th>Fully Systemic</th>
<th>Contact / Partially Systemic</th>
<th>Pre-emergent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Glyphosate</td>
<td>Diquat</td>
<td>Simazine</td>
</tr>
<tr>
<td>Fusilade Forte®</td>
<td>Paraquat</td>
<td>Duron</td>
</tr>
</tbody>
</table>

The type of herbicide chosen will have an influence on the amount of water that is required to be applied in order for the herbicide to cover and be taken up by the plant. Generally speaking, contact herbicides require higher water rates to achieve adequate coverage and control than fully systemic herbicides. Likewise larger weeds will also require higher water rates for adequate control than smaller weeds. It is important to always read the label and follow recommendations to get an effective weed kill. If excessive water rates, excessive adjuvant rates or even if adjuvants are added with herbicides that already contain adjuvants (Spray Seed 250® for example already contains an adjuvant in the formulation), it is likely that much of the herbicide could be washed off and the effectiveness of kill will be reduced. This may also cause environmental concerns. Some herbicides require addition of adjuvants at certain application rates.

It is vital that label recommendations are followed for any chemical application. This is especially the case with herbicide use for the following reasons:
- Some herbicides are subject to withholding periods (Check the Accolade Wines Spray Diary as well);
- Some pre-emergent herbicides require different water and chemical application rates depending on soil texture. Some have different incorporation requirements;
- Some herbicides have restriction of application depending on vine age;

Things to consider, to achieve an effective weed kill are-
- Apply when weeds are small, low populations, and not under stress (drought, waterlogging, frost).
- Avoid spraying when weeds are dusty
- Calibrate herbicide equipment
- Reduce spray drift
- Ensure double overlap of nozzle patterns at the top of the weed canopy
- Ensure correct adjuvants are added
ADJUVANTS

An adjuvant is any additive when mixed with a herbicide, is aimed at improving the effectiveness of the herbicide. Adjuvants can be classified as:

- **Surfactants** - increase the spread of droplets, or the wetting of waxy or hair surfaces. (E.g. BS1000®)
- **Penetrants** - these specific compounds which help dissolve waxy cuticles. (E.g. Pulse®)
- **Acidify/buffering Agents** - lower the pH of the spray solution (more acidic). (E.g. Primabuff®)
- **Compatibility Agents** – reduces the likelihood of antagonism from other agents in spray solution. Ammonium sulphate can be used to neutralise the effects of hard water on amine formulation such as glyphosate. (E.g. Liase®)
- **Vegetable Oils** – can reduce rainfast periods, give more uniform droplet size, reduce spray evaporation and lead to better penetration of herbicide into waxy leaves. (E.g. Synertrol Horti Oil®)

Always consult the herbicide label to determine if a specific adjuvant needs to be added to the spray solution.

DRIFT MINIMISATION

Spray drift is becoming a critical issue in herbicide application, and now is included in some label recommendations. Various things can affect spray drift, wind, inversion layers, nozzle type, adjuvants, Delta T and type of herbicide used. Spray drift is more likely when there are relative high wind speeds, a temperature inversion, and the spray is in small droplets.

Things to consider are -

1. **Wind speed** - Generally spray during the day when wind is between 3 and 15km/hr. as measured at the application site. Do not spray when there is little or no wind. If possible spray when wind is blowing away from any nearby susceptible plants/crops. I.e. neighbours’ crops/pastures.

2. **Temperature inversion** - Temperature inversions can lead to high concentrations of airborne pesticides being transported close to the surface in light and variable winds to area that cannot be predetermined. A surface temperature inversion is likely to be present if some of the following conditions are satisfied:
   - Mist, fog or dew have occurred
   - Smoke or dust hangs in the air and moves sideways, just above the ground surface
   - Wind speed is constantly less than 11km/hr. in the evening and overnight
   - Cumulus clouds that have built up during the day collapse towards evening
   - Distant sounds become clearer and easier to hear
   - Aromas become more distinct during the evening than during the day
   - Cool off-slope breezes develop during the evening and overnight

3. **Spray timing** - Spray during the day where possible, to reduce the possibility of a temperature inversion. Do not spray from 1 ½ hours before sunset until 1½ hours after sunrise, unless there is no surface temperature inversion.

4. **Delta T** - Delta T is an indicator based on the difference between the wet and dry bulb temperatures. It combines the effects of temperature and relative humidity. Delta T is a good indicator of the rate at which a herbicide droplet will evaporate. Spraying in excessively dry conditions can result in herbicides evaporating very rapidly, before they can be absorbed into the plant. This can reduce effectiveness. A common guideline is to spray when Delta T is between 2 and 8.

5. **Nozzle type** - Use nozzle types and operating pressures that produce a coarse spray quality, or larger flat fan nozzles should be selected for operation at the correct output and pressure. Consider nozzles such as “minidrift®” or other air – induction nozzles that produce large droplets that are less prone to drift.
RESISTANCE MANAGEMENT

Herbicide resistance develops when individual weeds that are naturally resistant survive a particular herbicide application and set seed, allowing further generations to continue to survive. This results in a significant part of the successive weed populations with resistance. There are four main factors that influence the development of resistance-

(1) **The intensity of selection**
   - Relates to how many weeds are killed by a herbicide. Poor control of weeds will result in an increase in weed numbers and put pressure on all herbicides used.

(2) **The frequency of use of a herbicide or mode of action group**
   - The greater the use of any particular herbicide mode of action group, the higher the selection pressure and higher the risk of herbicide resistance developing for that herbicide mode of action group.

(3) **The frequency of resistance present in an untreated population**
   - The greater the frequency of a resistant gene in a population the quicker resistance will occur.

(4) **The biology and density of the weed**
   - Weed species that produce large numbers of seed and have a short seed bank life in the soil will develop resistant populations faster.
   - Resistance is more likely detected in large weed populations

Diagram 1. How resistance develops

<table>
<thead>
<tr>
<th>1st Generation</th>
<th>2nd Generation</th>
</tr>
</thead>
<tbody>
<tr>
<td>X X X X X</td>
<td>X X X X X</td>
</tr>
<tr>
<td>X X X X X</td>
<td>X X X X X</td>
</tr>
<tr>
<td>X X X X X</td>
<td>X X X X X</td>
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<tr>
<td>X X X X X</td>
<td>X X X X X</td>
</tr>
</tbody>
</table>

Herbicide Applied

X=Individual weeds X= Individual weeds with herbicide resistance

Table 1: Assessment of resistance risk

<table>
<thead>
<tr>
<th>Management Option</th>
<th>Risk of Resistance</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Low</td>
</tr>
<tr>
<td>Herbicide Mix or rotation</td>
<td>&gt;2 modes of action</td>
</tr>
<tr>
<td>Weed control methods</td>
<td>Cultural, mechanical, and chemical</td>
</tr>
<tr>
<td>Use of same mode of action per season (herbicide group)</td>
<td>Once</td>
</tr>
<tr>
<td>Poor herbicide application practices (coverage, timing, rate, conditions)</td>
<td>Low coverage or uptake but no weeds survive to set seed</td>
</tr>
<tr>
<td>Weed infestation</td>
<td>Low</td>
</tr>
<tr>
<td>Control in last 3 years</td>
<td>Good</td>
</tr>
</tbody>
</table>

(reference: [www.pestresistance.com](http://www.pestresistance.com))
Ways to minimise risk of resistance developing:-

1. Use of alternate herbicide modes of action (groups) including residual herbicides
2. Use a “double knock” application – full glyphosate rate followed by a full label rate of Paraquat with the application being 5-7 days apart depending on weather conditions between the herbicide applications
3. Use of non-herbicide practices for weed control e.g. mowing (especially mid-row), mulching
4. Stopping weed control escapes from setting seed
5. Enter spring with low weed numbers
6. Ensure that machinery coming onto the property is clean (seed free)
7. Using cover crops and sod to compete with weeds
8. Ensure that application equipment is well maintained, and that herbicide label rates are followed

An example of alternate herbicide groups to control couch are-

<table>
<thead>
<tr>
<th>Chemical Name</th>
<th>Active Ingredient</th>
<th>Group</th>
<th>Rate</th>
<th>Water/Ha</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fusilade Forte</td>
<td>Fluazifop-p</td>
<td>A</td>
<td>3.3 – 6.6 L/ha</td>
<td>250L</td>
</tr>
<tr>
<td>Roundup Attack</td>
<td>Glyphosate (570gm/L)</td>
<td>M</td>
<td>1.9L/ha</td>
<td>300L</td>
</tr>
</tbody>
</table>

FURTHER INFORMATION


DISCLAIMER

The information supplied in the Fact Sheet was the best available at the time of publication. However, the understanding and control of pests and diseases is constantly evolving and recommendations regularly change. The reader should seek a professional opinion before acting upon information in this Fact Sheet and should always comply with the winery’s requirements and recommendations, food safety legislation and the information on chemical product labels.

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Box 238, Berri, South Australia 5343
Telephone (08) 8582 0355 Facsimile (08) 8583 2104