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ABSTRACT

Levels of bird damage to grape crops in the Adelaide Hills in season 2000 ranged from 11% to 97% bunches damaged with a mean of 46% bunches damaged. This corresponded to a total loss ranging from 0.5% to 39% grapes damaged with an average overall loss of 5% of grapes. The damage estimates for the 2000 season were statistically higher than those assessed in 1999.

The rate at which the bird damage occurred was similar between blocks, ranging from 0% to 2% new bunches damaged per day with an average of 0.6% of new bunches being damaged per day. This corresponded to an increase in damage ranging from 0% to 0.08% grapes damaged per day with an average value of 0.02% grapes damaged per day.

Despite different control methods being implemented between the vineyards, damage to new bunches occurred at all vineyards at similar rates. This implies that no control methods used in the study stopped damage from occurring, and that there were no apparent differences in the effectiveness of different methods of bird control. However, no participating vineyards were able to implement Best-Practice methods of bird management in the 2000 season.

Some vineyards had high levels of damage at first assessment (up to 79% of bunches damaged, 19% of grapes damage) before the grapes were ripe. Earlier bird control strategies should be implemented by these vineyards.

INTRODUCTION

In 1999, a study funded by the Adelaide Hills Grape-growers Association investigated bird damage to grape crops in the Adelaide Hills.

The birds that damaged grapes in the Adelaide Hills in 1999 included the native species Adelaide Rosella *Platycercus elegans adelaidae*, Red Wattlebird *Anthochaera carunculata*, Silvereye *Zosterops lateralis* and Little Raven *Corvus mellori*. The introduced species Common Starling *Sturnus vulgaris* and European Blackbird *Turdus merula* also damaged grapes. The Adelaide Rosella, Common Starling, and Red Wattlebird accounted for most of the birds in the vineyards.

Surrounding habitat type, tree cover, vine-canopy density, sugar concentration, and grape variety were likely to influence the level of damage.

Total grape damage in 1999 ranged from negligible levels to nine percent of grapes lost, although most blocks in the study had between one and two percent grapes lost.

This study aimed to:

1 - measure the levels of bird damage in grape crops in the Adelaide Hills for the 2000 harvest;
2 - compare 2000 damage estimates with those of 1999;
3 - record changes in damage levels over the ripening season; and
4 - examine relationships between bird control efforts and levels of damage.

The intention of the fourth aim was to determine if there were any consistent differences in the daily rates of damage on individual blocks that differed in the intensity or type of bird control that was being implemented.

METHODS

Six vineyards were studied, one each in Lenswood and Meadows, and two each in Eden Valley and Balhannah. These vineyards were: Henschke Vineyard, Lenswood (L1); Bingfield Vineyard, Meadows (M1); Southcorp Eden Valley Vineyard, Eden Valley (E1); Yalumba Heggies Vineyard, Eden Valley (E2); Vigara Vineyard, Balhannah (B1); and The Deanery, Balhannah (B2).

Eight varieties of grape were surveyed for bird damage at these vineyards, including white grapes (Chardonnay, Riesling, Sauvignon Blanc and Viognier) and red grapes (Cabernet Franc, Cabernet Sauvignon, Merlot and Shiraz). For some varieties levels of damage were assessed for only one block, while others had up to ten blocks surveyed. In all, assessments of bird damage were made on 26 blocks. Of these, 20 had two or more assessments made.

Where possible, two assessments of damage by birds to grapes were made in each block; one early in the season once damage and bird control programs had commenced, and again immediately prior to picking. The technique developed by Sinclair (2000) was used to estimate levels of damage (Appendix 1). This involved randomly selecting a sample of vines within a block and then scoring the bird damage of random bunches on the selected vines. Sinclair and Campbell (unpubl.) had previously established a relationship between percent bunches damaged and percent grapes damaged within a block, and this relationship was used to estimate bird damage. The relationship between percent bunches damaged and percent grapes lost is: Percent grape loss = ($e^{0.038 \text{ X percent bunches damaged}}$) – 1 (Sinclair & Campbell unpubl.). The damage estimates in this report are in terms of "percent bunches damaged" to improve accuracy when dealing with high damage levels.

So that accurate measures of changes in damage could be recorded, individual bunches that were scored early in the season were tagged and reassessed one to two days prior to picking. Bunches were tagged using small lengths of plastic flagging tape.

Bunches were inspected and scored for bird damage using the following scale:
0 = no damage,
1 = <10% of grapes in bunch damaged,
2 = 10-30% of grapes in bunch damaged,
3 = 31-60% of grapes in bunch damaged, and
4 = >60% of grapes in bunch damaged.
This scaling system was used to examine changes in damage to individual bunches from one survey to another.

There are a number of different ways in which growers can attempt to control birds in their vineyards. The “Best-Practice Method” (Sinclair 2000) is rarely used in the Adelaide Hills area, although the use of gas guns, shooting, kites and other bird scaring methods is common. The bird control effort employed by the growers was entered into logbooks (Appendix 2) and the information used to subjectively scale the effort into high, medium and low bird control efforts. The intensity of the application and the diversity of methods used were considered when scaling the effort.

RESULTS

Final levels of bird damage for the 2000 grape crop

Across all grape varieties, bird damage ranged from 11% to 97% of bunches damaged with an overall mean of 46% of bunches damaged (Fig. 1). There was no significant difference between the damage levels for the Shiraz compared to all other varieties combined (Mann-Whitney Test: P=0.07, Z=1.82, NS).

No statistical difference was found between the damage levels of the red grapes and the white grape varieties (Mann-Whitney Test: P=0.51, Z=0.65, NS), but sampling was limited for some varieties (Fig. 2).

Comparison of damage estimates in 1999 with 2000

The damage levels for all varieties in 2000 were significantly greater than those in 1999 (Mann-Whitney Test: P=0.0004, Z=-3.55) (Fig. 2). In 1999 none of the mean levels of damage for any variety was greater than 40% of bunches damaged. In 2000, only one out of the eight varieties had a mean damage level that was below 40% of bunches damaged (Sauvignon Blanc) (Fig. 2).

Changes to bird damage over the ripening season

The rate of increase in bird damage over time was reasonably consistent across all blocks, with daily rates ranging from 0% to 2% new bunches damaged per day and a mean of 0.64% (Fig. 3, 4 & 5). For white grapes the daily rate of increase in damaged bunches ranged from 0% to 1% with a mean of 0.69% (Fig. 4). Red grapes had a rate of increase in damage ranging from 0% to 2% per day, with a mean of 0.63% (Fig. 5). There was no significant difference between the damage rates of the white grapes compared to the red grapes (Mann-Whitney Test: P=0.51, Z=0.65, NS).

Figure 1: Bird damage estimates to grapes in the Adelaide Hill at final assessment, for the 2000 season.

Two blocks (L1: Cabernet Sauvignon – small and L1: Cabernet Sauvignon – main) were surveyed on three occasions (22/03/00, 30/04/00 and 7/05/00), and the rate of damage (slope of the line) was found to be constant for both blocks over time (Fig. 5).

For those blocks with two or more damage estimates made, the initial damage levels ranged from 0.51% to 79% of bunches damaged with a mean of 29.12% of bunches damaged (Fig. 4 & 5).

Changes to bird damage over the vineyard

Edges of blocks received more damage overall and the rate of damage to new bunches was also higher for these edges (Fig. 6, 7, 8 & 9). Initially high levels of damage were limited to outer rows (Fig. 6 & 8). At the second assessment the high levels of damage were also found towards the centre of the block. Damage remained higher on the edge but damage was sustained over the whole block (Fig. 6, 7, 8 & 9).

The relationship between bird control efforts and levels of damage

Properties that had low levels of effort invested in bird control were B2, L1, E1 and E2, while those that had medium levels were M1 and B1. The most commonly used bird control activities were shooting and the use of gas guns, both used on four of the six properties (Table 1). None of the properties were considered to exert high levels of effort.

There was no significant difference in the rate of bird damage increase between those two groups (Mann-Whitney Test: P=0.19, Z=-1.32, NS), nor was there a significant difference in the final damage levels between the two groups (Mann-Whitney Test: P=0.95, Z=0.06, NS).

Figure 2: Average level of bird damage to grapes in the Adelaide Hills at final assessment for 1999 & 2000 seasons.

Figure 3: Rate of increase in bird damage (% new bunches damaged per day), in the 2000 season for grapes in the Adelaide Hills.

Figure 4: Changes in the levels of bird damage over time, to white grapes in the Adelaide Hills, 2000 season.

Figure 5: Changes in the levels of bird damage over time, for red grapes in the Adelaide Hills, 2000 season.

Figure 6: Changes to damage levels per row over time for block B1: Merlot – young A, 2000 season.

Figure 7: Changes to damage levels per row over time for block B1: Merlot – young B, 2000 season.

Figure 8: Changes in bunch damage over time per row, B1: Merlot, young A, 2000 season.

Figure 9: Changes in bunch damage over time per row, B1: Merlot, young B, 2000 season.

Table 1: Bird control efforts used by each property during season 2000. Indicates only which methods were used, not the intensity of the methods. Includes methods used throughout whole property. See Methods for property name abbreviations.

Methods used	**L1**	**M1**	**E1**	**E2**	**B1**	**B2**
Shooting		✓	✓	✓	✓	
Gas guns	✓		✓	✓	✓	
Motor bike disturbance			✓		✓	
Helium balloons		✓				
Scare crows/hawk kites/etc.		✓			✓	
Shopping bags/car-yard bunting/etc.					✓	
Electronic device	✓	✓				
Electric wires		✓				
Netting		✓				✓

DISCUSSION

Final levels of bird damage for the 2000 grape crop

In the 2000 harvest, bunch damage ranged from 11% to 97% (Fig. 1) which corresponds to total grape losses of 0.5% to 38.9%. Clearly a negligible amount of damage such as 0.5% of grapes can be tolerated, but up to 40% grape loss is a problem that needs addressing. Apart from the primary loss of grapes in the crop, the efforts invested in growing those damaged grapes become an investment with no returns.

The main bird species doing the damage in the 2000 season were the Adelaide Rosella, Red Wattlebird, Silvereye, Little Raven and Common Starling. From growers' observations Common Starlings were seen less frequently in 2000 than in previous years and the European Blackbird was not seen in vineyards for the 2000 season. Grey Currawongs were seen feeding on grapes in vineyard B1 during the 2000 season, but are not considered to be a major bird pest species.

Based on the 2000 assessments of damage, no single technique can stop bird damage altogether, except perhaps well-installed nets. Thus growers must realize that there is no "quick-fix" device that can be installed to completely rid their grapes of bird damage. However, the levels of damage may have been higher if the devices had not been used.

Comparison of damage estimates in 1999 with 2000

Due to the very nature of environmental systems, no single grape harvest can be easily compared to another. Varying levels of rainfall, temperature fluctuations, and harvest schedules will all affect the final yield. Additional to this, the blocks surveyed in 1999 were not all surveyed in 2000. However, the grapes surveyed in 2000 had significantly more damage than those surveyed for the 1999 harvest.

Changes to bird damage over the ripening season

The initial levels of bird damage ranged from 0.5% to 79% of bunches damaged, up to 57 days before harvest. This indicates that some blocks were being damaged early in the season well before the fruit was fully ripe. For those blocks bird control should be started before damage begins to reduce this early damage.

The rate of bird damage was fairly consistent for most blocks in the study, with an average of 0.64% increase in bunches damaged per day. This rate was fairly consistent regardless of the initial damage level. However, damage was usually only measured twice on a block, therefore a steady rate of increase from one day to the next over this period may not actually exist. To further investigate this, damage assessments would need to be made once a week to determine the daily fluctuations in the rate at which bird damage was inflicted to grapes. This may be unique to each property.

The grower could estimate final bird damage by using the known rate of new damage per day. An estimate of damage could be made some time prior to the picking date and then reasonably extrapolated to the actual picking date using the known rate of damage per day. Further study would be required to refine this process.

The block with the highest rate of bird damage (2% per day) was situated in close proximity to one of the lowest rate blocks (0% per day) on the same large property, E1. As the season progressed, the birds may have ignored the highest damaged blocks and moved to lesser-damaged areas within the vineyard. This example illustrates the “edge effect” that is seen on smaller properties and individual blocks. The boundary between the high and low damage areas shifted towards the center of the block over time, and new damage to bunches was concentrated on previously undamaged areas.

Changes to bird damage over the vineyard

The so called “edge effect” to damage levels was probably caused by the easy access to edges of blocks by birds. The damage patterns over time (Fig. 7, 8, 9 & 10) show that this model was reasonably constant for a “typical” block.

The relationship between bird control efforts and levels of damage

The levels of final damage and rate of increase in damage were not significantly different between management effort groups. This indicates that at present none of the methods used by growers prevented new damage. Since the rates of damage were similar between blocks, the benefits of different methods are not obviously different. Sadly none of the properties implemented best-practice methods, and so no evaluation of best-practice is possible.

RECOMMENDATIONS

1. Further evaluation of the Best-Practice management strategies is required since few vignerons actually implement Best-Practice management.

2. Improved grower awareness of the results emerging from this report, in particular that current methods and techniques of control *do not stop damage* (except well-applied netting) and that there will always be moderate levels of damage at vineyards where intensive control is implemented

3. For those vineyards experiencing high losses of fruit early in the season, extended bird control programmes may be warranted.

4. Continued ongoing assessment of bird damage is warranted.

5. Further investigation into the rate at which bird damage is inflicted to determine if the rate of damage is constant and determine if it can be used to estimate final damage levels early in the season.

6. Investigation of long-term solutions to reduce bird damage that involves natural food resources for the pest species is still required.

REFERENCES

Sinclair, R. (2000) adapted from:
Best Practice Bird Management – part 1, *The Olive Press*, Autumn 2000, pp 13-16.
Best Practice Bird Management – part 2, *The Olive Press*, Winter 2000, pp 34-35.

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APPENDIX 1:
Guidelines to best practice bird control to minimise losses in vineyards.
From Sinclair 2000, appendix A.1:
How to measure bird damage.

Background

Before growers can work out how much money they can afford to spend on controlling pest birds; they need to know the level of bird damage they are sustaining. Unfortunately, there are no simple ways of measuring bird damage in grapes and experience suggests that most growers who make a 'guesstimate' of their damage significantly under-estimate the actual levels.

It is not feasible to weigh every bunch in a vineyard and count the number of missing grapes so we have to use a method of sampling that will provide an estimate of acceptable accuracy. Sinclair & Campbell (unpubl.), partly funded by the Dried Fruits Research and Development Corporation, gathered data on grape damage in the Riverland, Sunraysia, Barossa and McLaren Vale districts to establish a relationship between the incidence of damaged bunches and the percentage loss of grapes within a varietal block. Basically this means that by simply examining a large number of bunches (and recording the presence of any bird damage), one can get a reasonable estimate of the percentage loss in a block without having to estimate the total number of grapes in each bunch and try to count the number damaged or missing.

A grower must deal with two major problems before a meaningful estimate of damage can be obtained. The first problem is how to sample a vineyard block so as not to bias the selection of the bunches to be examined and the second problem is how to determine the number of bunches that should be selected.

Avoiding bias in sampling.

There will always be a tendency to want to select bunches in the places where damage is more likely to occur such as on vines adjacent to perching sites or at the end of rows nearest scrub. However, sampling only these areas would grossly over-estimate damage in the whole block.

To avoid this problem, it is necessary to adopt a sampling method that selects the vines and the bunches to be examined for damage in the most random way that is practical. One way growers can achieve this is by sampling the block using a regular interval between the rows and vines examined, for example, every 20th vine in every 3rd row. The interval chosen will depend on the size of the block and the extent of damage – more details follow.

It will also be easier to examine bunches roughly at head height on the outside of the vine canopy but again, sampling only these will bias the estimate. This is because these bunches tend to receive more damage than bunches low down or well inside the vine canopy especially from some species of birds.

Following a strict order of bunch selection can minimise the problem of bias. The grower needs to prepare a score-sheet that specifies the order of selection. Bunches need to be examined from both outside and inside the canopy, near to and distant from the vine stem, near the top, the middle and from near the bottom of the canopy. The score-sheet should show a sequence of sampling positions, for example:

> Sample 1: top canopy, out side, near stem (ie use a code like TON)

Sample 2: top canopy, out side, between stems (ie use a code like TOB)
Sample 3: top canopy, inside, near stem (ie use a code like TIN)
Sample 4: top canopy, inside, between stems (ie use a code like TIB)
Sample 5: mid canopy, out side, near stem (ie use a code like MON)
Sample 6: mid canopy, out side, between stems "
Sample 7: mid canopy, inside, near stem "
Sample 8: mid canopy, inside, between stems "
Sample 9: lower canopy, out side, near stem "
Sample 10: lower canopy, out side, between stems "
Sample 11: lower canopy, inside, near stem "
Sample 12: lower canopy, inside, between stems "

It is very important that the actual bunch examined is not visually selected. The person doing the sampling should thrust a hand 'blindly' into the canopy and the first bunch encountered as the sampler moves forward along the row, is the bunch to be examined for damage.

Determining the number of bunches to be examined.

Up to a point, the more bunches sampled the more accurate the estimate of damage but accuracy is of little importance when damage levels are low. Accuracy is far more important when damage is at significant levels as an error of even 5% of the estimate can mean a considerable difference in dollar terms to the grower. Determining how many bunches to examine is very difficult for a grower. Consequently, the following is offered to act as a guide.

Divide the vineyard block into zones of 'high' and 'low' damage: prepare a 'mud' map of the block showing the rows and an estimate of the number of vines per row. Calculate the total number of vines in the block.

- from a quick scan of the block, draw lines on the map to separate areas where damage is obviously higher than the bulk of the block. This might mean the last 10 vines of 30 row ends closest to a patch of scrub, 50 vines in each of 10 rows immediately adjacent to a small group of trees in the block, and so on… .

- sum the number of vines in each of the 'high' areas and subtract these from the total number to give the number in the 'low' zone. For example, in a block with 5000 vines, there might be 3 patches with 300, 500 and 200 vines (ie a total of 1000) in a 'high' damage zone and thus 4000 vines in the 'low' damage zone. .

- Calculate the percentage of the block in each zone ie the 'high' damage zone is 20% (1000/5000) and the 'low' damage zone is 80% (4000/5000) of the block. .

The number of bunches to be examined: as a very rough rule of thumb, 1-2% of vines in the 'low' zone should be sampled (as long as the number of bunches examined is at least 80 but preferably 100 or more) and somewhere between 5 and 10% of vines should be sampled

in the 'high' zone (again, preferably 100 or more).
.

- In the example above, a 5% sampling rate of the 'high' zone yields 15, 25 and 10 vines to be sampled which means only 50 bunches would be examined. A 10% sample would be preferable ie 30, 50 and 20 vines respectively totaling 100. A 1% sample of the 'low' zone would mean only 40 vines were to be sampled. If damage was truly low throughout this area, the 40 vines would suffice but it would definitely be at the bottom end of acceptability; a 100 vines sampled would be preferable.
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Carry out the survey.

In the example given above, 30 vines out of 300, 50 out of 500 etc (ie every 10^{th} vine) needs to be examined in the 'high' zone and 100 vines out of 4000 (ie every 40^{th}) in the 'low' zone. Start the survey in one corner of the block and examine a bunch in a pre-determined position (as outlined above) on every 10^{th} vine in the 'high' areas and every 40^{th} vine in the 'low' zone.

Remember, 'examining' a bunch means no more than looking for the presence (or absence) of damage ie record a score of "+" or "-" for each bunch. It therefore does not take long to examine a couple of hundred bunches as you do not need to count the total number of grapes per bunch or the number missing or damaged.

Calculate the percentage bunches damaged.

If in the 'high' areas in the above example, there were 12 out of the 30, 28 out of the 50 and 9 out of the 20 bunches that were examined that scored "+" for damage, the percentage bunches damaged would equal (12+28+9)/(30+50+20) ie 49%. Similarly, if in the 'low' zone there were 8 damaged bunches out of the 100 examined, then the percent bunches damaged would be 8%.

However, there is a need to account for the fact that the 'high' and 'low' zones occupy different proportions of the whole block. Thus the **percent bunches damaged** in the 'high' zone is multiplied by the proportion of block classified as 'high' and this is added to the percent bunches damaged in the 'low' zone multiplied by its proportion of the block classifies as 'low' damage. For the above, this means there was 49% of bunches damaged in 20% of the block ('high' zone) plus 8% damaged in 80% ('low' zone) ie

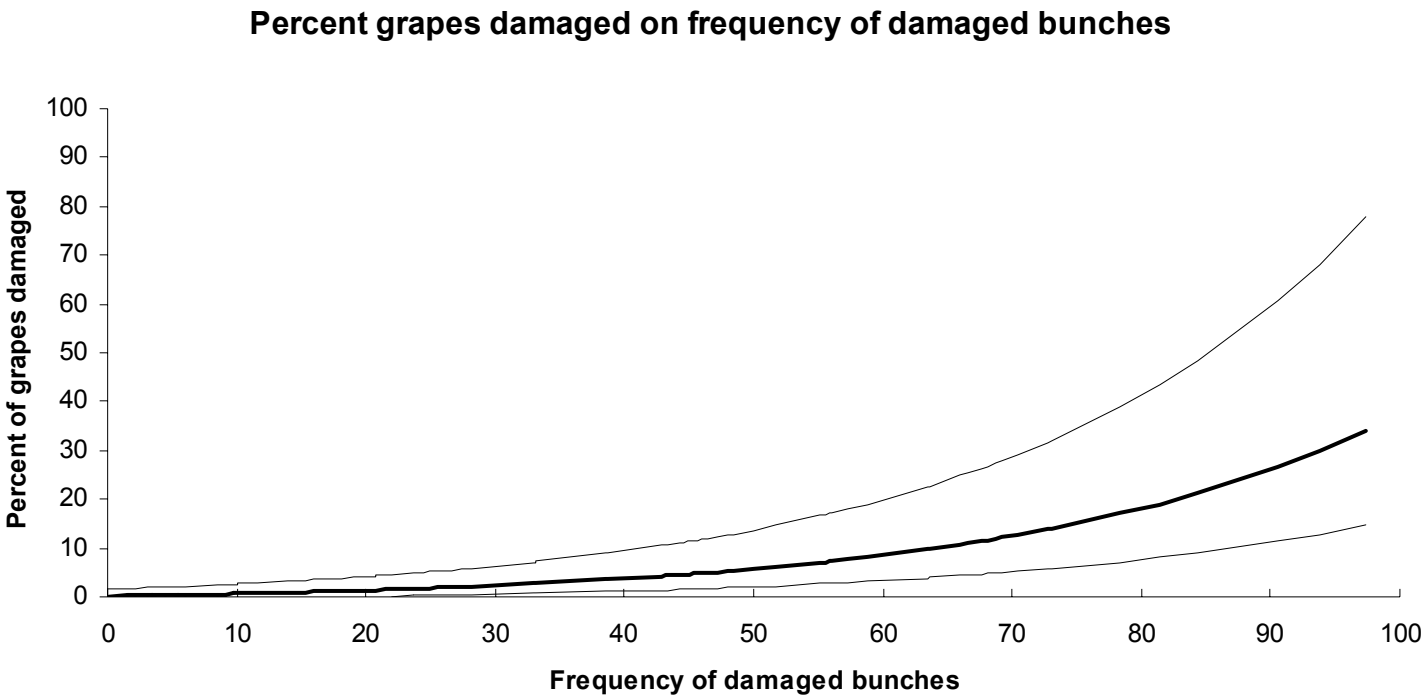
percent bunches damaged = (0.49 x 0.2) + (0.08 x 0.8) = 0.162 or **16.2%**

Converting percentage bunch damaged into percentage grape loss:

The graph in Figure A.1 below can be used to read off the percentage grape damage once percentage bunch damage has been calculated.

Note, the two faint curves flanking the main darker curve provide some guide as to the range of values for percentage grape loss that might be expected and this range increases markedly as the level of damage increases. This is the reason that to obtain an acceptable estimate of grape loss, larger sample sizes are advisable as damage levels increase.

Figure A.1


Percent grapes damaged on frequency of damaged bunches
Percent of grapes damaged
100
90
80
70
60
50
40
30
20
10
0
0
10
20
30
40
50
60
70
80
90
100
Frequency of damaged bunches

APPENDIX 2:

2000 logbook for pest bird management on vineyards.

2000 LOGBOOK

for pest bird management on vineyards

The aim of this logbook is to obtain information on the types of management programs used to reduce damage to grapes by birds. The logbook is designed to be filled in quickly, and although there may be many rows you only need to fill in details for those methods used. Since activities in any vineyard will change as different varieties ripen we also need you to record something about when bird management programs commenced on different varieties and when they were picked. Would you please provide information on the timing of these activities in the following table and complete the daily summary on the logbook section as well. Any queries should be addressed to Emma Crossfield on **8303 4742 or 8352 8416** (leave message if no answer). Emma will ring you about once a week to check that you are coping with the forms. Eventually we will determine (based on your records) whether you employed an intensive, moderate, light or negligible bird management program.

Name of Vineyard: …… Name of person filling in log: ……

Contact phone # …… Contact fax # ……

Variety	Block #	Area of each variety	Date bird management started:	Date variety picked: