Activity Overview

Most of New Zealand's land is either forest or the rural environment with approximately 2-3% in urban land use. So decisions that are made within the rural and forest environments have a big impact on the environmental, economic and social outcomes of New Zealand. There is high need for good decision makers that are able to make informed decisions.

The purpose of this exercise is to get students to be the decision makers and to use the information that they gather from the cards. Some cards have decision making points (in yellow); good decisions have positive points, better decisions are worth more points, poor decisions have negative points and sometimes all options are either negative or positive outcomes and it is about which option is the best one. To make good decisions we often connect with other specialists within the field to gather information and use a range of soft and hard data.

Instructions

- Each group of 3-4 students will need their own set of cards to play though.
- On the back of every card in that set, write the set number and the card number. The cards are on the desk blank side up so students don't see any information until they choose the card.
- Get one person in each group to be the 'runner' and they need to remember which pile/ set of cards is theirs. It is easier to administer if they all ask you for their cards saying = Set X: Card X.
- Hand out the **blank** score card so they can record the information. They will keep all the cards they gather as students often like to refer back to the information or see/ compare options. A number of students have expressed they would like to play again, so that could be a good way to show that experienced advisors are often valued and paid more.
- Hand out the introduction card. From then on you just need to keep handing out the cards they request. Some cards have decisions, some hold information. Most groups tend to progress well and discuss the different options.
- The team with the most points have the most successful harvest and environmental outcomes.
- **Optional extra:** If students can use scientific reasoning or logic to argue that a negative consequence would not occur or a way to avoid it, then you can choose to negate negative points.

Expansion/ Discussion: this activity was based on no financial constraints. As a class or in groups go through the cards and list the things that cost money and assign a number of $$$ signs (eg: cheap ($), medium expense ($$), expensive ($$$), very expansive ($$$$)). You could then allocate a number of $$$ signs they can spend and get them to decided where they would invest the $ and why.

Viticulture Pick-a-Path

Created by Faculty of Agriculture and Life Sciences 2022 – Lauren Roberts (2022)

Introduction

You are the owner of a Winery in the Canterbury region of New Zealand. The climate around your vineyard is most suited to growing grapes for a type of white wine called Chardonnay.

Viticulture (wine grape growing and harvesting) and oenology (wine production) is a skilled and technical process that involves using scientific knowledge to make decisions.

Every season and vineyard environment is different, which is why there are so many different types and flavours of wine. Decisions can change each year, depending on conditions, which is why it takes a skilled winemaker to produce good wine every year. The same is true for creating cider, beer, spirts and cheese.

In this task you will work through the key stages of wine production and make decisions with the aim of producing the highest quantity of a top-quality wine whilst considering carefully the health of the vineyard in order to care for the plants for many years to come.

Go collect Card 1.

Remember to ask using = set number: card number

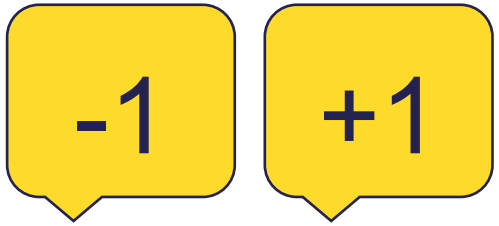
Name of Wine = _____

Scorecard

Write down the number of each card in your wine-making path. If there is a score bubble on a card, record the score and then add it up at the end to get a result. Your result is an indication of how good your wine is.

	Card Number	Score		Card Number	Score
a)			j)		
b)			k)		
c)			l)		
d)			m)		
e)			n)		
f)			o)		
g)			p)		
h)			q)		
i)			r)		

Score Bubble example…



Note: not all cards have them.

Final Score

It is May and the grape harvest has been completed.

The leaves on the grape vines have begun to turn yellow and fall from the vine.

Would you like to let the leaves decay naturally or mulch them into the soil surrounding the vines?

If you choose:

To let the leaves decay naturally	Go to 2
To mulch them into the soil around the vines	Go to 3

1

Letting the leaves decay naturally is good for-profit margins as no labour or machinery is required. However, a large proportion of leaves are blown away by the wind, which is a loss of nutrients from the vineyard. These nutrients could have been supplied back to the vines if microorganisms in the soil could have broken the leaves down underneath the plants.

Now that the leaves and other harvest waste has been cleared from the vineyard it is time to prepare the vineyard for the dormant, winter phase for the vines.

Would you like to mow the grass between the vines to help make the vineyard look tidy, or spray the grass (so it dies) and plant a mix of clover, herbs, grasses and wildflower seeds to make the vineyard look pretty in the Spring?

-1

If you choose:

Mowing	Go to 4
Plant a mixture	Go to 5

2

Mulching the leaves into the soil under the vines as they fall is an excellent way to retain nutrients in the vineyard. Microorganisms in the soil break down the leaves and release nutrients like carbon and nitrogen ready for absorption by the roots of the grapevines.

Now that the leaves and other harvest waste has been cleared from the vineyard it is time to prepare the vineyard for the dormant, winter phase for the vines.

Would you like to mow the grass between the vines to help make the vineyard look tidy, or dig up the grass and plant a mix of clover, herbs, grasses and wildflower seeds to make the vineyard look pretty in the Spring?

+3

If you choose:

Mowing	Go to 4
Plant a mixture	Go to 5

3

The grass being mowed is great for air flow around the vines and helps to keep them dry and free of fungal infections once buds form in the spring. The vineyard looks tidy and is easy to move around for pruning and vineyard maintenance.

+1

Go to 6

4

Planting a mixture of crops like clover, herbs, grasses and wildflowers is an excellent choice for improving the mauri of the vineyard. Clover is a legume crop and helps fix nitrogen (an important nutrient for healthy leaf development) in the soil.

Herbs, grasses and wildflowers help improve the biodiversity of the vineyard and encourage beneficial insects, which assist with pest control.

These types of plants are called cover crops. It is important to monitor the cover crops carefully to ensure appropriate air flow for the vines to protect from fungal infections.

+2

Go to 6

5

Oh no!! Your usual staff for vine pruning are unavailable in June when you had planned to prune the vines.

There is another group of workers in the area who have been pruning at other vineyards who could start immediately.

Do you delay the pruning until July or employ the new group of workers to prune the vines in June as planned?

If you choose:

Delay the pruning	Go to 7
Choose new group to prune	Go to 8

6

Delaying the pruning is not a huge deal to the vines as they are mainly dormant in terms of their growth over the winter.

Your usual workers can be trusted to clean and disinfect their footwear and equipment thoroughly before stepping into the vineyard. These hygiene practices are vital in preventing the spread of disease-causing microorganisms between vineyards.

+1

Go to 9

While these new workers are available now, unfortunately they show up to prune the vines while you are away from the winery.

They get straight to work and are finished within a week. Sadly, because they showed up while you were away, you didn't notice that they entered the vineyard without cleaning and disinfecting their footwear and tools.

In the Spring, when buds should be bursting, you notice some shoots in a section of the vineyard with numerous dead buds. Botryosphaeria fungus has infected around 20 vines which will impact the yield and quality of grapes grown and eventually kill these vines.

To save the infection from spreading you make the decision to remove the vines and burn them.

-2

Go to 9

8

You read about a study at a local university where researchers are looking to trial inoculating established grapevines with Arbuscular Mycorrhizal Fungus (AMF). The trial will involve this fungus being planted into the soil around half of the vines in your vineyard.

Do you apply to be a part of the study?

If you choose:

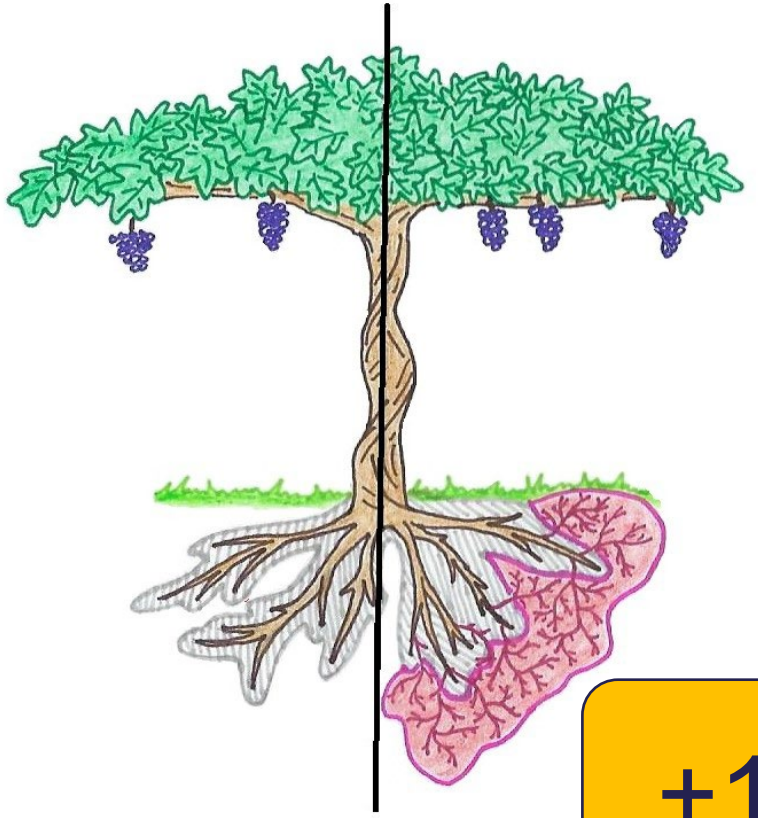
Apply	Go to 10
Don't apply	Go to 11

9

You are accepted into the study!

Small holes are made in the soil around half of your vines in the vineyard. The AMF (Arbuscular Mycorrhizal Fungus) is poured into the holes and researchers return in the summer to make observations and measurements.

The AMF colonise the roots of the vine and form a symbiotic (mutually beneficial) relationship. The vines provide the fungus with energy and carbon from photosynthesis. The fungus grow out into the soil, vastly improving the root system of the vine. This allows much greater uptake of key minerals for leaf development and vine health. This in turn improves grape quality and yield.



+1

Go to 11

10

Spring begins and is forecast to be warmer and wetter than average. Your weather stations predict rains to begin within 24 hours.

If you chose to plant cover crops between your vines you will need to mow these to improve airflow between the vines. Mulching this material and placing around the vines can recycle the nutrients and deliver them directly to the roots of the vine.

In addition to mowing, you need to choose whether to spray the vines to prevent mildew and mould (fungus) from growing on the vines.

If you choose:

Spray with fungicide	Go to 12
Avoid spray	Go to 13

11

A regular regime of fungicide spray is important in vineyards (even for growers following Organic farming principles) to protect both the leaves and the fruit from being infected by mildew and botrytis fungus. Warm, wet conditions are ideal for promoting fungal growth and the release of spores which can live on the vine, even throughout a cold winter.

By spraying before the spring rain you prevent the release of powdery mildew spores which can infect the fruit and greatly reduce the amount of useable fruit at harvest time.

Powdery Mildew

Botrytis

+1

Go to 14

12

While the desire to limit sprays used in horticulture is admirable, even Organic grape growers need to have a regular spraying regime in place to prevent fungal infection of the leaves and fruit.

Choosing not to spray gives the vines zero protection against the release of powdery mildew spores. The growth of powdery mildew over the fruit reduces your harvest by 20% and means that you spend more money on labour to separate out the good fruit from the infected fruit. It also takes you longer to harvest and clean up the vines following harvest, which also increases labour cost.

As fungal spores can survive on the wood of the vine over winter, the pruning waste from the infected vines would need to be removed from the vineyard to prevent the spores reinfecting the vines next season.

Powdery Mildew

Botrytis

-2

Go to 14

As Spring proceeds the buds swell and burst into leafy growth. Flowers appear on new shoots and develop into bunches of grapes. These ripen through the Summer and, depending on the type of wine being produced, will be ready for harvest late Summer to early Autumn.

To protect the fruit from birds many growers enclose part of their vines with netting. The netting is secured with plastic clips which are often flicked into the dirt when the netting is wound in prior to harvest. About 30 million of these plastic clips are used by the New Zealand wine industry every year.

This year a new but more expensive bioplastic clip is available for purchase, which would you like to purchase?

bioplastic clip

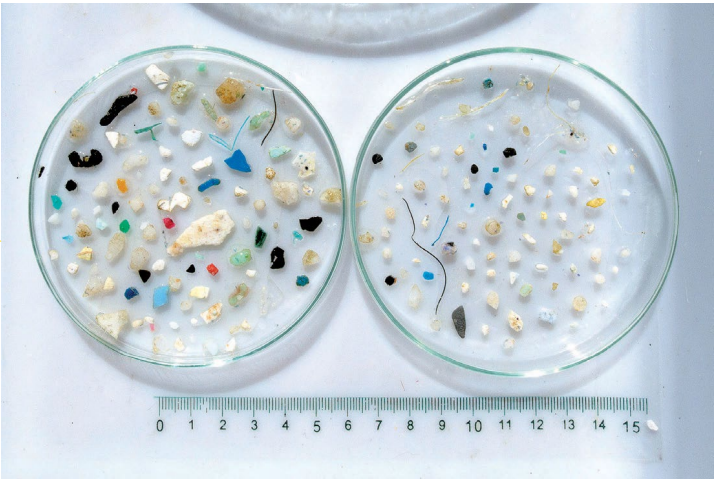
plastic clip

If you choose:	
Standard plastic clips	Go to 15
New bioplastic clips	Go to 16

14

The use of the reliable plastic clips is a good choice for cost saving. However, the plastic clips that flick into the soil break down very slowly overtime and introduce microplastics to the vineyard and surrounding environment.

These eventually wash out into waterways and oceans and are detrimental to the organisms living in these food webs.



-1

Go to 17

15

While the bioplastic clips do increase the running costs of the grape growing, they are much more environmentally friendly and can improve the mauri of the vineyard.

Bioplastics are produced by microorganisms and can therefore be degraded by microorganisms in the soil. The clips that flick off the nets can be a source of nutrition to the microorganisms in the soil and can support a diverse microbiome and therefore the health of the vines.

+1

Go to 17

Deciding when to harvest the grapes is one of the most important decisions a wine grower can make. The level of ripeness of a grape is linked to sugar content of the berry. This, in turn, is linked to the alcohol content of the finished wine as the sugar is converted to ethanol in the fermentation process.

Most grapes are harvested late Summer – early Autumn. Sugar levels and weather are carefully monitored to ensure the grapes are harvested at the best possible moment.

The sugar levels of the chardonnay grapes show the grapes are almost ripe enough for the wine you want to make this year. An Autumn storm is forecast for later in the week. Do you harvest now or leave the grapes to ripen more and harvest after the storm?

If you choose:

Harvest now	Go to 18
Harvest after the storm	Go to 19

17

You have chosen to save the grapes from potential damage by the storm and harvest now when the grapes are close to ideal ripeness.

Your vineyard is mostly hilly land so the harvest needs to happen by hand. This is a slower and more labour intensive method, but means that the grapes can be checked and sorted as they are harvested, with unsuitable fruit removed.

The harvest will take 3 days. Do you press the grapes at the end of each day to extract the must (juice) or wait until the end of the harvest and press all of the grapes at once?

+2

If you choose:

Press the grapes at the end of each day	Go to 20
Press the grapes at the end of the harvest	Go to 21

18

The storm comes and brings unexpected hail. This causes damage to some fruit and the rain that falls means all the fruit is wet and will need to dry prior to harvest.

By the time the fruit is dry enough for picking, some of the split fruit has gone mouldy and aerobic break down of sugars by natural yeast has begun. As the fruit has had to spend longer on the vine in order to dry out, water has evaporated from the splits in the fruit and the sugar concentrations are now higher than ideal. This will affect the quality of the wine.

The harvest takes twice as long as usual while the grapes are sorted and unsuitable fruit is discarded.

Do you press the grapes at the end of each day to extract the must (juice) or wait until the end of the harvest and press all of the grapes at once?

-2

If you choose:

Press the grapes at the end of each day	Go to 20
Press the grapes at the end of the harvest	Go to 21

19

Great choice! Pressing the fruit as it is picked means that the grapes don't have any time to decay or ferment prior to must extraction.

Once the must is extracted in the press, fermentation begins due to the wild yeasts found naturally in the bloom on the skin of the grapes. As a winemaker you need to choose whether to use these wild yeasts for fermentation or treat the wine to kill off these yeasts and use a specific type of yeast to ferment the wine.

Glucose ⟶ ethanol + carbon dioxide

+1

If you choose:

Let the wild yeasts ferment the must	Go to 22
Treat the must and use a specific yeast for fermentation	Go to 23

20

Leaving the picked grapes for days before pressing means that some grapes will decay, mould may begin to grow on the fruit or insects may feed on the fruit. All of these things could lead to off tastes in the finished wine.

Once the must is extracted in the press fermentation begins due to the wild yeasts found naturally in the bloom on the skin of the grapes. As a winemaker you need to choose whether to use these wild yeasts for fermentation, or treat the wine to kill off these yeasts and use a specific type of yeast to ferment the wine.

Glucose ⟶ ethanol + carbon dioxide

-1

If you choose:

Let the wild yeasts ferment the must	Go to 22
Treat the must and use a specific yeast for fermentation	Go to 23

21

It is really difficult to control the fermentation process when an unknown mixture of wild yeasts are present. Many of these wild yeasts will be killed off when the alcohol content of the must reaches around 4%; a long way short of the average 12% alcohol of most wines. Some of these wild yeasts can produce other by-products as part of their life processes and these can give off flavours in the wine.

To save your wine you have to introduce some of the common wine making yeast *Saccharomyces cerevisiae* when your wild yeasts die off (fermentation gets stuck).

Once the must (juice) is ready for fermentation it is piped to clean vats. Now to deal with the waste grape skins and fruit: keep or discard?

-2

If you choose:

Keep the skins and waste fruit	Go to 24
Discard fruit waste	Go to 25

22

Treating the must with SO_2 will kill off wild yeasts and any bacteria that may be present. These microorganisms would compete with the wine making yeast for sugars and affect the quality of the final wine.

Once treated, the must can be inoculated with a specific type of yeast to optimise fermentation. This yeast is typically *Saccharomyces cerevisiae.*

Once the must is ready for fermentation it is piped to clean vats. Now to deal with the waste grape skins and fruit: keep or discard?

+2

If you choose:

Keep skins and waste fruit	Go to 24
Discard fruit waste	Go to 25

23

You're really getting the hang of this aren't you? By keeping the skins and waste fruit you can retain these nutrients in the vineyard. And what better way to do this than by composting.

Combining the waste fruit with pruning waste and other plant waste from the vineyard makes an ideal mixture for decomposition by naturally occurring microorganisms. The broken-down plant mix is nutrient dense and can be delivered back to the area directly below the vines.

It's wine-making fermentation time!

- Should you leave the yeast in the grape juice to it?

- Or do you need to carefully monitor the progress of the fermentation?

+3

If you choose:

Leave fermentation to proceed naturally	Go to 26
Monitor carefully	Go to 27

24

Rookie mistake! That fruit waste was full of nutrients that could have been recycled back into the vineyard by composting. Plant waste can be broken down by naturally occurring microorganisms to create a nutrient dense mixture called compost. This compost can be delivered back to the plants and mixed into the soil for their roots to absorb these nutrients once more.

It's wine-making fermentation time!

- Should you leave the yeast in the grape juice to it?

- Or do you need to carefully monitor the progress of the fermentation?

-3

If you choose:

Leave fermentation to proceed naturally	Go to 26
Monitor carefully	Go to 27

25

Things started off so well….

But the yeast produced heat energy while fermenting and the must (juice) heated so much that the yeast were killed off before finishing the fermentation. Maybe you could fix this by cooling the must (juice) and introducing more yeast?

When fermentation is complete (no sugars remain), chardonnay often contains high quantities of malic acid, naturally present from the grape juice. Do you wish to leave the wine as it is, or further process it change the amount of malic acid present?

Malic acid has a smooth tart taste resembling that of citric acid or a tart green apple

-2

If you choose:

Leave the malic acid as it is naturally	Go to 28
Further process the wine to manipulate malic acid	Go to 29

26

Monitoring carefully is vital to ensure that the temperature remains in the right zone for optimal chardonnay production. The yeast release heat energy as part of the fermentation process and this could heat the must to the point that the yeast are killed off.

Electronic monitoring can help you keep your must fermenting in one of the two ideal temperature ranges for chardonnay; 10-16^{o}C or 20-25^{o}C

When fermentation is complete (no sugars remain), chardonnay often contains high quantities of malic acid, naturally present from the grape juice. Do you wish to leave the wine as it is, or further process it change the amount of malic acid present?

Malic acid has a smooth tart taste resembling that of citric acid or a tart green apple

+1

If you choose:

Leave the malic acid as it is naturally	Go to 28
Further process the wine to manipulate malic acid	Go to 29

27

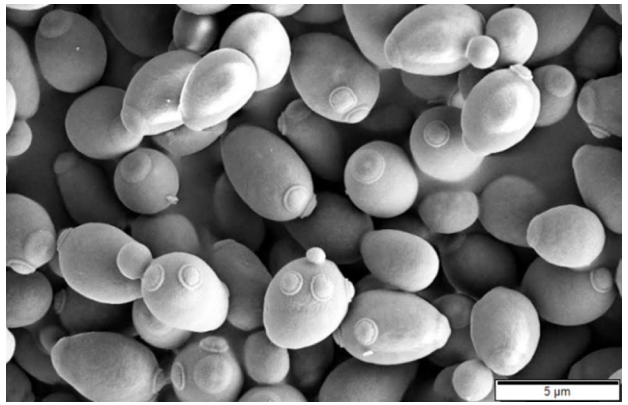
Malic acid makes the wine taste more acidic and feel different in the mouth. It is also a potential food source for food spoilage bacteria.

Processing the malic acid involves inoculating the wine with a bacteria, typically *Oenococcus oeni*, which uses the malic acid for nutrition and converts it to lactic acid and carbon dioxide.

Since you chose to skip this step, your wine will not be winning any taste awards this year, but it can still provide a good flavourful experience.

Almost there!

- Is it okay to bottle your wine now?
- Or will you need to remove any remaining yeast cells?



-2

If you choose:

Bottle the wine	Go to 30
Remove any remaining microorganisms	Go to 31

28

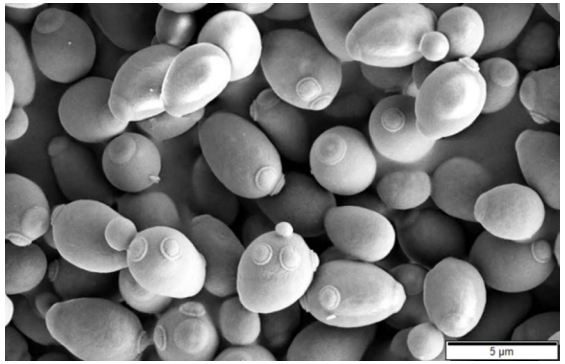
Processing the malic acid involves inoculating the wine with a bacteria, typically *Oenococcus oeni*, which uses the malic acid for nutrition and converts it to lactic acid and carbon dioxide.

Malic acid makes the wine taste more acidic and feel different in the mouth. It is also a potential food source for food spoilage bacteria and so having less present can help improve the shelf life of the wine.

Since you chose to introduce *Oenococcus oeni* bacteria, your wine has a smoother feel when drunk and tastes much more pleasant.

Almost there!

- Is it okay to bottle your wine now?
- Or will you need to remove any remaining yeast cells?



+2

If you choose:

Bottle the wine	Go to 30
Remove any remaining microorganisms	Go to 31

29

Bottling the wine without removing any remaining micro-organisms in the wine is probably a bad idea! Any remaining yeast or bacteria living in the wine could produce contaminants as part of carrying out their life processes. These could alter the taste of the wine and even cause the wine to spoil.

Some winemakers will add sulfur dioxide prior to bottling to kill any remaining micro-organisms and prevent any further contamination. Correct bottling techniques are also important. The bottles should be flushed with carbon dioxide or nitrogen prior to filling to remove any oxygen and help prevent oxidation of the alcohol.

And you've made wine! Remember to get back to the vineyard and look after those grapevines so that you can try it all over again next year.

What would you do differently next time?

-3

Did you add up your score? If you scored 23 then you've probably made a decent drop AND improved the overall quality of life in your vineyard.

30

It is an excellent idea to consider what micro-organisms are still present before bottling the wine! Any remaining yeast or bacteria living in the wine could produce contaminants as part of carrying out their life processes. These could alter the taste of the wine and even cause the wine to spoil.

Some winemakers will add sulphur dioxide prior to bottling to kill any remaining micro-organisms and prevent any further contamination.

Correct bottling techniques are also important. The bottles should be flushed with carbon dioxide or nitrogen prior to filling to remove any oxygen and help prevent oxidation of the alcohol.

And you've made wine! Remember to get back to the vineyard and look after those grapevines so that you can try it all over again next year.
What would you do differently next time?

+3

Did you add up your score? If you scored 23 then you've probably made a decent drop AND improved the overall quality of life in your vineyard.

31