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Grape and Wine Research and Development Corporation

Increasing irrigation water and controlling vigour by collecting runoff from the mid row of vineyards



Final report to

Grape and Wine Research and Development Corporation

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Abstract

Rainwater was harvested from vineyard rows during winter-spring of 2006-2007 and 2007-2008. The aim was to use the water for irrigation later in the season.

Black plastic laid in every second row covered a third of the total area and harvested a third of the rain that fell. In contrast a polymer soil sealant was unsuccessful but nevertheless remains an excellent treatment on roaded catchments.

It was concluded that the black plastic treatment was highly successful at harvesting rainwater without affecting vine vigour. Removal of a third of the rainwater would also help reduce unwanted recharge of the saline groundwater.

Executive summary

Vineyards in the Great Southern Region of Western Australia collect rainwater using roaded catchments. These are constructed with earth moving equipment to form a series of sloping surfaces of compacted clay to promote rainfall run-off (Stanton, 2005). An effective roaded catchment should harvest 30% of the annual rainfall- many times more than the runoff from a pasture paddock. Approximately one hectare of roaded catchment is needed for every 2.5 hectares of vineyard as rule for the region assuming an average rainfall of 600mm per year. However, the effectiveness of roaded catchments in the region has been shown to be very variable from property to property. An effective roaded catchment will shed water after about 5mm of rain or less. An ineffective roaded catchment may not shed rainfall until up to 15mm of rain has fallen. The Department of Agriculture and Food found that treating the surface of roaded catchments with a spray-on polymer soil sealant gave a run-off percentage of 60%- double that of an untreated "effective" roaded catchment. This technique has been quickly adopted on many vineyards in the region –at a cost of $2000 per hectare of roaded catchment.

The current project was conducted at Frankland in a block of 9 year old Shiraz vines on VSP trellises during 2006-2007 and 2007-2008.

Given the success of the soil sealant when applied to roaded catchments, the question arose as to whether the product could be used to harvest rainwater from within vineyard rows. Harvesting rainwater from within the planted area would have the advantages of reducing the area needed for roaded catchments and allowing more hectares of vines to be planted on the property. The practice may also help limit the excessive vigour of vines commonly experienced in the region. Moreover the harvesting of rainwater would reduce the infiltration down into the groundwater thereby addressing the regional problem of rising salinity.

We envisaged a system whereby alternate rows are treated, thus allowing every second row for tractors to travel for routine management practices. At harvest however, it is likely that traffic will pass over all rows, including those that have been treated.

The surface was scraped, contoured, compacted and treated with herbicide before the sealant was sprayed on according to the manufactures recommendations.

Black plastic sheeting laid in the mid row in a 1.5m strip was also evaluated in the trial. Again the soil surface was scraped and contoured before the sheeting was laid and the edges were secured by being tucked into the soil. During the course of the study a machine was developed to perform these tasks.

The untreated control for the study was a volunteer pasture sward of predominantly annual rye grass.

The results showed that the rows sprayed with the sealant worked well for a few weeks but then deteriorated with the surface becoming loose and prone to soil erosion. The loamy/sandy surface of the vineyard rows may contain too much organic matter and not enough clay for the sealant to seal the surface effectively. We chose not to continue with the soil sealant in the second year. It nevertheless remains an excellent treatment on roaded catchments.

In contrast the black plastic sheeting was highly successful. Being 1.5m wide and laid in every second row it covered a third of the total area and consequently harvested a third of the rain that fell in both years.

There were no significant treatment effects on vine vigour, fruit yield or quality in either year. The 2006 year received only half the average rainfall and the 2007 was also very dry. Thus, even

though we had two drought years, the removal of the rainwater by the black plastic had no significant effects on the vines as compared to the control treatment of volunteer sward. This was a surprising and pleasing result.

The black plastic system used here stands out as a practical and effective way of harvesting rainwater from within vineyard rows. It would be appropriate for properties where there is not sufficient suitable land for roaded catchments. Ideally the concept would be included at the initial vineyard planning stage prior to planting to orient vine rows to optimize use of slopes for water catchment.

The system works particularly well in the Great Southern region where the vast majority of the rain comes in winter and spring. Thus the black plastic harvests the majority of the annual rain before bud burst occurs in the vineyard. These results may not be transferable to other regions where the rainfall patterns are different.

Similarly the results may not be transferable to warmer regions where the soil temperature under the black plastic would be higher than the relatively cool conditions of the Great Southern.

As to future research, a study of the longevity of different types of plastic sheeting under vineyard conditions would be worthwhile to identify the most economic material over the years. In addition, a study of the effects on soil biology under the plastic may be needed to test the acceptability of the technique in terms of soil health.

Ongoing communication of the results from this study is probably required for any uptake to occur. As the technique is particularly applicable to vineyard development it would be appropriate to target the information to consultants and others involved in vineyard planning.

Acknowledgements

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Background

Grape growers in the Great Southern Region of Western Australia harvest rainfall for irrigation by using roaded catchments made from compacted clay subsoils (Stanton, 2005). These are designed as a series of sloping roads and collecting drains leading to a dam (Photo 1.)



Photo 1. Section of a roaded catchment showing water being harvested during a rain event.

The availability of sufficient water for irrigation is a major limitation in many years. Vineyard owners in the region need to build approximately one hectare of roaded catchment for every 2.5 hectares of vines. This is a major cost and takes up land that could otherwise be used for viticulture.
A previous project: RD 03/20-4 “Increasing run-off from roaded catchments by chemical application”, was undertaken by Neil Lantzke and Rod Short of the Department of Agriculture and Food Western Australia. These researchers tested several products and found that a polymer substance called TGC (Total Ground Cover) was the most effective and appropriate product for use on roaded catchments in wine vineyards. When sprayed onto the surface of a roaded catchment the product typically gives at least double the run-off (Lantzke, 2005). The cost is around $2000/ha and the benefit lasts for at least two seasons. The viticulture industry in the Great Southern took great interest in the research and the polymer is now being used successfully by a number of large vineyards. RITA project RT07/02-1 will also continue to demonstrate and extend these findings during the summer of 2008-2009.

In the project being reported here we wanted to examine whether the polymer could also be used to harvest rainfall from within vineyard rows. As well as removing the need for so many hectares of roaded catchments, we postulated that this technique may reduce the problem of excessive vine vigour in spring.

The technique may also reduce the amount of water infiltrating down to the saline groundwater and exacerbating the serious regional problem of rising salinity.

We were also interested in testing a treatment of black plastic sheeting in mid-rows as a means of harvesting water.

The concept is to treat the ground surface to reduce or eliminate rainfall infiltration in alternate vine rows. Vineyard tractors could operate from the remaining rows leaving the treated rows undisturbed until harvest. The water would be allowed to run off and be collected in a dam for use later in the season. Reducing the infiltration of rainfall in alternate vine rows will reduce the soil water available to the vine by up to about one third. This may have a significant effect on controlling vigour particularly in vigorous varieties such as Shiraz.

Project aims and performance targets

The original stated objectives of the project were:
To establish a trial on a commercial vineyard in the Great Southern Region of Western Australia to investigate techniques to maximize vineyard water (rainfall) collection from the mid row of the vineyard. A replicated and randomized trial will be established in investigate whether:

- *Infiltration reducing chemicals*
- *cover crop management and*
- *black plastic*

can increase runoff (without soil erosion) from the inter- row and decrease vine vigour. Increasing the amount runoff collected will result in more water available for irrigation later in the season. Reducing infiltration should reduce excessive vegetative growth of vines early in the season leading to improvements in fruit quality.

With one exception these objectives remained the same throughout the project. The two seasons of the project both had rainfall that was considerably lower than average. This meant that the objective of harvesting rainwater to reduce excessive vine vigour shifted to one of harvesting rainwater without adversely affecting vine vigour.

An additional objective of reducing groundwater recharge has also been adopted in the study. If not harvested, a proportion of the rainwater would infiltrate down to recharge the saline groundwater causing the water level to rise and adding to the regional problem of salinity in the lower parts of the landscape.

The stated project outputs remained the same throughout the project, apart from an approved shift of one year forward in the timeline. The trial site was established for the 2006-2007 growing season when the full set of planned measurements were taken, a field day held and industry articles published. A poster and a paper were presented at the 2007 Australian Wine Industry Technical Conference.

A second, final year of measurements was then undertaken as planned in 2007-2008. The work was again presented at a field day and published in industry articles.

Year 1 of the project (2006-2007)

Design and layout in Year 1.

The experiment was set up in mid 2006 at Powder Bark Ridge Vineyard at Frankland in the Great Southern Wine Region of Western Australia. The soil type at the site is a sandy loam with a high gravel content and clay at depth. This soil is fairly typical of vineyards in much of the region. A block of nine year old Shiraz vines on VSP trellis was selected for the study. The block is on a gentle slope facing towards the west-north-west. The vineyard rows run up and down the slope. Frankland has an annual rainfall of approximately 600mm with most falling in winter and spring and dry summers and autumns.

The treatments studied in Year 1 were:

- sealant applied to the mid row surface on one side of the vines
- black plastic sheeting applied to the mid row surface on one side of the vines
- control of volunteer sward- mainly ryegrass- covering the ground on both sides of the vines

These treatments were replicated five times and randomly applied within rows of vines, with at least one row of vines in between to separate experimental rows and act as buffers.

Thus there were three treatments and five replicates of each.

Within each replicate there were six experimental vines from which the data was collected giving a total of 30 vines per treatment. Several buffer vines were used within rows to separate replicates.

Measurements (applies to both years)

Vines

Pruning weights from the previous year
Phenological dates
Bud numbers
Shoot length fortnightly
Canopy assessment (point quadrat)
Ripening profiles- Brix, pH
Harvest yield, bunch numbers and berry weights
Harvest Brix, pH and TA
Pruning weights

Cover crop

Estimation of tonnes/ha dry matter and botanical composition at bud burst and before being slashed later in the season

Soil moisture

Data loggers and gypsum blocks at 30, 60 and 90 cm under vines (in 3 replicates only)
Data loggers and gypsum blocks at 30 and 60 cm under vines (in 3 replicates only)

Rainfall

Automatic weather station placed at site

Rainfall harvested

A system of nine tipping buckets was specifically designed and built for the project (Photo 2.). The principle is the same as used in many automatic weather stations.

Rainfall runoff from treated and control rows was collected in sumps at the end of each row and piped by gravity to the tipping buckets. Each tip of the buckets was detected by a switch system. Data loggers were attached to provide information on the number of switching events. The volume of the buckets multiplied by the number of switching events gives the amount of rainfall harvested.



Photo 2. One of nine tipping buckets installed at the site

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Methods in Year 1.

The polymer and black plastic treatments were applied to the mid row area of every second row.

Using only every second row allows all machinery travel (apart from harvesting) to be confined to the non- treated rows. This minimizes damage to the treated surfaces.



Photo 3. Sealant being applied to the mid row

Inter rows were graded and shaped to concentrate the runoff into the centre. The sealant was sprayed on twice according to the product recommendation (Photo 3.). Prior to this a weedicide was sprayed to prevent weed growth breaking the surface integrity. Black plastic was laid on the plots with the edges dug into the soil to prevent movement (Photo 4.).
A grassed control mid row is shown in Photo 5.

The system used to trap water running off the rows is shown in Photos 4. and 5. A white cloth ‘sock’ was filled with sand to make an elongated sand bag to direct the water through a grill into a sump below from where it ran by gravity through a buried pipe leading to the tipping bucket system (Photo 1.).



Photo 4. Plastic sheeting fitted to mid row (water collecting grill shown by arrow)



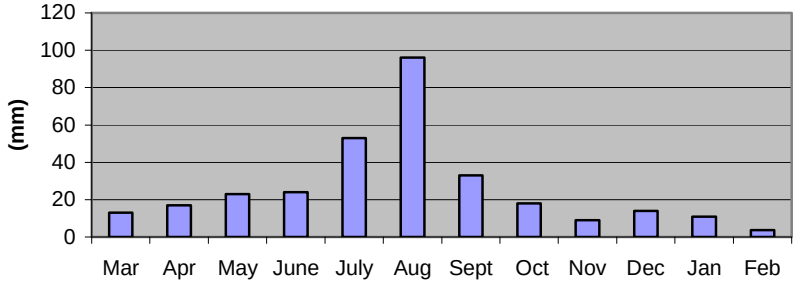
Photo 5. Grassed control row

Results and Discussion Year 1.

Rainfall

Year 1. was very dry with a total of 298mm overall, the district average being close to 600mm annually (Figure 1.).

Figure 1. Rainfall Year I. (2006-2007 season)



Rainfall harvested

The black plastic sheeting collected 90% of the rain that fell and this was piped into a drain leading to a dam (Table 1.). In contrast, almost all rain falling on the grassed control soaked in totally. The rows treated with the sealant ran rainwater initially at about 60% of that of the black plastic, but within a few weeks the efficiency deteriorated to average 28% of rainwater harvested overall.

Unlike the excellent results with the sealant previously obtained on the clayey surfaces of roaded catchments, the vineyard rows have a sandy/loamy surface with little clay and appear to contain too much organic matter for the polymer to seal the surface effectively. Most of the

rain soaked through the surface and down into the soil rather than running off. The run-off gradually decreased- eventually being similar to untreated bare soil. This also presented a problem with weed germination which had to be addressed repeatedly on this treatment during the season. It would also pose a serious erosion risk had a larger area been involved.

The results for the black plastic sheeting are very encouraging. The sheeting covers a third of the vineyard floor and would collect 0.74 megalitres of water per hectare in an average year (Table 1.). A water budget of 1megalitre per hectare of vines is typical for the region. It follows then that the black plastic technique would supply three quarters this requirement, assuming average rainfall.

Table 1. Rainfall run-off harvested from the different treatments in Year 1.

Treatment	Total rain that fell between June and November mm	% collected as run-off	Amount collected in on a per hectare basis (megalitres)
Soil sealant	247	28%	0.23
Black plastic	247	90%	0.74
Control (grass)	247	2%	0.16

Cover crop

A volunteer sward emerged on the grass control rows after the very late break of the season. The composition was mainly annual ryegrass, some perennial ryegrass, a minor amount of subterranean clover and other broadleaved species. There was an estimated 2.2 tones/ha dry matter by late September when it was slashed after which it gradually senesced.

Soil moisture

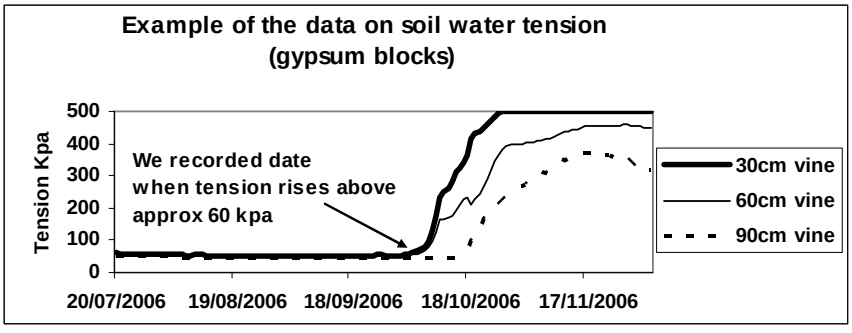


Figure 1.

Figure I. gives an example of the data obtained from the gypsum blocks. It shows the trend in soil water tension over time. A soil water tension of around 60Kpa is quite damp and all treatments were at this level for the initial weeks. Different treatments then rose above the 60Kpa as they dried out at various times in late spring.

We counted the days from bud burst when the drying above 60kpa began for each replicate and these data were analysed and graphed in Figure 2.

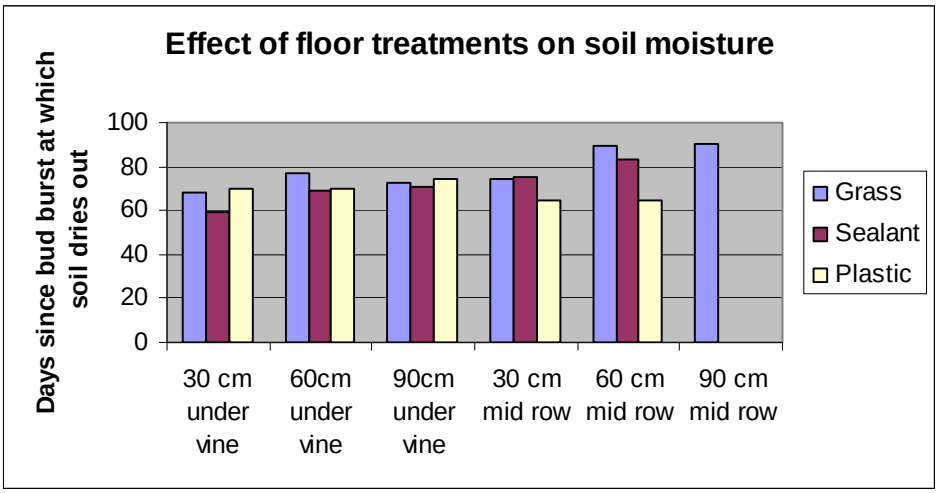


Figure 2.

The largest difference in these comparisons is for soil in the mid row 60 cm under the plastic where the period remaining wet lasted 62 days as compared to 88 days for the grass control. This may be associated with the soil under the plastic being unable to benefit from later rains as compared to the grass control (Figure 3).

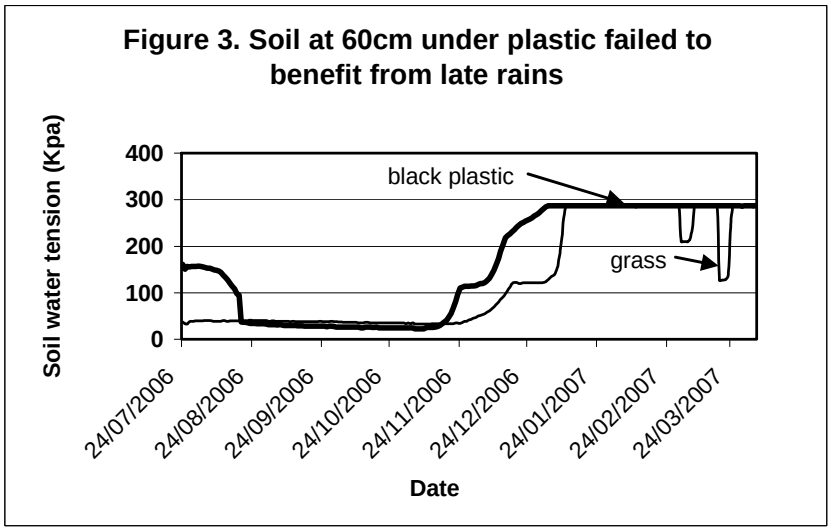


Figure 3.

Shoot length

As an estimate of vine vigour we regularly measured average shoot length over the season.

The final shoot length for the vines in the black plastic treatment was 75cm on 1st December at which time the shoots had stopped growing. This result was no different for the vines on the grass control which also had an average shoot length of 75cm on 1st December.

It is encouraging that the black plastic has not reduced the shoot growth as compared to the grass control. Even though it has shed many litres of water from the area (one third of the water from the pair of mid rows either side of the vines) the soil has still eventually wetted-up and the shoot length has not been affected.

The final shoot length on 1st December was 79cm for the vines on the sealant treatment, being significantly longer than the shoots from the grassed control which averaged 75cm (LSD=2.8, p=0.05). The sealant treatment, having failed to retain an impermeable surface, appears to have
allowed moisture into the soil in the same way as would untreated bare ground. The grass cover crop on the control rows seems to have competed with the vines for soil moisture whereas little such competition could come from the bare (and eventually permeable) sealant treatment.

Harvest results

There were no significant treatment differences in any of the harvest data. Overall means were- yield: 4.2 kg/vine, bunches per vine: 64, berry weight: 1.3g, sugar: 22.8 degrees Brix, pH: 3.3 and titratable acidity: 5.9g/L.

There was large variability in the data between vines and between replicates, particularly in yield and bunch number. This variability may have overshadowed any treatment differences. The least significant differences for yield and bunch number were 2.5 kg/vine and 11.4 bunches/vine respectively (p = 0.05).

Recharge of groundwater

A proportion of the water harvested by the ground treatments would have otherwise probably infiltrated down to recharge the groundwater. This would be a significant amount of water in the case of the black plastic. It is quite encouraging as a method for reducing the serious environmental problem of groundwater recharge in the Great Southern Region.

Conclusions Year 1.

Black plastic as used here was highly successful at harvesting water, vine vigour has not been affected and significant recharge of groundwater has been avoided.

The sealant deteriorated quickly in this context and is probably unsuited for use in vineyards, particularly as the surface became prone to erosion.

Year 2 of the project (2007-2008)

Design and layout in Year 2. (2007-2008)

The sealant treatment was not used in Year 2. and the number of replicates was increased from five to seven for the black plastic and control treatments in order to achieve a more sensitive comparison of harvest data.

Within each replicate the number of experimental vines was increased from six to ten giving a total of 70 vines per treatment as compared to 30 vines per treatment in Year 1. Buffer vines were again used within and between rows to separate replicates.

Results for 2007-2008

Rainfall

The rainfall was higher and better distributed through winter and spring than that which fell during the drought of 2006-2007 (Figure 2. compared to Figure 4.). However the rainfall was still lower than average their being a total of 507mm for the 2007 calendar year.

Rainfall harvested

The proportion of rainfall harvested by the black plastic was 90%, the same as Year 1.
This compares to the grassed control plots where less than one percent of rainfall was harvested, similar to the 2% figure for Year 1
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Soil moisture

We again calculated the number days from bud burst at which soil moisture began to dry out for each treatment (soil tension above 60Kpa, see Figure 1.).

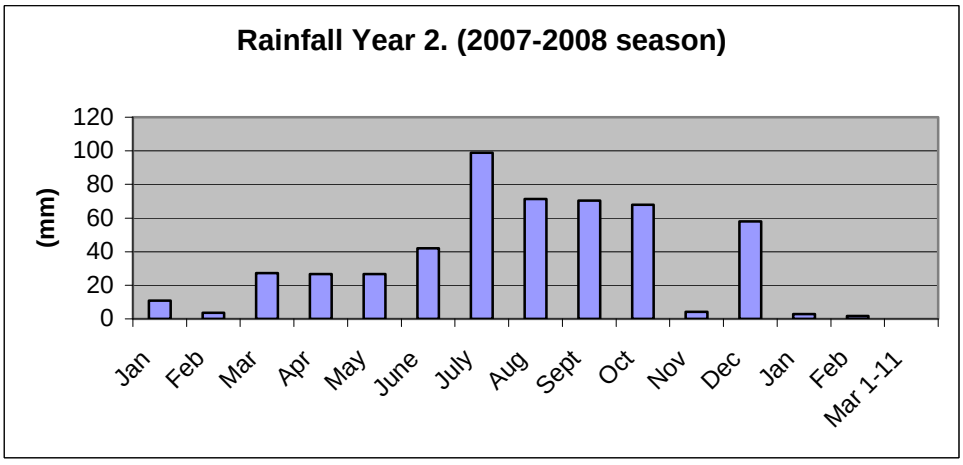


Figure 4. Rainfall during Year 2. (2007-2008 season)

The results for 30cm under the mid row show the most striking effect (Figure 5.) The soil retained moisture for 77 days under black plastic compared to only 62 days for the grassed rows.

However the under vine results were similar for both treatments. This is logical as the ground treatments in the narrow strip under the vines were the same (grass) for both treatments. The plastic was only laid in a 1.5m wide strip in the mid row.

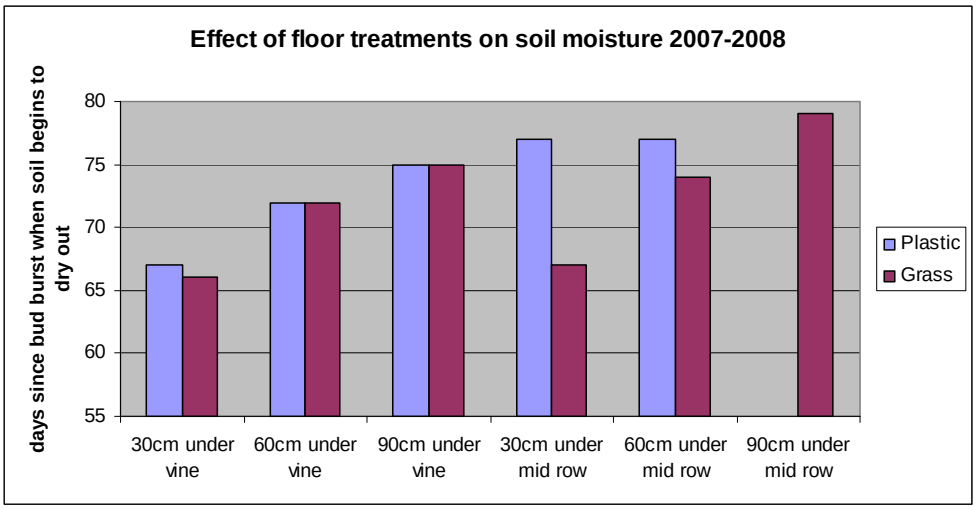


Figure 5.

Shoot length

There was no significant difference in average shoot lengths of vines with plastic laid in the mid-row as compared to vines with grassed mid rows. Means were 95cm for vines in the grass treatment and 96cm for vines in the plastic treatment. Even though the black plastic harvested a third of the rainfall, shoot length was again unaffected.

It is interesting that the mean shoot lengths were 94 and 95 cm in Year 2. and only 75-79cm in Year 1. This is probably a reflection of greater rainfall in Year 2. compared to Year 1.

Harvest results

There were again no significant treatment differences in any of the harvest data. Overall means were- yield: 5.5 kg/vine, bunches per vine: 60, berry weight: 1.2g, sugar: 23.8 degrees Brix, pH: 3.4 and titratable acidity: 7.6g/L.

There was again a large variability in the data between vines and between replicates, particularly in yield and bunch number. This variability may have again overshadowed any treatment differences. The least significant difference of 1.9kg/vine for yield is lower than that of 2.5kg/vine in Year 1. (p=0.05). However, the least significant difference for bunch number of 12.6 bunches per vine is higher than that of 11.5 bunches/vine in the previous year (p=0.05).

Recharge of groundwater

Again a proportion of the water shed by the ground treatments would have been stopped from infiltrating down to recharge the groundwater. This is again quite encouraging as a method for reducing the serious environmental problem of groundwater recharge in the Great Southern Region.

Durability of the black plastic sheeting

Unless treated for resistance to UV light, black plastic sheeting deteriorates in sunlight. The material we used was not UV treated but it had the advantage of being made from recycled plastic.

The sheeting performed well for two seasons. However when it was removed at the end of Year 2. it was found to be very brittle and prone to break into small pieces.

Sheeting treated for UV resistance costs a little more but should last considerably longer.

As for damage from vehicles it was found that tractors travelling downhill cause negligible damage. However, tractors travelling uphill can cause considerable damage if wheel slippage occurs, such as when pulling a heavy load of fruit.

Economics of various means of harvesting rainwater

An assessment of the relative costs of rainwater harvested by various methods was undertaken during the study.

The deeper gravely soils in Frankland can be ideal for viticulture but poor for roaded catchments due to low clay content. Building a roaded catchment without enough clay can reduce water harvesting efficiency. This can result in an increase in the cost of the water by more than threefold compared to an efficient roaded catchment ($700/megaL compared to $200/megaL, Table 1.)

We have made assumptions about the cost of earthworks, maintenance and longevity. People should make their own calculations using their own figures/assumptions.

We estimated the cost of the water harvested from a polymer treated catchment would be in the order of $400/megaL (Table 2.). The efficiency of the roaded catchment can be markedly improved by compaction and/or the use of spray on polymer.

Our trial has shown that laying black plastic sheeting on vineyard rows harvests water at a cost of $400/megaL (Table 2.)

The black plastic treatment of vineyard rows may be viable when a vineyard finds it needs more water but does not have enough suitable land for more roaded catchment.
Alternatively people may want to plant extra vines rather than use the land for extra roaded catchment.

Table 2. Rough estimates of costs of vineyard irrigation water when harvested by different means, Frankland 2007

	Inefficient roaded catchment (run-off threshold 15mm)	Efficient roaded catchment (run-off threshold 5mm)	Polymer treatment of roaded catchment	Polymer treated vineyard rows	Black plastic sheeting on vineyard rows
Establishment cost in first year: materials plus construction/application ($/ha)	6000	6000	6000 to build the catchment plus 2200 for polymer	850	1000
Years before needing to be replaced	25	25	2	1	2
Annual maintenance cost ($/ha)	200	200	200	n/a	n/a
Annualised total costs based on the above ($/ha/yr)	440	440	1540	850	500
Percent of rainfall harvested/ha	10	30	60	9	30
Water harvested/ha in 600mm region (megaL)	0.6	1.8	3.6	0.54	1.8
Water cost based on the above ($/megaL)	700	200	400	1600	300

The average cash flow from a hectare of wine grapes over the first 15 years in south west WA has been estimated to be in the order of $1422/ha/yr (calculated from Gartrell, 2003, DAFWA). This seems an attractive option returning ten times more than the value of the water harvested from the same area of an efficient roaded catchment.

Out trial has shown that polymer soil sealant on vineyard rows works well for only a few weeks after which the surface deteriorates and allows water to infiltrate into the surface. The overall figure for run-off is around only 30 percent for this treatment making the cost of the water nearly three times the cost from the black plastic method ($1600/megaL compared to $600/megaL, Table 2.). The sealant treatment also needs to be applied to three times the number of rows as does the black plastic method in order to catch the same amount of water. Moreover, because the sealant treatment deteriorates after a few weeks leaving the surface prone to erosion, it is probably not a realistic option.

Plastic laying machine

A device for laying the plastic sheeting into vineyard rows has been developed during the project by Rob Hetherington (Photo 5.). It attaches to the three point linkage of a normal vineyard tractor. The machine is suitable for commercial use and has been tested at Powderbark Ridge vineyard. It is very effective provided the vineyard floor is relatively free of canes and mulch (as in after routine vineyard sweeping).

The device prepares the surface, lays the plastic and burries the edges all in one pass. A blade mounted at the front shapes the surface to make a concave centre to hold the water. Small discs at the sides make shallow channels to hold the edges of the plastic. The plastic feeds from rollers and the edges are buried in the channels by small blades that return the overburden before being compacted by press-wheels.



Photo 5. Rob Hetherington demonstrates his plastic laying machine at a field day in February 2008. He developed this machine during the project.

Overall conclusions from the project

The black plastic was highly successful at harvesting rainwater in both years, vine vigour was not adversely affected and significant recharge of groundwater was avoided.

The surface treated with polymer sealant in Year 1. deteriorated quickly when used in this context and is probably unsuited for use in vineyard rows, particularly as the surface became prone to erosion.

However, the polymer remains an excellent sealant for treating roaded catchments.

It would be useful to know what findings would occur for the mid row treatments in a year with average or high rainfall. Originally we proposed that the treatments may reduce unwanted vine vigour. However, the two years of study both had much less rainfall than average and this provided a very good test of the perhaps more important question of whether the treatments would adversely reduce vine vigour and yield in a dry year.

For the black plastic treatment in both years the results showed that vigour and yield were not significantly reduced even though a third of the rainwater was removed by the treatment. These were surprising and very encouraging results.

We estimated the cost of harvested rainfall to be in the order of $300/megalitre using our black plastic technique in vineyard rows, assuming average rainfall. The only method achieving lower cost water would be an efficient roaded catchment where the figure was $200/meglitre. However, the advantage of the black plastic technique is that it allows a greater proportion of the property to be planted to vines rather than having to leave such large areas to be used for roaded catchment.

We have also addressed the practicality of laying the black plastic. The machine developed/adapted by Rob Hetherington works very effectively and has been demonstrated to growers. They are now aware of how straightforward the process of laying the plastic can be.

Recommendations

- *Identify any future research directions arising from this research.*

Effects on vine vigour in wet years

As discussed, the two years of the project both had very low rainfall. While this was a good test that the harvesting of rainwater from vineyard rows did not reduce vine vigour or yield, the question remains as to what would be the case in a wet year.

Type of plastic sheeting

The plastic sheeting we used had the advantage of being made from recycled plastic and being of low cost. It would be useful to know the cost and longevity of plastic treated for UV light resistance.

We understand that white sheeting is used on the floor of apple orchards to enhance ripening and colouring via reflecting light up to fruit on the trees. It would be useful to know whether white plastic sheeting would also give the same benefit to fruit quality of wine grapes as well as harvesting rainwater.

Clear plastic sheeting is also available and may be worth testing.

Removable plastic sheeting

Because most of the rain falls in the winter and early spring, the plastic sheeting could be removed for storage early in the grape season in many years. This would probably improve the longevity of the plastic to a large degree as it would not be subjected to the UV radiation that occurs during our long summer and autumn period.

One can imagine water filled piping attached to the edges of the sheeting to provide weight to hold the plastic in place.

Soil microbiology under the plastic

Further research to study effects on soil microbes under black plastic sheeting would be useful.

Soil temperature effects if used in other regions

The Great Southern is the coolest wine region in Western Australia. Soil temperatures under black plastic in warmer regions would be much higher. This may alter the vine responses as compared to our findings. Research should be undertaken before adopting our findings in a warmer climate.

- *Put your research outcomes into the context of broader industry practices and identify priorities for further R&D, extension and policy.*

  We have a current RITA project (RT 07/02-1) that is partly concerned with demonstrating and extending the findings of the research being reported here. The RITA project involved a seminar and field walk on 8 February 2008. A presentation on the use of black plastic in vineyard rows was given at the seminar and the laying machine was demonstrated on the field walk (Photo 5.). The project will test 15 roaded catchments in the region over the summer of 2008-2009 after which a workshop will be held to extend the findings.

  Ongoing extension of the findings of the project is also envisaged at routine field days seminars and updates as they arise.

  The technique of laying black plastic within vineyards rows is perhaps unlikely to be adopted on properties that are already set up with roaded catchments of sufficient size. If a greater proportion of rainfall needs to be harvested on these properties then the best options may be to compact the surface and use the polymer treatment on the roaded catchment.

  The black plastic technique for vineyard rows is probably best targeted at people intending to develop new vineyard properties. Many of these people will be exposed to our research through articles and papers in viticulture newsletters and journals and at seminars and conferences. However, it can be difficult to develop links with them on a personal level until after their vineyards are set up and they have joined the local industry network. One of our approaches to this problem is to keep the viticulture consultants well aware of the research findings and implications as they are often engaged to provide advice on new viticulture ventures.

Appendix 1: Communication

Communication of the outcomes of research is an important part of the GWRDC's activities.

- *Outline how the outcomes of this project have been communicated during the project.*
- *If any journal articles were written or published during the conduct of the project please list them and where possible include copies in the appendix.*
- *If you believe further communication activities would enhance the uptake of this project's findings please identify them i.e. the conduct of field days, workshops or the production of brochures or identification guides*.

Field days and seminars held

Field day at Powder Bark Ridge vineyard, Frankland with DAFWA soil technical officers. 2 August, 2006

Field day at Powder Bark Ridge vineyard, Frankland with students undertaking studies in viticulture and oenology at Curtin University of Technology, Margaret River. 22 August 2006. People from neighbouring vineyards also attended.

Water Management in Viticulture Field Day at Powder Bark Ridge vineyard, Frankland. Premium Wine Project and NRM staff in conjunction with the Oyster Harbour Catchment Group project. 14th of December 2006

Vineyard Floor Management' field visits to Mount Barker. Frankland and Pemberton with Australian researchers. 8-9 May 2007

Poster display: "Treating vineyard floors increases harvested water for irrigation" R.E. Hetherington, C. L. McDonald and A.J van Burgel. Australian Wine Industry Technical Conference, Adelaide 2007.

Field day at Powder Bark Ridge vineyard, Frankland with students undertaking studies in viticulture and oenology at Curtin University of Technology, Margaret River. 5 September, 2007. People from neighbouring vineyards also attended.

Viticulture Field Day: "Rainfall and harvesting; how good is your system?" Gilberts and Fox River Vineyards, Mt Barker, 8th February 2008.

Publications

Hetherington, R and McDonald, C (2006) 'Early Results from covercrop width trial at Powderbark Ridge', Wine Industry Newsletter no. 81, December 2006..

Hetherington, R and McDonald, C (2006) (2007). Water harvesting and cover crop research in Frankland. Australian Viticulture 11 (2, Mar/Apr): 44-47

Hetherington, R, McDonald, C (2006) and van Burgel, A. (2007). "Treating vineyard floors increases harvested water for irrigation". Poster summary, Australian Wine Industry Technical Conference, Adelaide 2007.

Appendix 2: Intellectual Property

Identify the intellectual property and/or valuable information arising from the research.

The plastic laying machine (Photo 5. in this report) was developed by using existing technology and adapting it to the new application. We have not sought advice as to whether this represents new intellectual property. Similarly we have not sought advice as to whether the technique of using black plastic to harvest rainfall from the vineyard rows represents new intellectual property.

Appendix 3: References

Gartrell, Peter (2003) 'Fruit development budget guide for the south-west of Western Australia', Government of Western Australia, Department of Agriculture Miscellaneous Publication, 22/2003

Lantzke, Neil (2005) 'Increasing run-off to on-farm irrigation dams'
Australian Viticulture, September/ October 2005, Vol 9, No 5, pp 70-71

Stanton, David (2005) 'Roaded catchments to improve the reliability of farm dams'. Government of Western Australia, Department of Agriculture Bulletin 4660.

Appendix 4: Staff

Colin McDonald, Senior Research Officer, DAFWA, Albany
Rob Hetherington, Senior Technical Officer, DAFWA, Albany

Andrew van Burgel, Biometrician, DAFWA, Albany, has also assisted on the project at no charge to GWRDC.

Appendix 6: Budget reconciliation

Please use Form B, downloadable from the GWRDC website at www.gwrdc.com.au