CFPA	SAAPPA / SASPA / SAT	DFTS	Winetech
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FINAL REPORT
FOR 2010/2011

PROGRAMME & PROJECT LEADER INFORMATION

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PROJECT INFORMATION

Project number	WW 02/06
Project title	Evaluation of different soil management practices in a vineyard at Robertson specifically for competition and environmental effects
Project Keywords	

Industry programme	**CFPA**	
	Deciduous	
	DFTS	
	Winetech	Soil Science
	Other	

Fruit kind(s)	Wine grapes
Start date (dd/mm/yyyy)	01/03/1993
End date (dd/mm/yyyy)	31/03/2006

(Note: adjust footer – insert the project number no, researcher and research institution)

FINAL REPORT

1. Executive summary

Triticale has the ability to produce significantly more dry matter than the local weeds over the long-term, if sown mid-April, irrespective of the management practice applied. Rotating triticale and vetch annually or biennially did not improve the dry matter production of these species over the long-term. This indicated that under similar environmental conditions mono-cropping can be applied with these two species for as long as 11 years without a significant loss in dry matter production. The data suggested that a grain species such as triticale and rye should be an integral part of any cover cropping system in the Breede River Valley. If the cover crop can only be established late May, it seems prudent to allow the cover crop to keep on growing after grapevine bud break in order to facilitate additional growth from grapevine bud break to grapevine berry set, thus maximizing dry matter production. When sown mid-April, this management practice should be considered for vetch only.

Meaningful differences in weed control efficacy between treatments manifested only three years after application, illustrating the importance of and need for long-term soil cultivation trials in crops. Effective winter weed suppression, as well as significantly improved summer weed control may be achieved in this grapevine region with triticale controlled chemically full surface from bud break. This cultivation practice results in total suppression of winter growing weeds over the medium to long term, which allows a reduction in the application of herbicides. Triticale, a rye/faba bean mixture or a biennial rotation of triticale and vetch as cover crop in combination with full surface chemical control during bud break, as well as combining full surface straw mulch with full surface chemical control during bud break, may achieve total summer weed control after eight years of application. This allows producers to omit the herbicide spray to be given in irrigated vineyards in this semi-arid region when the grapevine berries reach pea size. A permanent cover crop or mechanical cultivation in the work row did not suppress the winter and summer growing weeds significantly.

Full surface post-emergence chemical control should be applied from the end of August to just before harvest in young vineyards established on medium textured soils in the Breede River Valley wine grape region. Cover crops should be sown annually and controlled chemically before bud break, as it will enhance the development of the permanent structure of trellised grapevines.

A permanent cover crop should not be established, and mechanical cultivation should not be applied, in the work rows of vineyards during the first five seasons after being established on medium textured soils in the Breede River Valley, as it may lead to early season N-deficiencies and affect shoot growth and yield negatively.

It is beneficial to the performance of full bearing grapevines to chemically control a cover crop before bud break, rather than allowing it to complete its life cycle, especially where grazing vetch is used as cover crop. Although grazing vetch controlled chemically at the end of August may create an early season over-supply of N if sown for two consecutive years or more, it will not necessarily cause excessive shoot growth, but may result in above average grape yields over the long term. This N-fixing cover crop also contributed positively to the N status of the grapevines during the latter part of the grapevine growing season. A full surface straw mulch packed out annually promotes early season uptake of N and has a significant positive impact on grape yield over the long term. It seems that the competition for nutrients between the full bearing grapevines and the permanent cover crop was rendered negligible by the relatively fertile medium textured soil used in the study. Although the different soil management practices affected grape yield significantly over the 12-year period, they had no significant effect on wine quality.

Surface mulch limited the diurnal variation in temperature of a medium textured soil during the grapevine growing season. The soil covered by a full surface straw mulch throughout the year takes approximately one week longer to reach temperatures conducive to soil organism activity during early summer than soils subjected to other management practices. It may also delay bud break slightly. It does, however, create a favourable environment for the grapevine roots throughout the grapevine growing season. By using an annual cover crop which is controlled chemically just before grapevine bud break, sub-optimal soil temperatures experienced with a full surface straw mulch during the first two weeks after grapevine bud break can be avoided. To help ensure that N applied post-harvest in the vineyards of the Breede River Valley is readily available to the grapevines, irrespective of the soil cultivation practice applied, the application of N should be restricted to the period between mid-March and mid-May. Where an annual cover crop is used, the post-harvest application of N may be considered from as early as mid-February.

Cover crop management resulted in an increase in soil organic matter to a depth of 600 mm. This could also be achieved with full surface chemical control and mechanical control in the work row if the winter growing weed spectrum is dominated by ripgut brome. With cover crop management it was possible to raise the soil organic matter content to a level at which the annual application of N fertilizer becomes unnecessary.

During the first three years after the vineyard was established the total inorganic N in the 0-600 mm soil layer of the treatments in which an annual winter growing N fixing cover crop was sown, was always higher (mostly significantly higher) than that of the treatments in which no cover crop was sown or in which a permanent cover crop or full surface mulch was employed. This trend was observed during full bloom, veraison and post harvest.

Over the medium term, grazing vetch controlled chemically full surface from bud break resulted in the level of total inorganic N in the 0-600 mm soil layer during full bloom to exceed the level at which it is unnecessary to apply inorganic N fertilizer. During veraison, this was achieved with grazing vetch controlled in the vine row from bud break and in the work row from berry set (end of November). Over the long-term this was achieved with both the above-mentioned treatments during full bloom. During veraison, only the treatment in which grazing vetch was controlled in the vine row from bud break and in the work row from berry set could elevate the total inorganic N in the 0-600 mm soil layer above the level at which no inorganic fertilizer needs to be applied in these medium textured soils. In the long term, the use of a full surface straw mulch or the use of annuals as a winter growing cover crop may supply in the fertilizer needs of the grapevines during the post harvest period level.

2. Problem identification and objectives

To establish the economic viability of different soil management practices, as well as the effect of these practices on grapevine performance and the environment in the long-term. An additional goal is to supply region-specific guidelines for environment-friendly soil management practices.

3. Workplan (materials & methods)

The materials and methods are fully explained in:

FOURIE, J.C., 2010. Soil Management in the Breede River Valley Wine Grape Region, South Africa. 1. Cover Crop Performance and Weed Control. S. Afr. J. Enol. Vitic. 31, 14-21.

FOURIE, J.C., 2010. Soil Management in the Breede River Valley Wine Grape Region, South Africa. 2. Soil Temperature. S. Afr. J. Enol. Vitic. 31, 165-168.

FOURIE, J.C., 2011. Soil Management in the Breede River Valley Wine Grape Region, South Africa. 3. Grapevine Performance. S. Afr. J. Enol. Vitic. 32, 60-70.

FOURIE, J.C., 2011. Soil Management in the Breede River Valley Wine Grape Region, South Africa. 4. Organic Matter Content and Macro-nutrient Content of a Medium-textured Soil. S. Afr. J. Enol. Vitic. 32, submitted for publication.

4. Results and discussion

Rotating *Triticale* v. Usgen 18 (triticale) and *Vicia dasycarpa* Ten. (vetch) did not improve dry matter production (DMP) of either species. Average DMP decreased as follows: triticale > *Secale cereale* L. v. Henog (rye)/*Vicia faba* L. v. Fiord (faba bean) mixture > triticale/vetch biennial rotation > triticale/vetch annual rotation > vetch. Triticale (BB) resulted in total winter weed suppression from 1995 to 1996 and from 2001 to 2004. Total weed control from bud break to the pea size berry stage of the grapevines was achieved with straw mulch (BB), triticale (BB), rye/faba bean mixture (BB) and triticale/vetch rotated biennially (BB) from 2001 to 2003. For triticale combined with full surface post-emergence chemical control applied from grapevine berry set (AB) and triticale/vetch rotated annually (BB) this was restricted to 2001 and 2003. From the pea size berry stage to harvest straw mulch (BB), triticale (BB), vetch (BB), rye/faba bean mixture (BB) and triticale (AB) reduced the weed stand significantly, compared to the control.

Differences in soil temperature between the un-mulched and mulched treatments, as measured in the grapevine rows, were negligible from late April to the end of August. From mid-September (grapevine bud break) to the end of March, the temperature of the mulched soil was, with the exception of the third week in October, lower than that of the un-mulched soil. Results indicated that soil temperatures during early spring had a slight effect on the onset of grapevine bud break. Mulching minimised the diurnal variation in soil temperature. The annual cover crop did not cause any delay in bud break and kept the soil temperatures below 25°C, with the exception of a three week period just before harvest.

In the BB treatments, grapevine shoot growth was significantly higher than in the treatment where a perennial cover crop was established in the work row during both the second (1993/94) and third (1994/95) season after the grapevines were established. The grape yield in all the BB treatments, except the one in which a mixture of *Secale cereale* L. v. Henog and *Vicia faba* L. v. Fiord was sown, was significantly higher than that of the control and the treatment in which a perennial cover crop was sown in the work row during the 1995/96 season. During the 2001/02 season, the grape yield of the BB treatment with a full surface straw mulch was significantly higher than that of all the other treatments. The different soil management practices had a significant effect on the N status of the juice, but did not affect wine quality.

After three seasons all the minimum cultivated treatments showed an increase in the percentage soil organic matter (SOM) in the 0 mm to 300 mm soil layer, with the exception of the treatments in which grazing vetch was established continuously as cover crop. The percentage SOM in the 0 mm to 150 mm soil layer of the cover crop treatments also exceeded the 1.5% level regarded as the level above which it may not be necessary to apply fertilizer N to vineyards established on soils with a clay content of 6% or more. During the first three years after the vineyard was established the total inorganic N in the 0-600 mm soil layer of the treatments in which an annual winter growing N fixing cover crop was sown, was always higher (mostly significantly higher) than that of the treatments in which no cover crop was sown or in which a permanent cover crop or full surface mulch was employed. This trend was observed during full bloom, veraison and post harvest. Over the medium term, grazing vetch controlled chemically full surface from bud break resulted in the level of total inorganic N in the 0-600 mm soil layer during full bloom to exceed the level at which it is unnecessary to apply inorganic N fertilizer. During veraison, this was achieved with grazing vetch controlled in the vine row from bud break and in the work row from berry set (end of November). Over the long-term this was achieved with both the above-mentioned treatments during full bloom. During veraison, only the treatment in which grazing vetch was controlled in the vine row from bud break and in the work row from berry set could elevate the total inorganic N in the 0-600 mm soil layer above the level at which no inorganic fertilizer needs to be applied in these medium textured soils. In the long term, the use of a full surface straw mulch or the use of annuals as a winter growing cover crop may supply in the fertilizer needs of the grapevines during the post harvest period level.

For a detailed discussion of the data consult the above-mentioned publications.

Milestones	**Achievements**
Determine the effect of different soil management practices on cover crop performance, weed control efficacy and weed spectrum in the long-term.	Objective achieved June 2005.
Determine the effect of different soil management practices on grapevine nutrient status, vegetative growth and yield in the long-term.	Objective achieved June 2005
Determine the effect of different soil management practices on the organic matter content and soil nutrient status of the soil in the long-term.	Objective achieved June 2004
Determine the effect of different soil management practices on the recompaction of the soil in the long-term.	Objective achieved March 2006.

Determine the effect of different soil management practices on the seasonal irrigation water consumption in the long-term.	Objective achieved June 2005
Determine the economic viability of the different soil management practices in the long-term.	Objective achieved June 2005
Publish the data in a scientific journal and the Wineland	Scientific objective achieved July 2011. Wineland publications will follow

5. Accumulated outputs

Technology development, products and patents

Medium to long term guidelines for the management of a variety of cover crops, suitable for use in the Breede River Valley wine grape region has been developed that will help ensure the maximum production of quality grapes.

Human resources development/training

A student from The University of Venda passed her BSc Honours degree with a seminar (86%) on field work she did in this study.

	Student level (BSc, MSc, PhD, Post doc)	Cost to project (R)
1.	BSc Honours	None (Funded by THRIP)
2.	MSc (Soil Science)	None
3.		
4.		
5.		

Publications (popular, press releases, semi-scientific, scientific)

FOURIE, J.C., 2001. The use of cover crops in an integrated approach to Winegrape production in the Breede River Valley. In: Soil science aspects for optimum wine quality in the Breede River Valley (Afrikaans).

Brink, D., 2007. The effect of different surface management practices on the root distribution of grapevines. PhD dissertation University of Stellenbosch.

FOURIE, J.C., 2010. Soil Management in the Breede River Valley Wine Grape Region, South Africa. 1. Cover Crop Performance and Weed Control. S. Afr. J. Enol. Vitic. 31, 14-21.

FOURIE, J.C., 2010. Soil Management in the Breede River Valley Wine Grape Region, South Africa. 2. Soil Temperature. S. Afr. J. Enol. Vitic. 31, 165-168.

FOURIE, J.C., 2011. Soil Management in the Breede River Valley Wine Grape Region, South Africa. 3. Grapevine Performance. S. Afr. J. Enol. Vitic. 32, 60-70.

FOURIE, J.C., 2011. Soil Management in the Breede River Valley Wine Grape Region, South Africa. 4. Organic Matter Content and Macro-nutrient Content of a Medium-textured Soil. S. Afr. J. Enol. Vitic. 32, submitted for publication.

Presentations/papers delivered

HERBST, K. & FOURIE, J.C., 2001. Economic viability of different soil cultivation practices in the Breede River valley. The South African Society for Agricultural Technologists conference, 18-20 September, Brenton-on-Sea, Knysna (Poster).

FOURIE, J.C., 2001. The use of cover crops in an integrated approach to wine grape cultivation in the Breede River Valley. ARC Infruitec-Nietvoorbij short course, 17 October, Goudini. (talk).

FOURIE, J.C., 2002. Cover crop management in vineyards and orchards. Conservation tillage workshop on fruit, grapes and vegetables. Department of Agriculture, Western Cape, 27 August, Stellenbosch (Talk).

FOURIE, J.C., 2002. Evalution of soil cultivation practices in a wine grape vineyard in Robertson. Winetech Information day, 4 September, Robertson (Talk).

FOURIE, J.C., 2003. Cover crops:perennial vs annual species. SASEV Wine and Vine Forums: Autumn meeting, 25 April, Stellenbosch (Talk).

FOURIE, J.C., 2003. Cover crop management in the vineyards and orchards of the Western Cape. Nexus Farmers Day, 21 May, Paarl (Talk).

FOURIE, J.C., 2004. Integrated weed control in a sustainable manner. Herbicide resistance action committee meeting, 15 October, Robertson (Demonstration talk).

FOURIE, J.C., 2005. Weed control and the use of cover crops in the Klein Karoo. Vinpro and Winetech Farmers Day, 22 March, Calitzdorp (Talk).

FOURIE, J.C., 2007. Cover crops in vineyards and orchards. *Talk*. Bien Donné Agricultural Expo, 2 November, Paarl.

FOURIE, J.C., 2007. Effect of soil management practices on the soil, weeds and performance of perennial crops. *Talk*. UAP training day, 25 July, Paarl.
FOURIE, J.C., 2007. Effective and environment friendly weed control in perennial crops. *Lecture*. Visit of students from the University of Venda, 2 July, Stellenbosch.

FOURIE, J.C., 2007. The effect of cover crop management practices on the soil and the performance of perennial crops. *Talk*. ARC Infruitec-Nietvoorbij Soil Science information session, 20 June, Stellenbosch.

FOURIE, J.C., 2007. Soil cultivation in perennial crops: the status quo. *Talk*. ARC Infruitec-Nietvoorbij Soil Science information session, 25 May, Stellenbosch.

FOURIE, J.C., 2007. Soil cultivation strategy for integrated weed control: Factors that should be taken into account. *Talk*. Nexus grapevine training day, 24 May, Paarl.

FOURIE, J.C., 2007. Soil cultivation research at ARC Infruitec-Nietvoorbij. *Talk*. Visit by CEO and members of ARC Council, 17 May, Stellenbosch.

FOURIE, J.C., 2007. The effect of cover crop management practices on the performance of cover crops in the cooler and warmer climatic regions of South Africa. *Talk*. Worcester/Breedekloof After Harvest Information Day, 15 May, Worcester.

FOURIE, J.C., 2010. The effect of different soil cultivation practices on the soil and the performance of wine grapes. *Talk.* UAP Crop Care Information Day, 2 March, Plettenberg Bay.

FOURIE, J.C., 2010. Cover crop management-status quo. *Talk.* Meeting technical personell Agricol (PTY) LTD, 30 July, Bellville.

FOURIE, J.C., 2010. Soil cultivation research at ARC Infruitec-Nietvoorbij *Talk.* Soil & Water Science Information Day, 22 July, Stellenbosch.

FOURIE, J.C., 2010. Summary of soil cultivation research with special emphasis on soil temperature, weed control and cover crop guidelines for the different wine grape regions. *Talk.* Meeting Vinpro consultation services, Vinpro, 10 September, Paarl.

FOURIE, J.C., 2010. Advantages of cover crop management. *Talk.* Information Day Robertson/Rawsonville, UAP Crop Care, 21 September, Robertson.

FOURIE, J.C., 2010. Weed control efficacy of different soil cultivation practices on a medium textured vineyard soil in the Breede River valley. 32nd Conference of the South African Society for Enology & Viticulture (SASEV) Congress, 18 November, Somerset West (Paper).

FREITAG, K., FOURIE, J.C. & OCHSE, C.H., 2010. Effect of different soil cultivation practices on soil temperature in the 0-200 mm soil layer of a medium textured vineyard soil. 32nd Conference of the South African Society for Enology & Viticulture (SASEV) Congress, 18 & 19 November, Somerset West (Poster).

4. Total cost summary of project

	Year	CFPA	Deciduous	DFTS	Winetech	THRIP	Other	TOTAL
	2000/01				109 612		255 761	**365 373**
Total cost in real terms for year 9	2001/02				141 587		212 380	**353 967**
Total cost in real terms for year 10	2002/03				169 712		234 365	**404 077**
Total cost in real terms for year 11	2003/04				157 383		192 357	**349 740**
Total cost in real terms for year 12	2004/05				159 188		194 563	**353 751**
Total cost in real terms for year 13	2005/06				106 352		110 692	**217 044**
TOTAL (last six years)					**843 834**		**1 200 118**	**2 043 952**