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DUTCH MINISTRY FOR THE ENVIRONMENT

REGIONAL ANALYSIS OF USE PATTERNS OF PLANT PROTECTION PRODUCTS IN SIX EU COUNTRIES

PES - A/PHASE 2

A COMPARISON OF AGROCHEMICAL USE ON VINES IN THREE REGIONS IN EUROPE

Bordeaux, France
Rioja, Spain
Verona, Italy

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VINES - CROSS REGIONAL REVIEW

CONTENTS

	Page
SUMMARY	v-1
1.0 THE REGIONS, METHODOLOGY AND SAMPLES	v-6
1.1 The regions	v-6
1.2 Methodology	v-6
1.3 The survey samples	v-6
2.0 GENERAL RESEARCH FINDINGS	v-8
2.1 Farming demographics	v-8
2.1.1 Land tenure	v-8
2.1.2 Occupational status	v-8
2.1.3 Farming enterprises	v-9
2.2 Agronomy	v-10
2.2.1 Varieties	v-10
2.2.2 Soil types	v-11
2.2.3 Fertiliser use	v-12
2.3 Commercial issues	v-13
2.3.1 Destination of produce	v-13
2.3.2 Agrochemical restrictions in production contracts	v-13
3.0 PESTICIDE USE	v-15
3.1 Summary of pesticide use	v-15
3.1.1 Herbicides	v-15
3.1.2 Fungicides	v-15
3.1.3 Insecticides	v-15
3.1.4 Other pesticides and agrochemicals	v-15
3.2 Variation in chemical load between farms and regions	v-18
4.0 WEEDS AND WEED CONTROL	v-20
4.1 Target weeds	v-20
4.2 Weeds claimed to be resistant to herbicides	v-21
4.3 Levels of weed control sought	v-21

Page

4.4 Herbicide use v-22
 4.4.1 Bordeaux v-22
 4.4.2 Rioja v-23
 4.4.3 Verona v-24
4.5 Herbicide use parameters v-25
 4.5.1 Average number of herbicide applications v-25
 4.5.2 Herbicide placement v-26
4.6 Herbicide load per farm v-27
4.7 Mechanical weed control v-29
4.8 Herbicide use in the study year (1994) compared with an average year v-30
4.9 Opportunities to reduce herbicide load v-30

5.0 DISEASE AND FUNGICIDES v-32

5.1 Target diseases v-32
5.2 Diseases claimed to be resistant to fungicides v-33
5.3 Levels of disease control sought v-33
5.4 Fungicide use by active ingredient v-34
 5.4.1 Bordeaux v-34
 5.4.2 Rioja v-36
 5.4.3 Verona v-37
 5.4.4 Fungicide active ingredients used - general commentary v-38
5.5 Fungicide use parameters v-39
5.6 Fungicide load per farm v-42
 5.6.1 Sulphur v-45
5.7 Fungicides use in the study year (1994) compared with an average year v-46
5.8 Factors determining the start of fungicide application v-47
5.9 Opportunities to reduce fungicide load v-49

6.0 INSECTS AND INSECTICIDES (INCLUDES MITES) v-50

6.1 Target insects v-50
6.2 Insects exhibiting resistance v-52
6.3 Level of insect and mite control sought v-52
6.4 Insecticide and acaricide use v-53
 6.4.1 Bordeaux v-53
 6.4.2 Rioja v-55
 6.4.3 Verona v-56
 6.4.4 Insecticides and acaricides used - general commentary v-57
6.5 Insecticide and acaricide use parameters v-58
 6.5.1 Application volumes v-58
6.6 Insecticide/acaricide load per farm v-59
6.7 Insecticide/acaricide use in the study year (1994) compared with an average year v-61
6.8 Factors determining the start of insecticide/acaricide applications v-62
6.9 Opportunities to reduce the insecticide/acaricide load v-64

Page

7.0 MISCELLANEOUS PESTS AND PESTICIDES v-65

8.0 OTHER AGROCHEMICALS v-65

9.0 TRENDS IN PESTICIDE USE v-66

9.1 Variation in pesticide use over the last five years v-66
9.1.1 Herbicides v-66
9.1.2 Fungicides v-66
9.1.3 Insecticides/acaricides v-67
9.2 Plans to maintain or change pesticide use in vines v-67

10.0 PESTICIDE/AGROCHEMICAL GENERALITIES v-69

10.1 Sufficiency in choice of products v-69
10.2 Attitudes to developments in the agrochemicals market v-69
10.3 Attitudes to handling restrictions on the label v-70
10.4 Attitudes to environmental restrictions of the label v-70
10.5 Sources of information v-71

11.0 PROFITABILITY AND PESTICIDES v-72

11.1 Profitability of the vine crop v-72
11.2 Returns and costs of production v-73
11.3 Influence of anticipated profit on pesticide use and choice v-74
11.4 The effect of agrochemicals on profitability v-75

12.0 ALTERNATIVE CROP PROTECTION SYSTEMS v-77

12.1 Awareness of alternative systems v-77
12.2 Interest in developing alternative systems v-78

13.0 ENVIRONMENTAL ISSUES v-79

13.1 Vineyards in restricted areas v-79
13.2 Considerations influencing the choice of chemicals v-79

APPENDIX I Definitions and caveat v-80
APPENDIX II Contacts and collaborators v-82

VINES - CROSS REGIONAL REVIEW

SUMMARY

The study was conducted in mid 1995 on practices employed in 1994. Three regions were reviewed: Bordeaux (Gironde, Charente and Charente Maritime) (F), Rioja (E) and Verona (I). These were covered by farmer surveys and discussions with key specialists in the regions.

General

The three vine growing areas in the study were each different from one another. Vine holding per farm was largest in Bordeaux at 11 ha/farm and smallest in Verona at 0.7 ha/farm. The study samples however, which were designed to review similar farm numbers across the farm holding profile, over-sampled the larger holdings in each region and reduced the variation in average holding size between regions.

Chemical load

The average volumes of active ingredients applied per hectare of crop grown in the samples were:

		Average	(Range)
Bordeaux	(F)	45 kg ai/ha	(7.9 - 87.3 kg ai/ha)
Rioja	(E)	17 kg ai/ha	(2.9 - 146.9 kg ai/ha)
Verona	(I)	34 kg ai/ha	(0.8 - 142.4 kg ai/ha)

There was some evidence that growers in Rioja and Verona had not declared all their sulphur use which if additionally estimated brings all regions to a similar average level.

Weed control - herbicides

Target weeds indicated that perennial broad leaf weeds were seen as most of a problem in the Bordeaux region and least in Verona. The perennial grass weeds were seen as important in Rioja and Verona. Demand for a high level of weed control was highest in Bordeaux and considerably lowest in Verona. This is reflected in herbicide use where 90% of the growers used herbicides in Rioja and Bordeaux while in Verona this was only 43%.

The heaviest load of herbicides was applied in Bordeaux where soil-acting residual herbicides were most used. Farmers in this region, however, also appeared to target the treatments to the greatest degree.

Mechanical cultivations were made in all three regions. These were carried out for other reasons as well as weed control and appeared to have no effect on reducing herbicide load.

Herbicide use has moved substantially to use of contact herbicides which can be used as and when the problems are seen. Herbicide placement through spraying along the rows and spot spraying is also well entrenched. Only limited further load reductions can be envisaged through increased use of contact herbicides as opposed to soil-acting chemicals and increased use of treatments along the rows and spot treatments.

Disease control - fungicides

The two main diseases, *Plasmopara viticola* (downy mildew) and *Uncinula necator* (powdery mildew), determine the necessity to protect the vines throughout the season. *Botrytis cinerea* (grey mould) is also of importance. The relative importance of the two main diseases varies by region with *Plasmopara* the more dominant disease in Bordeaux and Verona and *Uncinula* in Rioja.

The level of disease control expected by growers was virtually 100% except in the Verona region where they were less demanding. There officials indicated that *Plasmopara* only required maximum control early in the season.

Fungicides were overwhelmingly the largest component of chemical load in the three regions owing to the number of treatments required to protect the crops season-long and the low activity (high dose rate) of some of the chemicals employed (eg copper salts and sulphur).

Amongst the most used active ingredients, contact/protectant chemicals were most important in Bordeaux and Verona whilst in Rioja most chemicals were systemic, targeted (as was sulphur) at *Uncinula*.

ICM techniques are being promoted in all regions. In Rioja farm scale trials have shown that a near halving of the number of applications can be achieved with this technique.

Official warning systems are available in all regions to determine the time to start spraying. These were most used in Bordeaux and Rioja. Greater use, particularly in Verona, might help to target applications and reduce any unnecessary use.

Insect and mite control - insecticides and acaricides

The main pest in all regions was the grape berry moth, *Lobesia botrana*. Mite pests used to be important and in the minds of growers still are. They have declined except in Bordeaux. The other important pests were leaf-hoppers, mainly *Empoasca* species, where there were suggestions of their increase.

Programmes of pest control adopted in the three regions were different. The active ingredient list in Bordeaux was a 'modern' one, using products with high levels of activity. Several specific acaricides were amongst the most used products. The active ingredients used in Rioja were essentially 'traditional'. The most used product was a formulated mixture of parathion in petroleum oil. Mites were less important and there were only two specific acaricides mentioned apart from sulphur. The influence of the multiple sulphur applications for disease control in maintaining a low level of mite infestation is discussed. The active ingredients used in Verona were indicative of the influence of IPM in the region but pest infestations may be lower as well because 26% of growers did not apply any insecticide in 1994. This could, though, be a further indication of successful IPM.

IPM is currently practised in all regions, but there are indications in this study that pesticide use could be considerably reduced if IPM techniques were adopted more enthusiastically. Official warning systems are avilable in all regions to determine timing of sprays for some pests. These were most used in Rioja and Bordeaux. Greater use, particularly in Verona, might help to target applications more tightly.

Trends in pesticide use and agrochemical generalities

Growers in Bordeaux felt that use of pesticides had remained the same over the last five years. Growers in Rioja were divided. Half thought the position was the same whilst half thought there had been an increase. There were also mixed opinions in Verona, some believing there had been an increase and others a decrease.

About three-quarters of growers had no plans to change their pesticide/agrochemical use in the near future. Of those who might change, most numerous in Rioja, the main areas for change were in insecticides/acaricides and fungicides, for reasons of 'better control'. A significant minority of growers in Rioja gave 'environment' as a reason for change.

All growers professed that they considered handling and environmental restrictions on the label as important or very important, and a large majority were generally satisfied with developments in the agrochemical market. Specialists did not believe that growers were being perfectly honest in their response concerning environmental restrictions on the label - they felt, particularly in Bordeaux and Rioja, that growers were being polite!

Information sources

In all three regions the most important source of information was the co-operative representative, particularly so in Bordeaux and Verona. In Rioja a wider spread of sources was used, including agrochemical merchants, official plant protection advisors and private consultants - the latter two receiving high scores for the quality of the information they gave. In Verona larger farmers used merchants more than the smaller farmers because they tended not to be members of the local Cantine Sociali (co-operative). It is significant that although the official plant protection advisors achieved high scores in Verona, they were not used by many growers.

Profitability

The majority of growers in all regions said that the profitability of vines was satisfactory (or better) in 1994. Strictly comparable raw data on economic models were not available for each region, but a comparison of factors such as agrochemical costs as a proportion of all variable costs and of gross income was possible. Concerning agrochemical costs as a proportion of gross income, Bordeaux and Rioja were very similar at 8 and 9% respectively whilst, as might be expected, in Verona it was only 4.5%.

The influence of anticipated profit on growers' use and choice of pesticides varied both within and between regions, but the majority would be uninfluenced.

Growers in all regions felt that fungicides were the main sector affecting profitability. Despite this, in all regions, and especially strongly in Rioja, it was felt that reductions in fungicide use could be made without affecting profitability.

Alternative crop protection systems

Growers in Bordeaux showed most general awareness of all the three alternative systems ICM, IPM and OP. In Rioja and Verona IPM and OP were most recognised but by less than half of the growers. Lack of awareness of terminology may have led to an understatement of knowledge in Rioja and Verona although the PPS in Rioja confirmed a lack of interest in that region. In Verona specialists said that growers had been using elements of IPM and ICM for years but would be unaware of the terms. Most interest in developing IPM or ICM on their farms was found in Bordeaux, and most interest in OP in Rioja.

Environmental issues

Only one farm in Bordeaux and four in Verona were in areas with environmental restrictions. Three of the four in Verona said it made their choice of agrochemicals difficult.

In response to questioning of all growers on environmental factors influencing their choice of agrochemicals, over half in Bordeaux and Rioja, and just under half in Verona, were not influenced by any environmental criterion. In Bordeaux 'produce quality' and absence of residues from grapes were the main factors of interest, and in Verona it was 'soil protection'. Specialists in Bordeaux and Rioja confirmed that growers had little interest in or awareness of environmental considerations.

Conclusions

The vine areas of Bordeaux, Rioja and Verona are three quite different climatic and agricultural regions. The problems presented to the growers in each are different.

IPM and ICM techniques appear to be in the process of being implemented in Bordeaux and Verona, and to a lesser degree in Rioja, but from grower answers to questions and the lists of active ingredients used there still seems to be a long way to go in all regions. Trials in Rioja suggest that a substantial reduction in fungicide use could be achieved by following such a regime.

Greater use of the official warning systems available for determining spray timing for disease and insect control might target applications more accurately and reduce any unnecessary use.

1.0 THE REGIONS, METHODOLOGY AND SAMPLES

1.1 The regions

Three well developed vine growing regions were selected. The regions chosen were:

France - the broad Bordeaux region encompassing Gironde, Charente and Charente Maritime

Spain - Rioja

Italy - Verona

1.2 Methodology

The format followed consisted of two group discussions, one in Bordeaux and one in Verona, to determine broad parameters followed by farmer surveys in the three regions using a questionnaire of approximately one hour in length. Fieldwork was conducted in mid 1995 and questions related to agrochemical use in the previous season 1994. Results, having been obtained and partially analysed, were used as the basis of interviews with local specialists in the regions to discuss findings and broaden discussion.

1.3 The survey samples

The objective of the farmer survey was not only to ascertain current agrochemical practices in the region but also to identify differences in agronomic practice between farms.

Patterns of crop distribution by farm in all regions showed the typical pattern of the largest area of crop concentrated in the hands of relatively few larger units.

When designing the sample prior to commencement of research the causal factors of any variation are not fully known. It is often found, however, that one of the main common bases for variation in practice is enterprise size.

Budgetary restraint limited the sample size to around 60 in a region. It was decided that in order to expose variation a sample with as far as practically possible adequate numbers of farms across the crop distribution profile should be represented.

The statistics for the regions are presented in the individual regional reviews but are not easily presented in summary. The samples resulting were the following.

Table 1.3 Farm survey samples

Vine area per farm - ha	Bordeaux (France)		Rioja (Spain)		Verona (Italy)	
	Farms %	Area %	Farms %	Area %	Farms %	Area %
0.2 - 2	-	-	-	-	34	4
2 < 5	-	-	-	-	34	17
1 < 5	2	0.2	23	3	-	-
5 < 10	29	8	29	9	16	16
10+	-	-	-	-	15	64
10 < 20	34	19	23	13	-	-
20+	36	72	-	-	-	-
20 < 50	-	-	16	21	-	-
50+	-	-	10	56	-	-
Total No., ha	59	1,420	62	1,383	61	412
Average per farm - ha	-	24	-	22	-	6.8
Regional average per farm - ha	-	11	-	3	-	0.7

The average crop areas for the sample are compared above to the average for the region as a whole. From this it may be seen that the average areas in the samples were larger than for the regions as a whole, a consequence of spreading the sample as evenly as possible down the farm profile.

2.0 GENERAL RESEARCH FINDINGS

2.1 Farming demographics

2.1.1 Land tenure

Table 2.1.1 Land tenure

Region	Bordeaux (F)	Rioja (E)	Verona (I)
Number of farms	59	62	61
Total crop area - ha	1,420	1,383	412
Ownership	Farms %		
>60% owned 40 - 60% owned <40% owned	64 14 22	94 3 3	85 8 7

In Bordeaux there was a significant proportion of growers who did not own their complete farm.

2.1.2 Occupational status

Almost all growers in the study were full-time vine growers, although in the Rioja region this was not representative of the area where most farms are smaller than in the study and the growers are mostly part-time.

2.1.3 Farming enterprises

Table 2.1.3 Farming enterprises

Region	Bordeaux (F)	Rioja (E)	Verona (I)
Number of farms	59	62	61
	Farms %		
Crops			
maize	51	8	49
small grain cereals	37	44	36
soya beans	8	2	8
sugar beet	12	11	11
sunflowers	3	2	3
field vegetables	5	18	5
top fruit	31	3	30
soft fruit	2	3	2
temporary grass	15	2	15
permanent grass	19	0	18
Animals			
dairy	14	0	13
beef	14	0	13
veal	15	0	15
pigs	0	2	0
poultry	8	0	8

Verona and Bordeaux appeared to be similar in their type of farming enterprise. Rioja had more small grain cereals and vegetables together with virtually no livestock.

2.2 Agronomy

2.2.1 Varieties

Table 2.2.1 Main grape varieties

Bordeaux (F)		Rioja (E)		Verona (I)	
Crop area 1,420 ha		Crop area 1,383 ha		Crop area 412 ha	
Main varieties Area %					
Uniblanc	34	Tempranillo	49	Corvina	24
Cabernet	33	Garnacha	17	Garganega	14
Sauvignon	24	Viura	11	Cabernet Sauvignon	10
Merlot	2	Mazuelo	7	Rondinella	9
St Emilion	2	Corvina	2	Trebbiano/Castelli	7
Colombar				Romano	
				Pinot varieties	6
				Tocay	6
				Verduzzo	4
				Riesling	4

There was a much greater spread of varieties grown throughout the sample in Verona than in the other two regions. For all regions there were many other varieties grown on small areas.

In Bordeaux, specialists suggested that there were no particular consequences for agrochemical use as a result of growing different varieties. Comments made by specialists in Rioja were that Tempranillo was susceptible to *Uncinula necator* (vine powdery mildew), but resistant to *Plasmopara viticola* (vine downy mildew), and that Garnacha and Viura were susceptible to all diseases.

A fairly detailed assessment was given for Verona for which the disease susceptibility of the varieties mentioned above are as follows:

Disease	Susceptible varieties
Plasmopara	Corvina, Tocay
Botrytis	Trebbiano, Pinot, Tocay
Phoma	Rondinella

2.2.2 Soil types

Table 2.2.2 Soil types - main constituents

Region	Bordeaux (F)	Rioja (E)	Verona (I)
Crop area - ha	1,420	1,383	412
Broad soil type	Area %		
Sand	27	15	10
Silt	4	6	10
Clay	40	54	61
Organic	0	3	12
Other	26	23	8

Clay was the main component, particularly in Verona. There were not thought to be any consequences for agrochemical use.

2.2.3 Fertiliser use

Table 2.2.3 Fertiliser use

Region		Bordeaux (F)	Rioja (E)	Verona (I)
Crop area - ha		1,420	1,383	412
Constituent	Specification kg/ha	Area %		
Nitrogen				
High	> 50	1	2	0
Medium	26 - 50	96	97	56
Low	1 - 25	1	1	41
Nil	0	0	0	0
No answer		2	0	3
Phosphorus				
High	> 50	5	4	1
Medium	26 - 50	36	34	19
Low	1 - 25	36	62	38
Nil	0	0	0	27
No answer		22	0	15
Potassium				
High	> 80	24	86	34
Medium	51 - 80	17	10	8
Low	1 - 50	53	3	26
Nil	0	0	0	20
No answer		1	0	15

With the exception of Verona there was little variation in nitrogen usage, most were firmly in the medium category. The levels of many growers in Verona were in the low category. Specialists in Verona said that these lower rates were applied where growers were following ICM practices - the lower levels minimise the severity of disease attack from *Uncinula necator* and *Botrytis.*

Levels of phosphorus were more varied but again in Verona the spread was widest with many applying low volumes and some none. Larger growers tended to apply the higher rates of both nitrogen and phosphorus in Verona. Specialists in Rioja believed that the rates of phosphorus applied were too low as 72 - 144 kg/ha was the recommendation.

2.3 Commercial issues

2.3.1 Destination of produce

Growers were asked in what form and to whom their produce was sold.

Table 2.3.1 Destination of produce and customers

Region	Bordeaux (F)	Rioja (E)	Verona (I)
Number of farms	59	62	61
Destination	Farms %		
Wine	92	92	54
Grapes	17	48	34
Other	2	11	21
Customer			
Coop/dealer	42	92	70
Direct to consumer	52	6	20
Other	5	2	21

In Bordeaux, growers sold their grapes through co-operatives who then made wine. The produce remains the property of the grower until the wine is sold. In Rioja the grapes were sold by weight of grapes or by weight x alcohol level of the wine. In the region as a whole the majority was sold to co-operatives and about 30% to wine producers.

In Verona, larger growers sold to ‘consumers’, believed to be wine-makers, whilst the smaller growers sold to co-operatives.

2.3.2 Agrochemical restrictions in production contracts

Table 2.3.2 Agrochemical restrictions in production contracts

Region	Bordeaux (F)	Rioja (E)	Verona (I)
Number of farms	59	62	61
	Farms %		
Restrictions	22	5	3

The sectors affected by restrictions were fungicides and insecticides.

Specialists in Bordeaux explained that there were normally two types of restrictions, both related to market requirements. The first was for products which were registered in France but not in the USA. In these cases they may only be used before flowering - examples were pyrimethanil and fludioxonil. The second type of restriction concerned vines from which the grapes were destined for cognac production, and here there were quite a series of restrictions concerning which fungicides and insecticides might be used and when. These are detailed in the country report.

3.0 PESTICIDE USE

3.1 Summary of pesticide use

Regional totals and splits by chemical sector are presented in Table 3.1.

The lowest chemical load was in Rioja and highest in Bordeaux. There are some indications that sulphur was under-reported in Rioja and Verona. If these are adjusted to include extra sulphur use then the regional loads are very similar.

3.1.1 Herbicides

Demand for a high level of weed control was greatest in Bordeaux where the herbicide load was highest. Targeted weed control was highest also in Bordeaux but the high load resulted from greater use of soil-acting residual chemicals.

3.1.2 Fungicides

The fungicide load dominated the total chemical load in all regions. Season long protection against diseases is required and many chemicals are traditional (copper salts and sulphur) with low activity and consequential heavy loads.

3.1.3 Insecticides

This sector shows low levels of chemical load except in Rioja where sulphur and petroleum oils were used. Removing these provides a chemical load similar to the other regions.

3.1.4 Other pesticides and agrochemicals

Minimal use.

Table 3.1 Summary of chemical use

Region	Bordeaux (F)			Rioja (E)			Verona (I)		
Area grown (ha)	1,420			1,383			412		
	Proportion of crop treated %	Average volume of active ingredient kg/ha		Proportion of crop treated %	Average volume of active ingredient kg/ha		Proportion of crop treated %	Average volume of active ingredient kg/ha	
		on crop treated	on crop grown		on crop treated	on crop grown		on crop treated	on crop grown
Herbicides	85	4.1	3.5	80	2.4	1.9	52	1.7	0.9
Fungicides									
1 Grower responses	100	40.5	40.5	99	10.4	10.2	100	31.8	31.8
2 Grower responses and computed	n/a	n/a	n/a	100	35.4	35.4	100	40.8	40.8
sulphur	100	22.9	22.9	99	0.7	0.7	100	24.1	24.1
3 Grower responses excluding all sulphur									
Insecticides	96	1.1	1.0	99	4.7	4.6	62	1.4	0.9
1 As declared in survey	n/a	n/a	n/a	98	1.4	1.3	n/a	n/a	n/a
4 Excluding sulphur and oil adjuvant	1	0.02	<0.01	<1	0.2	<0.01	0	0	0
Other pesticides	0	0	0	1	0.5	<0.01	0	0	0
Other agrochemicals									
All sectors									
1 Grower responses	**100**	*	**45.0**	**100**	*	**16.8**	**100**		**33.6**
2 Grower responses excluding fungicide sulphur	**n/a**		**27.4**	**100**		**7.2**	**100**		**25.9**

Notes: * Treatments were not applied to the same areas of crop in each class of agrochemical and so no total is provided for this column.

Notes to Table 3.1

Fungicides and sulphur use (Rioja and Verona particularly):

1 Specialists commented that sulphur would have been applied in multiple treatments on all farms. It is believed farmers barely regard sulphur as a pesticide and therefore did not mention it.

2 As a consequence to determine the likely real load, sulphur has been added at an average load to those farms not declaring it in order to provide an overall load that is more realistic.

3 Sulphur is, however, a low activity high volume fungicide and so in this line sulphur has been stripped out completely to show the load of remaining fungicides.

4 Sulphur is also used as an insecticide. In addition a number of applications were made with mineral oil in the formulations with certain insecticides. Both these chemicals are used at substantial dose rates and so to give an indication of chemical load without them, the sulphur and mineral oil elements have been stripped out.

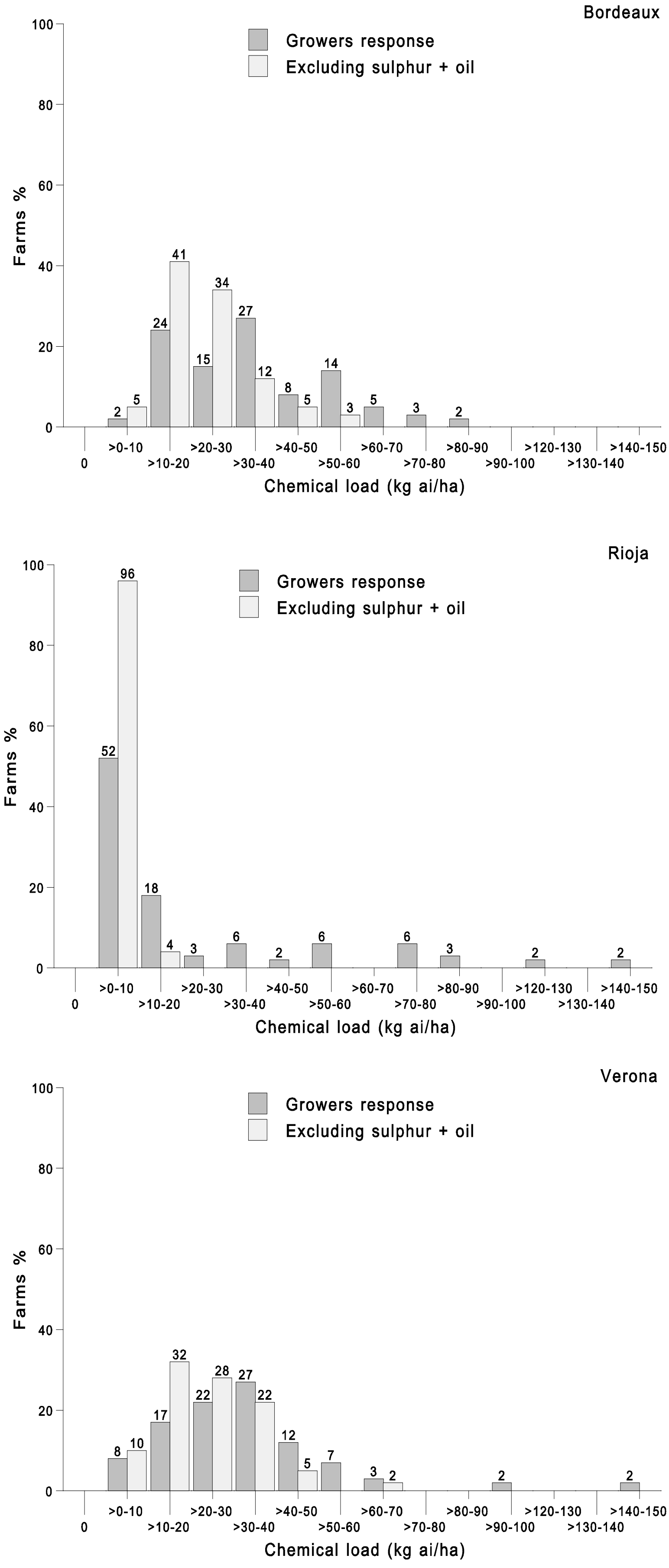
3.2 Variation in chemical load between farms and regions

The variation in chemical load as indicated by the grower replies and stripped of sulphur and mineral oil are presented in the tables and graphs below.

Table 3.2 Variation in chemical load between farms and regions

Region	Bordeaux (F)		Rioja (E)		Verona (I)	
Number of farms	59		62		61	
Chemical load kg ai/ha	Farms %					
	Growers response	Excluding sulphur + oil	Growers response	Excluding sulphur + oil	Growers response	Excluding sulphur + soil
0	-	-	-	-	-	-
>0 - 10	2	5	52	96	8	10
>10 - 20	24	41	18	4	17	32
>20 - 30	15	34	3	-	22	28
>30 - 40	27	12	6	-	27	22
>40 - 50	8	5	2	-	12	5
>50 - 60	14	3	6	-	7	-
>60 - 70	5	-	-	-	3	2
>70 - 80	3		6		-	
>80 - 90	2		3		-	
>90 - 100	-		-		2	
>120 - 130	-		2		-	
>130 - 140	-		-		-	
>140 - 150	-		2		2	
Range kg ai/ha of crop grown	7.9-87.3		2.9-146.9		0.8-142.4	

Chart 3.2 Variation in chemical load between farms and regions



4.0 WEEDS AND WEED CONTROL

4.1 Target weeds

Table 4.1 Main target weeds

Region	Bordeaux (F)	Rioja (E)	Verona (I)
Number of farms	59	62	61
	Farms %		
Dicotyledons			
Amaranthus retroflexus	49	31	38
Artemesia spp	-	13	13
Chenopodium album	24	35	20
Chrysanthemum spp	-	-	3
Cirsium arvense *	52	30	7
Convolvulus arvensis *	83	94	36
Diplotaxis muralis	-	ss	-
Equisetum spp *	12	-	-
Erigeron canadensis	-	s	-
Fumaria oficinalis	+	ss	-
Malva neglecta	7	13	15
Papaver spp	+	-	8
Portulaca oleracea	8	+	13
Raphanus raphanistrum	+	ss	-
Rubus spp *	7	-	3
Rumex spp *	17	-	3
Salsola kalli	-	8	-
Senecio vulgaris	10	-	-
Sinapis arvensis	-	ss	-
Sonchus asper	-	ss	-
Urtica spp *	-	-	8
Veronica hederifolia	-	ss	-
Monocotyledons			
Alopecurus myosuroides	5	-	7
Cynodon dactylon *	7	56	69
Digitaria sanguinalis	14	-	3
Echinochloa crus-galli	12	-	3
Lolium perenne *	44	ss	-
Poa spp	14	+	3
Setaria glauca	-	s	-

Sorghum halepense *	+	18	39

Key: * = perennial
- = not mentioned
+ = mentioned by growers
s = mentioned by specialists
ss = believed by specialists to be important

A similar weed flora was claimed for most regions. Differences were most marked in the perennial weeds. The dicotyledons appeared worst in Bordeaux and least in Verona, while the difficult grass perennials were most prevalent in Rioja and Verona.

4.2 Weeds claimed to be resistant to herbicides

Growers in all three regions (up to 35% in Rioja) claimed to have experienced cases of weeds resistant to herbicides. In the vast majority of cases, specialists refuted these as being the result of using inappropriate herbicides or of badly managing the application process. There were some cases with which they agreed:

Bordeaux - *Amaranthus, Agropyron* and several other species may be resistant to triazines.

Rioja - *Cynodon* and *Convolvulus* may be resistant to simazine.

Verona - Specialists believed there was no genuine resistance in the region.

4.3 Levels of weed control sought

Table 4.3 Levels of weed control sought

Region	Bordeaux (F)	Rioja (E)	Verona (I)
Number of farms	59	62	61
% control	Farms %		
< 70%	2	2	11
71 - 80%	3	0	18
81 - 90%	12	5	30
91 - 100%	83	79	25
No answer	0	14	16

The level of control sought was high in Bordeaux and Rioja, especially in the former with respect to dicotyledons. The apparent low requirement in Verona should be set

against the fact that only 43% of growers used herbicides in 1994.

4.4 Herbicide use

4.4.1 Bordeaux

Crop area treated: 85%.

Table 4.4.1 Herbicide active ingredients used in Bordeaux

Active ingredient	Activity	% of crop treated	No. of applications where used		Cumulative dose on crop receiving that ai g ai/ha		
		(Base area 1,420 ha)	Range per farm	Ave per ha treated	min	max	ave
glyphosate	c	63	1 - 2	1.5	21	4,800	998
diuron	s	57	1 - 2	1.3	71	4,560	1,214
terbuthylazine	s	54	1 - 2	1.3	71	4,828	1,469
amitrole	cs	35	1 - 2	1.2	47	6,000	1,662
ammonium-thiocyanate	c	17	1 - 2	1.0	225	1,800	1,166
oryzalin	s	12	1	1.0	1,176	3,359	2,873
simazine	s	11	1 - 2	1.0	45	2,100	525
paraquat	c	11	1 - 2	1.1	83	400	193
glufosinate	c	6	1 - 2	1.3	104	1,500	598
isoxaben	s	6	1	1.0	262	556	524
terbumeton	c	4	1 - 2	1.5	813	1,162	987
diquat	c	1	1	1.0	200	200	200
glyphosate-trimesium	c	1	1	1.0	590	590	590

Key to abbreviations:

c = contact post-emergence s = soil acting residual

4.4.2 Rioja

Crop area treated = 80%.

Table 4.4.2 Herbicide active ingredients used in Rioja

Active ingredient	Activity	% of crop treated	No. of applications where used		Cumulative dose on crop receiving that ai g ai/ha		
		(Base area: 1,383 ha)	Rang e per farm	Ave per ha treated	min	max	ave
terbumeton	s	43	1 - 2	1.1	250	2,312	791
terbuthylazine	s	43	1 - 2	1.1	250	2,312	791
simazine	s	27	1 - 2	1.0	625	5,000	2,214
glyphosate	c	26	1 - 2	1.0	108	3,039	717
paraquat	c	14	1	1.0	40	1,200	440
glyphosate-	c	9	1	1.0	719	3,840	3,235
trimesium	c	4	1	1.0	451	451	451
glufosinate	s	2	1	1.0	100	100	100
oryzalin	sc	2	1	1.0	2,000	3,600	3,280
amitrole	s	0.4	1	1.0	2,000	2,000	2,000
diuron	c	0.1	1	1.0	156	156	156
fluazifop-p-butyl							

Key to abbreviations:

c = contact post-emergence s = soil acting residual

4.4.3 Verona

Crop area treated 52%.

Table 4.4.3 Herbicide active ingredients used in Verona

Active ingredient	Activity	% of crop treated	No. of applications where used		Cumulative dose on crop receiving that ai g ai/ha		
		(Base area: 412 ha)	Range per farm	Average per ha treated	min	max	ave
glyphosate	c	25	1 - 3	1.6	119	4,920	1,961
paraquat	c	21	1 - 2	1.0	23	650	131
diquat	c	18	1 - 2	1.0	12	147	35
terbumeton	c	15	1	1.0	766	766	766
terbuthylazine	c	15	1	1.0	766	766	766
glyphosate-trimesium	c	7	1 - 2	1.1	256	960	756
metolachlor	s	3	1	1.0	1,370	1,370	1,370
glufosinate	c	2	1 - 2	1.1	112	360	179
MCPA	c	1	2	2.0	144	144	144
bensulfuron-methyl	cs	1	2	2.0	60	60	60
rimsulfuron	c	1	2	2.0	15	15	15

Key to abbreviations:

c = contact post-emergence   s = soil acting residual

The lists of active ingredients were broadly what specialists in each region expected.

In Bordeaux typically a contact/systemic such as glyphosate was used, possibly mixed with or followed by a soil-acting residual such as diuron. In both Rioja and Verona formulated mixtures of the soil-acting terbumeton and terbuthylazine were very popular. The lists from each region were generally similar, as might be expected in a perennial crop such as vines in climatically similar zones.

Specialists in Rioja expected that oxyfluorfen and pendimethalin would have been mentioned, and those in Verona felt that glyphosate-trimesium was in general used less than suggested. The latter also pointed out that metolachlor and rimsulfuron are maize herbicides and that bensulfuron-methyl is a rice herbicide.

Dose rates used in all regions were low. In Rioja and Verona around the lower end of any recommended rate range, and in Bordeaux below recommended label rates. Some of the dose rate ranges recommended on the label are very wide, particularly for cross-spectrum soil-acting residual herbicides such as the triazines, and the post-emergence total weed killers, such as glyphosate. This factor coupled with the variability resulting from different herbicide placements, detailed in Section 5.2, means that there are wide variations in cumulative doses in Tables 4.4.1 - 4.4.3.

4.5 Herbicide use parameters

4.5.1 Average number of herbicide applications

Table 4.5.1 Average number of herbicide applications

Region	Bordeaux (F)	Rioja (E)	Verona (I)
Proportion of crop treated	85%	80%	52%
On vineyards using herbicides			
No. of active ingredients used per farm	4.3	2.6	1.7
No. of active ingredients used per ha	2.8	1.7	1.1
No. of product applications per ha	2.8	1.6	1.6
Proportion of growers spraying parts of their vineyard - %	44%	34%	19%
Average herbicide load kg ai/ha	3.5	1.9	0.9

It must be presumed that weeds present a more difficult problem in Bordeaux than in Rioja and in Verona.

4.5.2 Herbicide placement

Table 4.5.2i Herbicide placement

Region	Bordeaux (F)	Rioja (E)	Verona (I)
Number of farms	59	62	61
	Farms %		
Overall	32	55	13
Between the rows			
- only	3		8
- as a supplement		3	
Along the rows			
- only	59	42	10
- as a supplement		5	
Spot treatment			
- only	5	2	16
- as a supplement	17	2	

Growers in Bordeaux appeared to make more directed sprays than in Rioja.

Specialists were consulted in each region about the actual area covered by each of these placements, bearing in mind different row widths and local custom. These could be very variable within a region but the following averages were taken.

Table 4.5.2ii Proportion of vineyard surface treated under different herbicide placement methods

Region	Bordeaux (F)	Rioja (E)	Verona (I)
	Proportion of vineyard surface treated %		
Overall	100	100	100
Between the rows	70	60	60
Along the row	33	25	30
Spot	5	5	5

The reason for such wide variability in single and cumulative doses, as recorded in Tables 4.4.1 - 4.4.3, can be interpreted with the information in Tables 4.5.2i and 4.5.2ii in mind.

4.6 Herbicide load per farm

Table 4.6 Herbicide load per farm

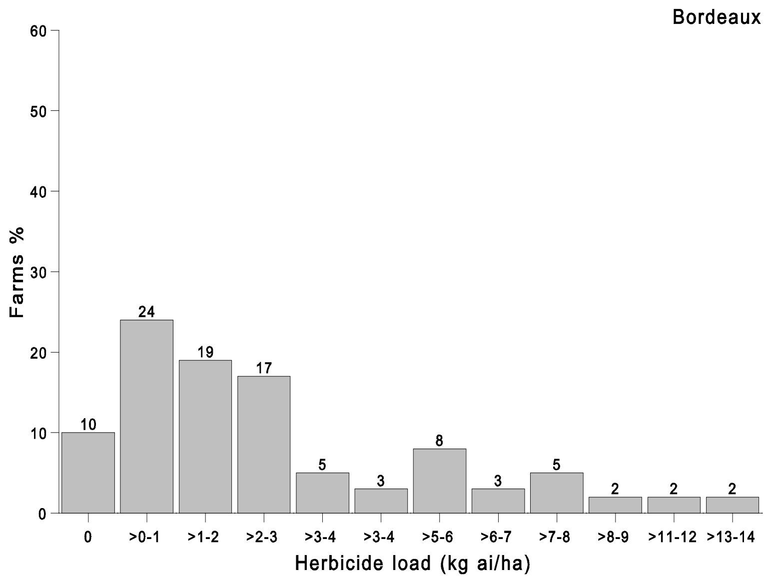
Region	Bordeaux (F)	Rioja (E)	Verona (I)
Number of farms	59	62	61
Chemical load kg ai/ha	Farms %		
0	10	5	57
>0 - 1	24	18	27
>1 - 2	19	23	7
>2 - 3	17	37	3
>3 - 4	5	5	5
>4 - 5	3	6	2
>5 - 6	8	3	
>6 - 7	3	2	
>7 - 8	5	2	
>8 - 9	2		
>11 - 12	2		
>13 - 14	2		
Load kg ai/ha Average	3.5 kg/ha	1.9 kg/ha	0.9 kg/ha
Range	(0)0.01 - 13.3	(0)0.03 - 7.6	(0)0.01 - 4.9

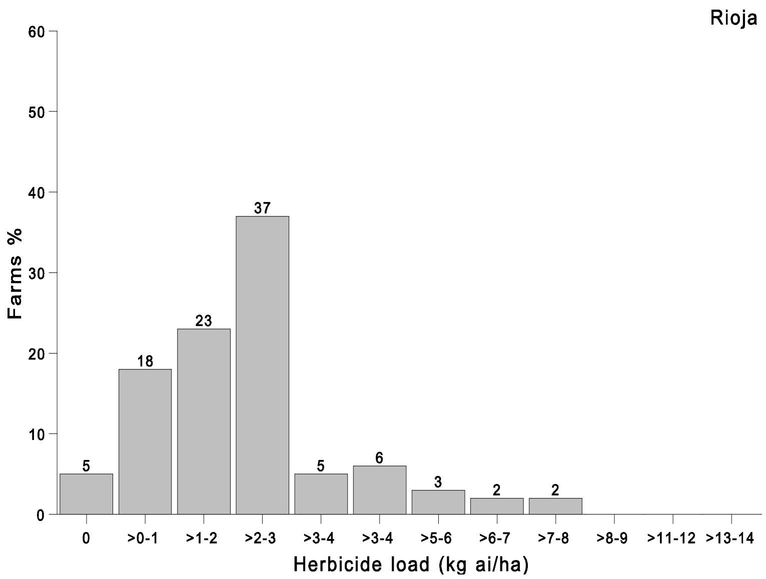
In all regions the reason for heavier loads was the use of dose rates which were higher than average for that region, although still within the recommended label rate range. In addition, in Bordeaux and Rioja heavier loads occurred on vineyards where the whole surface was sprayed - a factor which was not as evident among the heavier users in Verona. In Verona an additional factor was a higher number of repeat applications.

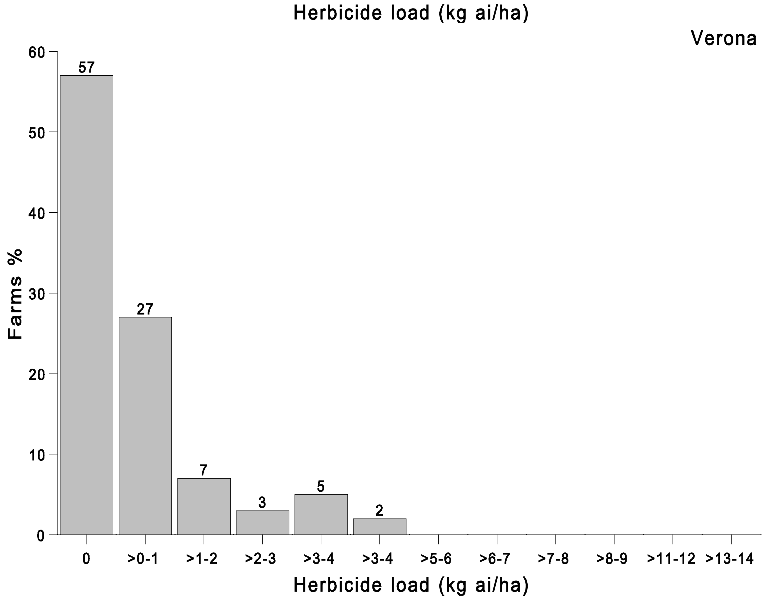
Lighter loadings were mainly the result of herbicide placement only along, or between, rows. It was also the consequence of the use of lower than average doses.

The regional comparison shows the extremes of Bordeaux (high) and Verona (low), with Rioja in between. Farmers in Bordeaux made the highest use of directed spraying along the rows and targeted spraying through spraying only parts of their vineyards and use of spot spraying. Their higher load appears to be linked to a more troublesome weed flora particularly perennial dicotyledons. Specialists in Bordeaux commented that 1994 had been a wetter year than normal.

Chart 4.6 Herbicide load per farm


Bordeaux
Farms %
60
50
40
30
20
10
0
10
24
19
17
5
3
8
3
5
2
2
2
0
>0-1
>1-2
>2-3
>3-4
>3-4
>5-6
>6-7
>7-8
>8-9
>11-12
>13-14
Herbicide load (kg ai/ha)


Rioja
Farms %
60
50
40
30
20
10
0
5
18
23
37
5
6
3
2
2
0
>0-1
>1-2
>2-3
>3-4
>3-4
>5-6
>6-7
>7-8
>8-9
>11-12
>13-14
Herbicide load (kg ai/ha)


Verona
Farms %
60
50
40
30
20
10
0
57
27
7
3
5
2
0
>0-1
>1-2
>2-3
>3-4
>3-4
>5-6
>6-7
>7-8
>8-9
>11-12
>13-14
Herbicide load (kg ai/ha)

4.7 Mechanical weed control

Mechanical treatment of the soil in vineyards was common. Shallow harrowing between the rows to aerate the soil controls weeds to some extent, and some cognac producers in Bordeaux plant grass between the rows to deplete soil nitrogen. The grass is subsequently mown. There is often manual hoeing between plants in the row, especially specifically directed to certain weeds.

Table 4.7 Mechanical weed control and herbicide use

Region	Bordeaux (F)		Rioja (E)		Verona (I)	
Number of farms	59		62		61	
Number of mechanical passes	% farms	herbicide kg ai/ha	% farms	herbicide kg ai/ha	% farms	herbicide kg ai/ha
0	25	4.4	10	1.9	43	0.3
1	19	2.0	18	3.3	8	1.0
2	24	2.5	19	0.9	15	0.1
3	19	4.7	13	2.8	13	0.3
4	7	0.4	10	2.1	16	1.2
5	0	0	18	2.9	2	
6	2	n/a	5	1.4	2	
7	2	2.1	6	1.1	0	
8	2	6.4	0	0	0	
9	0	0	0	0	0	
10	2	1.8	2	1.1	2	

Note: It has been assumed that the whole vineyard received the mechanical treatment.

There are no clear relationships between the amount of mechanical weed control performed and the corresponding herbicide load. There are some indications however:

- In Bordeaux, the average of all farms which used mechanical methods was 3.1 kg ai/ha compared with 4.4 kg ai/ha for those which did not.
- In Rioja, the figures were the same for those who used mechanical methods and the same for those who did not.
- In Verona, figures suggest that a greater herbicide load was used on the few farms who used both mechanical methods and herbicides.
- It was suggested that making only one pass brings weed seed to the soil surface, and allows them to germinate.

A larger sample size would be needed to elucidate the true value of mechanical treatments in controlling weeds in vineyards. However, it is of relevance that such practices are not necessarily carried out solely or even primarily for weed control, and this might explain the lack of a relationship.

4.8 Herbicide use in the study year (1994) compared with an average year

Table 4.8 Herbicide use in the study year (1994) compared with an average year

Region	Bordeaux (F)	Rioja (E)	Verona (I)
Number of farms	59	62	61
Herbicide use	Farms %		
Lower use	25	10	34
Greater use	71	89	59
No answer	3	2	7

It is very interesting that the majority of growers in all regions felt 1994 had been a year of high use. Specialists in Bordeaux put this down to it being a wetter year than normal, while those in Verona wondered whether the area being sprayed was increasing as dose rates were lowered. Those in Rioja did not feel that the increase in 1994 represented a trend.

4.9 Opportunities to reduce herbicide load

The reasons for low herbicide use in Verona do not appear to lie within agricultural practices adopted there, rather it appears to be the result of low weed pressure consequent upon a comparatively dry climate. The weed spectrum includes low levels of the two difficult dicotyledon weeds, *Convolvulus arvensis* and *Cirsium arvense*, which in the other two regions are of much greater importance.

Spot spraying appears to be the most practical means of directly reducing the amount of herbicide applied per unit area. There are now available a wide range of highly-active post-emergence herbicides capable of dealing with most species and so the tools for spot spraying exist. Spot spraying is not a panacea, however. As was implied in the comments of specialists in Verona, the result can be a requirement to use several active ingredients and the cost-efficacy may be poor compared with a more general and simple application of a broad-spectrum product. In addition, the low levels of weeds not treated in the area outside the spot treatment gradually build a seed bank in the soil which may be difficult to control in future years.

Mechanical methods of weed control occurred in most vineyards though the process was often used for soil aeration. The data found in this study do not show that mechanical cultivation reduces the use of herbicides. In general this is surprising though less if the objective is to achieve soil aeration rather than weed control.

5.0 DISEASE AND FUNGICIDES

5.1 Target diseases

Table 5.1 Target diseases in vines

Region	Bordeaux (F)		Rioja (E)		Verona (I)	
Number of farms	59		62		61	
Target diseases	Farms %	Spec	Farms %	Spec	Farms %	Spec
Plasmopara viticola (downy mildew)	63	++	76		89	
Uncinula necator (powdery mildew)	41		92		77	
Botrytis cinerea (grey mould)	32	++	58	-	43	
Phompsis viticola (excoriose)	10		48	--	0	+
Guignardia bidwellii (black rot)	7		6	--	3	
Stereum hirsutum (yesca)				++		
Eutypa lata (esca)						+

Key: Specialists comments ++ = should be much higher than stated
+ = should be higher than stated
-- = should be much lower than stated
- = should be lower than stated

Specialists agreed with the farmers responses with the above exceptions.

In 1994 in Bordeaux, *Plasmopara* and *Botrytis* were worse than normal as result of wet weather. In Verona, *Plasmopara* had increased in recent years, as had *Phomopsis* due to the reduced use of protectant fungicides and the increasing adoption of ICM.

5.2 Diseases claimed to be resistant to fungicides

Some growers in each region (12% in Bordeaux, 21% in La Rioja, and 28% in Verona) claimed to have experienced disease resistance. Specialists in each region disagreed with the majority suggesting that they were due to inappropriate fungicides or more likely, poor application. *Botrytis* resistance to vinclozolin and procymidone and *Plasmopara* resistance to folpet/ofurace was accepted as occurring in Bordeaux, and *Plasmopara* resistance to cymoxanil in Verona.

5.3 Levels of disease control sought

Table 5.3 Levels of disease control sought

Region	Bordeaux (F)	Rioja (E)	Verona (I)
Number of farms	59	62	61
	Farms %		
< 70%	0	0	0
71 - 80%	2	0	5
81 - 90%	0	2	52
91 - 100%	98	98	40

There is a clear regional difference with growers in Verona seeking less than perfect control. In Verona, *Plasmopara* was said by specialists to require 100% control only early in the season, and the other diseases do not normally require this level either.

5.4 Fungicide use by active ingredient

5.4.1 Bordeaux

Crop area treated 100%.

Table 5.4.1 Fungicide active ingredients used in Bordeaux

Active ingredient	Activity	% of crop treated (Base area 1,420 ha)	No. of applications where used		Cumulative dose on crop receiving that ai g ai per ha		
			Range per farm	Ave per ha treated	min	max	ave
folpet	c/b	94	1 - 8	5.9	750	15,819	5,817
fosetyl-al	s/b	89	1 - 8	4.9	875	15,700	8,067
sulphur	c/*Unc*	80	1 - 9	4.0	1,600	72,000	22,011
cymoxanil	cs/*Plas*	71	1 - 8	3.7	11	1549	472
mancozeb	c/b	60	1 - 9	3.4	875	15,100	6,016
copper	c/*Plas*	50	1 - 8	1.9	500	10,500	3,896
thiram	c/*Bot*	25	1 - 2	1.5	3,192	6,392	4,894
copper oxychloride	c/*Plas*	22	1 - 6	2.4	750	18,000	3,953
iprodione	c/*Bot*	20	1 - 2	2.0	467	1,968	1,254
flusilazole	s/b	20	1 - 3	2.4	4	18	10
carbendazim	s/*Bot*	17	1	1.0	500	550	523
diethofencarb	s/*Bot*	17	1	1.0	500	550	523
difenoconazole	s/b	15	2 - 4	3.0	59	120	91
myclobutanil	s/*Unc*	15	2 - 4	3.0	57	612	130
procyimdone	s/*Bot*	15	1	1.0	500	750	644
vinclozolin	c/b	14	1 - 2	1.2	500	1,500	841
dinocap	c/*Unc*	13	1 - 8	2.6	97	1,120	424
dimethomorph	s/*Plas*	12	1 - 8	2.2	44	600	201
hexaconazole	s/*Unc+Gui*	10	3 - 4	3.1	5	15	7
dichlofluanid	c/b	8	1	1.0	200	264	226
maneb	c/*Plas*	8	1 - 5	1.8	300	6,400	1,674
metiram	c/b	8	1 - 3	2.0	160	4,800	2,779
pyrifenox	s/*Unc*	7	1 - 4	1.9	40	160	74
triadimefon	s/*Unc+Gui*	7	2	2.0	150	150	150
captafol	c/b	3	1 - 3	4.0	334	902	673
copper hydroxide	c/*Plas*	2	4	4.0	899	899	899
zineb	c/*Plas*	2	1	1.0	300	300	300
tebuconazole	s/b	1	3	3.0	300	300	300
oxadixyl	s/*Plas*	1	2 - 4	2.4	400	600	476
penconazole	s/*Unc*	1	1	1.0	18	18	18

Key to abbreviations:

c	=	contact	b	=	broad-spectrum
s	=	systemic	*Bot*	=	*Botrytis*
			Plas	=	*Plasmopara*
			Unc	=	*Uncinula*
			Gui	=	*Guignardia*

5.4.2 Rioja

Crop area treated = 100%.

Table 5.4.2 Fungicide active ingredients used in Rioja

Active ingredient	Activity	% of crop treated (Base area 1,383 ha)	No. of applications where used		Cumulative dose on crop receiving that ai g ai/ha		
			Range	Ave per ha treated	min	max	ave
metalaxyl	s/*Plas*	65	1 - 5	2.2	80	2,500	462
folpet	c/b	54	1 - 3	2.2	287	2,430	793
penconazole	s/*Unc*	52	1 - 4	2.2	15	188	44
triadimenol	s/*Unc*	48	1 - 4	1.5	25	250	55
pyrifenox	s/*Unc*	43	1 - 4	1.5	16	320	34
myclobutanil	s/*Unc*	37	1 - 3	1.3	18	294	29
sulphur	c/*Unc*	23	1 - 4	2.6	1,600	96,000	34,780
fenarimol	s/*Unc*	23	1 - 5	1.9	14	150	39
copper sulphate	c/*Plas*	17	1 - 4	1.7	31	2,351	1,479
cymoxanil	cs/*Plas*	13	1 - 3	1.5	25	750	104
copper	c/*Plas*	13	1 - 2	1.7	41	1,200	370
oxychloride	c/*Plas*	6	1 - 4	2.3	11	447	283
maneb	c/b	6	1 - 3	2.1	140	1,728	1,166
mancozeb	s/b	5	1 - 2	1.2	59	120	71
ofurace	s/*Plas*	4	1 - 2	1.4	5	160	74
benalaxyl	s/*Unc+Gui*	4	1 - 2	1.9	12	34	22
hexaconazole	c/*Plas*	3	1	1.0	400	1,600	1,443
diclofluanid	c/b	3	1 - 3	1.4	200	750	308
vinclozolin	s/b	2	1 - 3	1.7	112	450	316
benomyl	c/*Plas*	2	1 - 4	3.0	120	839	599
copper	c/*Plas*	2	2	2.0	320	320	320
zineb	c/b	1	4	4.0	1,679	1,679	1,679
propineb	s/*Plas*	1	1 - 2	1.1	99	100	99
oxadixyl	s/*Unc*	1	1	1.0	62	62	62
bupirimate	s/b	1	1	1.0	575	575	575
fosetyl-al	s/*Unc*	<1	1	1.0	45	45	45
diclobutrazol	c/b	<1	4	4.0	6,300	6,300	6,300
metiram	c/*Pho+Ster*	<1	1	1.0	2,500	2,500	2,500
sodium arsenite							

Key to abbreviations:

c = contact
s = systemic

Plas = *Plasmopara* (Downy mildew)
Unc = *Uncinula* (Powdery mildew)
Gui = *Guignardia* (Black rot)
Pho = *Phoma* (Escoriose)
Ster = *Stereum hirsutum* (yesca)

5.4.3 Verona

Crop area treated = 99%.

Table 5.4.3 Fungicide active ingredients used in Verona

Active ingredient	Activity	% of crop treated (Base area: 412 ha)	No. of applications where used: Range per farm	No. of applications where used: Ave per ha treated	Cumulative dose on crop receiving that ai g ai/ha: min	max	ave
mancozeb	c/b	78	1 - 12	4.3	639	38,400	6,141
cymoxanil	cs/*Plas*	74	1 - 12	4.1	104	15,000	859
copper	c/*Plas*	60	1 - 17	5.4	1,200	34,500	12,359
oxychloride	c/*Unc*	53	1 - 17	8.4	1,440	104,000	15,267
sulphur	c/*Plas*	47	1 - 12	6.0	1,600	32,400	11,903
copper sulphate	s/*Plas*	35	1 - 4	1.7	360	1,500	869
metalaxyl	c/b	28	1 - 6	3.2	503	2,880	2,218
folpet	s/*Unc*	18	2 - 3	2.1	94	472	442
penconazole	s/*Plas*	15	2	2.0	479	479	479
oxadixyl	c/*Plas*	13	1 - 9	6.8	1,192	45,000	27,179
copper	c/*Plas*	10	3 - 13	5.6	2,880	11,339	9,477
metiram	s/*Unc*	5	2 - 15	3.2	40	1,687	189
triadimenol	c/*Bot+Ph*	5	1	1.0	765	765	765
iprodione	c/*Plas*	3	2 - 17	3.3	767	3,599	2,077
zineb	c/b	3	4 - 15	5.7	4,199	18,375	7,015
propineb	s/b	2	1 - 4	2.7	1,299	4,679	3,770
fosetyl-al	c/b	2	1	1.0	74	74	74
vinclozolin	s/*Bot*	1	4 - 15	8.4	1,600	11,250	5,459
carbendazim	s/*Plas*	1	2	2.0	360	360	360
benalaxyl	s/*Unc*	1	3	3.0	108	108	108
myclobutanil	s/*Unc*	1	15	15.0	505	505	505
nuarimol	s/*Bot*	<1	4	4.0	3,380	3,380	3,380
procymidone							

Key to abbreviations:

c = contact
s = systemic

b = broad spectrum
Bot = *Botrytis*
Ph = *Phoma*
Plas = *Plasmopara*
Unc = *Uncinula*

5.4.4 Fungicide active ingredients used - general commentary

The basic pattern of treatments in vines revolved around control of the two main diseases, *Plasmopara viticola* and *Uncinula necator*. A continuous programme of treatments was made for these two on the back of which were applied treatments for *Botrytis* and *Phomopsis*. Copper-based products were commonly applied to control *Plasmopara*.

There are large differences between the active ingredient lists of each of the regions shown in Tables 5.4.1 - 5.4.3. The most obvious of these are as follows:

- All except one of the dominant fungicides used in Bordeaux were of low activity, and high dose rate, the more active fungicide being cymoxanil. Of the six active ingredients, which were used on 50% or more of the vine crop, only two were systemic, fosetyl-al and cymoxanil, and of the top ten there were only three systemic actives. Products used would have controlled all the main diseases especially *Plasmopara* and *Uncinula*.

- A similar though less obvious situation occurred in Verona. Apart from the two systemics, cymoxanil and metalaxyl used for *Plasmopara* control, all of the seven dominant fungicides were low activity, high dose protectants.
  In both Bordeaux and Verona traditional sulphur and copper-based products were very important.

- Rioja was strikingly different from the other two regions. Of the dominant seven fungicides (including sulphur which is believed to have been grossly understated by growers - see below) only two were contact, folpet and sulphur, all the rest being systemic. This range of products, with the major exception of metalaxyl, was predominantly targeted towards control of the main disease, *Uncinula*.

Other comments on the active ingredient lists by country are:

Bordeaux - The systemic triazoles are recommended in a fixed three-spray programme for the control of *Uncinula* and *Guignardia* as a strategy to prevent resistance occurring, and there is good evidence that this is adhered to. Specialists noted that captafol had not been registered for several years.

Rioja - Specialists thought that folpet was less used in the region as a whole than was represented in the study sample. They also said that all growers used sulphur several times during the season. It is believed that because sulphur is such a basic part of vine cultivation in the region, important for its effect primarily on *Uncinula*, but also for its acaricidal and foliar fertiliser effects, many farmers forget to specifically consider it. Accordingly, based on the rates of use of those who did mention it, calculations have been made in order to produce a sulphur treatment for all growers. This data is presented in Section 5.6.1.

Verona - Copper use was higher in the study sample than in the region as a whole and specialists also thought that triadimenol, fosetyl-al and myclobutanil were under-rated. The same comments regarding sulphur applied to Verona as in Spain. The data appears in Section 5.6.1.

5.5 Fungicide use parameters

Table 5.5i Average number of fungicide applications

On vineyards using fungicides (100% in all except Verona - 99%)	Bordeaux (F)	Rioja (E)	Verona (I)
No. of active ingredients used per farm	8.4	3.8*	4.0*
No. of active ingredients used per hectare	7.1	4.3	4.6
No. of product applications per hectare	13.5	5.3*	16.2*
Proportion of growers spraying parts of their vineyard %	8%	24%	0%
Average load kg ai/ha as declared	40.5	10.4	31.8

* These data do not include the calculations of extra sulphur usage.

Table 5.5ii Fungicide spray volumes

Region	Bordeaux (F)	Rioja (E)	Verona (I)
Number of farms	59	62	61
Spray volume l/ha	Farms %		
100	42		
200	40		
300	10	6	
400	3	57	3
500		33	3
600		2	3
700			15
800			3
900			2
1,000			43
1,200			7
1,300			3
1,500			13
1,600			2
1,800			3

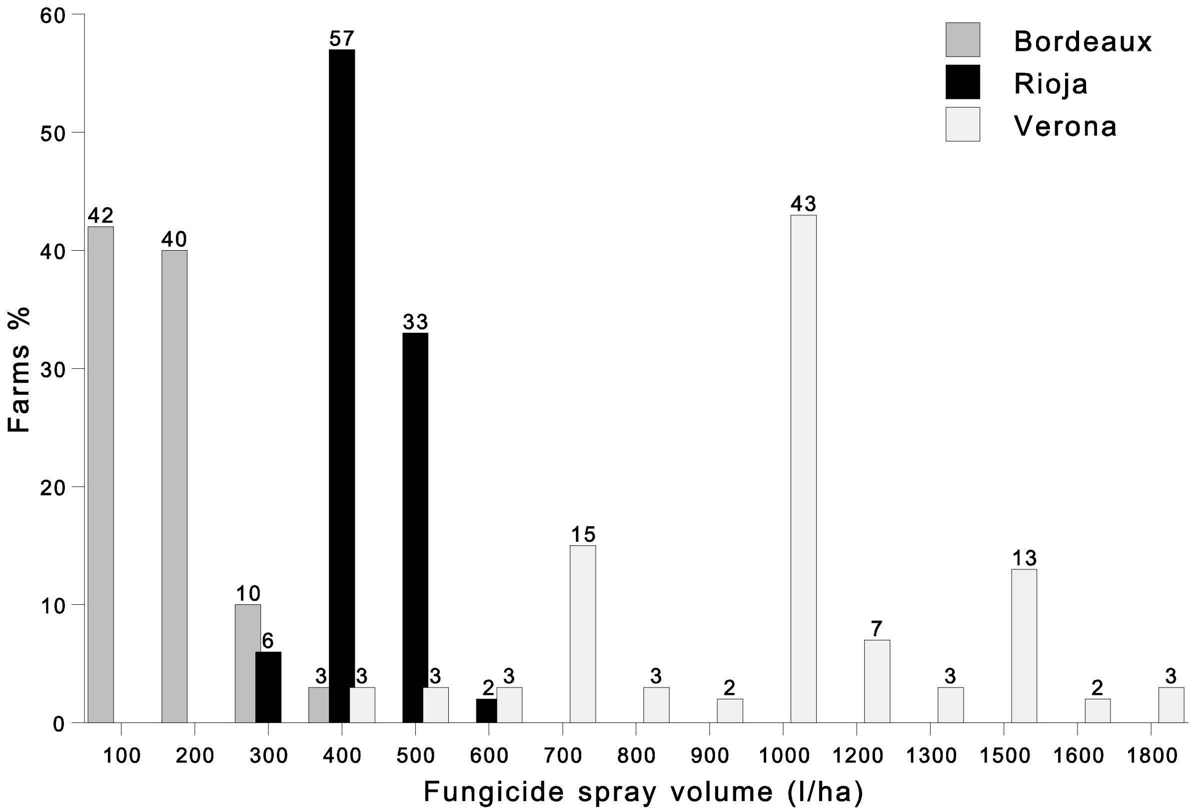


Chart 5.5ii Fungicide spray volumes

Growers in Bordeaux were using ‘low’ volumes for their fungicide applications. Given the relative similarity of the lists of fungicides and of the disease spectra for these two regions the reasons for the large difference in spray volumes must be connected with the architecture of the crop/vineyard or local tradition.

Variation in spray volume in turn effects chemical dose rate per hectare. In Italy (Verona) and Spain (Rioja) dose rates are all given as concentration per hectolitre of spray. This occurs also in France (Bordeaux) although there 60 - 70% of the dose rates are given per hectare.

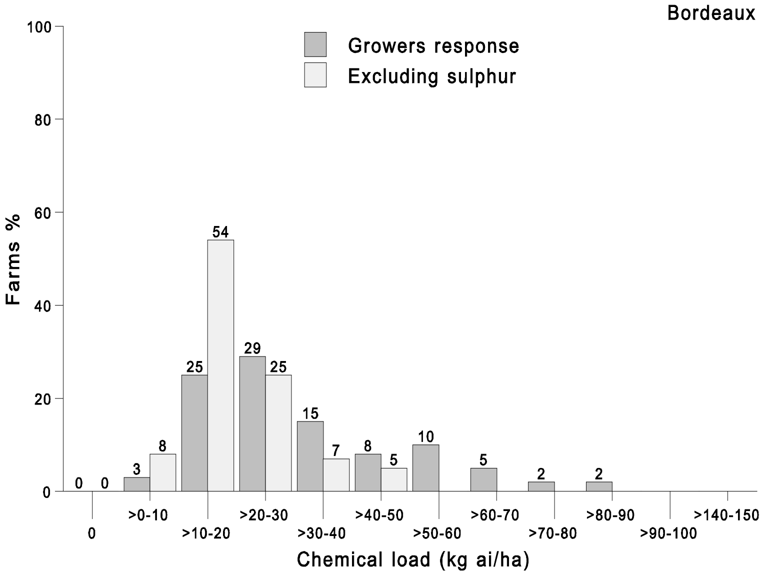
5.6 Fungicide load per farm

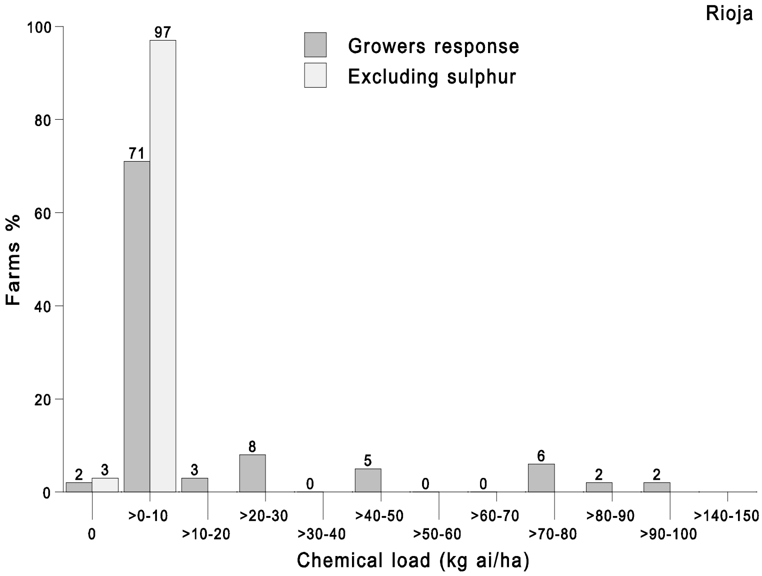
Table 5.6i Fungicide load per farm

Region	Bordeaux (F)		Rioja (E)		Verona (I)	
No. of farms	59		62		61	
	Farms %					
Fungicide load kg ai/ha	Grower responses	excl. sulphur	Grower responses	excl. sulphur	Grower responses	excl. sulphur
0	0	0	2	3	0	0
>0 - 10	3	8	71	97	11	13
>10 - 20	25	54	3		23	43
>20 - 30	29	25	8		20	25
>30 - 40	15	7	0		27	12
>40 - 50	8	5	5		8	5
>50 - 60	10		0		3	0
>60 - 70	5		0		3	2
>70 - 80	2		6		2	
>80 - 90	2		2		0	
>90 - 100			2		0	
>140 - 150					2	
Load kg ai/ha of crop grown						
Average Range	40.5 4.3 - 85.4	22.9	10.4 (0)0.03-96.4	0.7	31.8 0.6-142.4	24.1

Rioja was very different from the other two regions. The spread of loads below 5.0 kg ai/ha is shown in Table 5.6ii.

Chart 5.6.i Fungicide load per farm





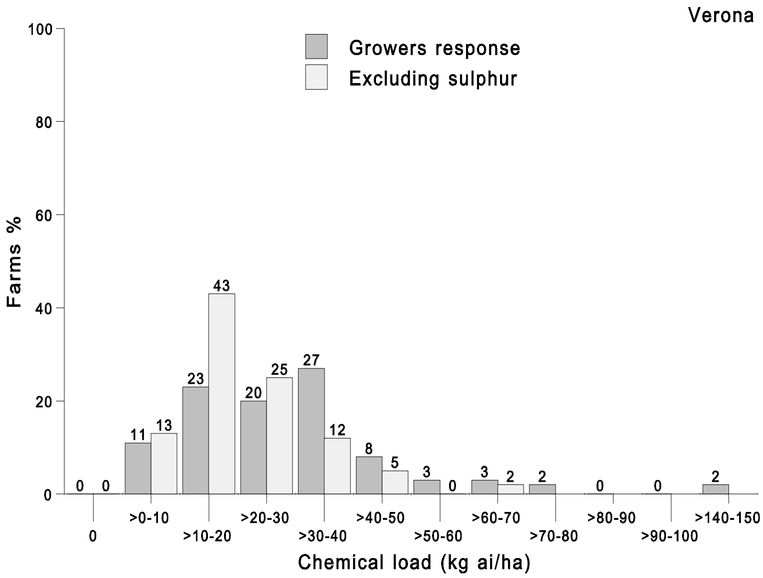


Table 5.6ii Fungicide load per farm in Rioja (extract)

Fungicide load kg ai/ha	Farms %	
	Growers response	excluding sulphur
0	2	3
>0 - 0.5	24	40
>0.5 - 1.0	11	13
>1 - 2	15	19
>2 - 3	8	13
>3 - 4	6	8
>4 - 5	3	2

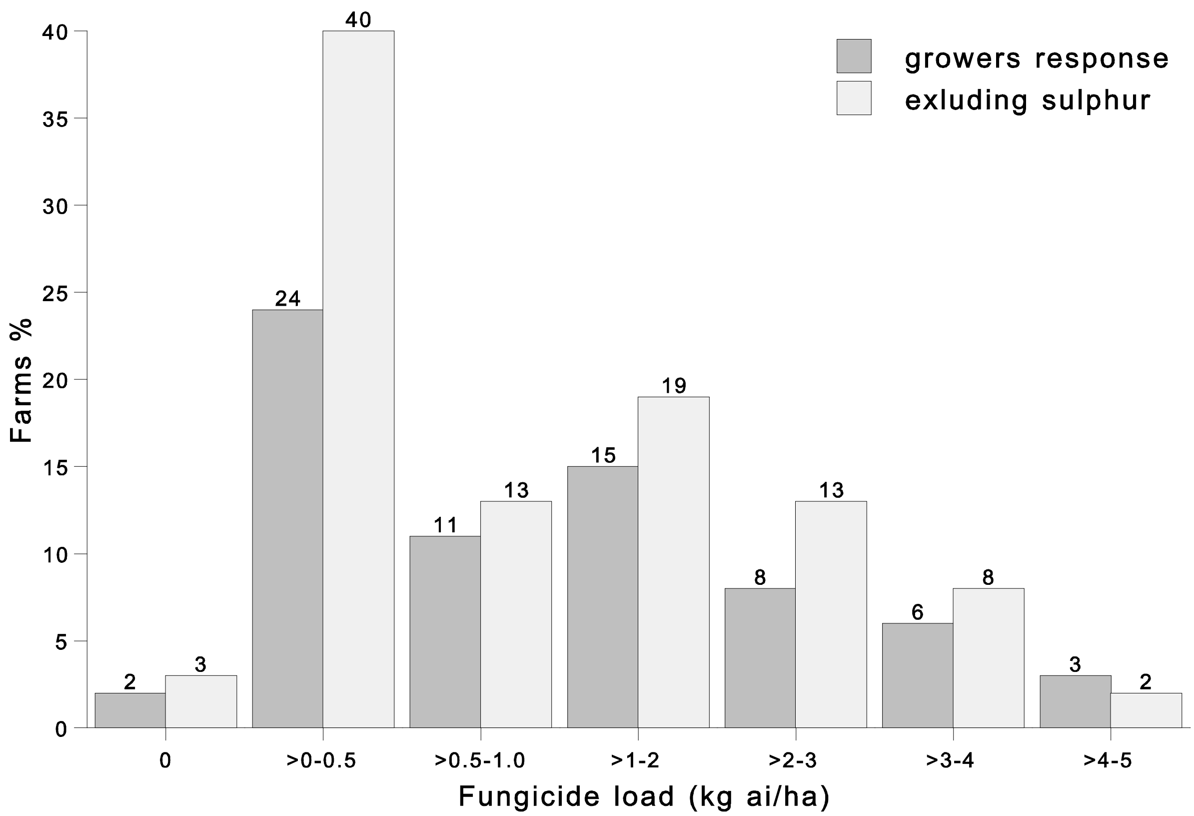


Chart 5.6ii Fungicide load per farm in Rioja (extract)

5.6.1 Sulphur

The average load of sulphur per hectare was:

-	Bordeaux	Growers' response	17.6 kg ai/ha
-	Rioja	Growers' response	9.5 kg ai/ha
		As calculated for all growers	34.7 kg ai/ha
-	Verona	Growers' response	7.7 kg ai/ha
		As calculated for all growers	16.7 kg ai/ha

If specialists were correct in advising that extra sulphur usage should be added to growers' replies in Verona and Rioja, then two observations may be made.

- the similarity in sulphur load between Bordeaux and Verona is remarkable
- there is a much greater use of sulphur in Rioja than in the other two regions (given the greater importance of *Uncinula*).

General

Dose rates in all regions appeared to be around the recommended levels, the variability resulting from different water volumes. There do not appear to be any practices operating in one region which may be considered of use in another.

The heaviest loads in all regions, ignoring sulphur use, were the result of making more product applications (product x number of sprays) than the norm.

Lightest loads were the result of fewer product applications. Additionally in Rioja a greater degree of partial spraying was apparent than in the other regions.

5.7 Fungicides use in the study year (1994) compared with an average year

Table 5.7 Fungicide use in the study year (1994) compared with an average year

Region	Bordeaux (F)	Rioja (E)	Verona (I)
Number of farms	59	62	61
Fungicide use	Farms %		
Lower use	15	16	16
Greater use	8	5	8
The same	76	73	74
No answer	0	7	2

Three quarters of the growers in all regions thought 1994 had been an average year, while most of the remainder (in Verona, mainly larger farmers) felt use had been less than normal.

In Verona, specialists felt that *Botrytis* had reduced over the last ten years as a result of lower nitrogen levels being used - an ICM measure. However, they thought that *Phomopsis* was increasing.

5.8 Factors determining the start of fungicide application

There are some interesting points of comparison in the factors triggering fungicide application as shown in Table 5.8.

Plasmopara. In the two regions having the most severe *Plasmopara,* Bordeaux and Verona, it appears that growers in Bordeaux used the local warning system, in addition to the stage of plant development and the weather whereas those in Verona used only the external signals such as 'date' and 'weather'. The suggestion is that in Verona growers were less inclined than in Bordeaux to base their spray decisions on the presence of the disease itself, and as mentioned earlier, specialists said that they recommend 100% control early in the season.

Uncinula. This disease occurred in all three regions, and was the predominant disease in Rioja. The main factors used in Verona were both external pointers - the date and weather. In the other two regions the stage of plant development was used backed up by use of a warning system and, in the case of Rioja, weather conditions. In spite therefore of strong promotion of ICM in Verona the growers appeared to persist in adopting a prophylactic approach to *Uncinula* control, the same strategy as for *Plasmopara.*

Botrytis. Bordeaux growers appeared to suffer this disease most. The most important trigger for control measures there was the stage of plant development, although some used a warning system. Growers in Rioja whose vineyards suffered the disease used several factors more or less equally, including the stage of development of the disease itself.

Guignardia. Only in Bordeaux was this disease important. There the growers used all the external factors, including a warning system, but particularly plant stage and weather.

Phomopsis. Only in Rioja did growers provide answers for this disease. As for *Guignardia* in Bordeaux, all the external factors were used.

Table 5.8 Factors determining the start of fungicide application (Farms %)

Factor	Date			Plant stage			Disease stage			Weather			Warning system			Don't know			No disease		
Region	B	R	V	B	R	V	B	R	V	B	R	V	B	R	V	B	R	V	B	R	V
Disease																					
Plasmopara	10	6	46	47	48	16	14	26	11	56	32	62	53	40	10	-	-	2	0	23	7
Uncinula	8	6	34	47	63	11	12	21	10	12	35	46	46	37	11	-	2	2	3	8	18
Botrytis	10	5	7	36	23	2	5	27	5	15	19	11	19	16	-	-	3	5	5	40	70
Guignardia	5	-	3	31	-	-	7	-	2	29	-	8	22	-	-	-	-	5	12	-	77
Phomopsis	-	3	-	-	31	-	-	2	-	-	19	-	-	19	-	-	2	-	-	52	-

Region abbreviations: B = Bordeaux, R = Rioja, V = Verona

5.9 Opportunities to reduce fungicide load

The difference between Rioja and the other two regions is remarkable. In the absence of sulphur the fungicide load drops to less than 1 kg ai/ha in Rioja compared with about 23 and 24 kg ai/ha for Bordeaux and Verona respectively. The reason for this is the absence of significant levels of *Plasmopara* in Rioja.

The fungicide load in Rioja is devoted almost entirely to the control of *Uncinula,* and, if the extra calculated sulphur applications are included, then about 35 kg ai/ha are applied for that purpose. It can be deduced that in Bordeaux 17.6 kg ai/ha and in Verona 7.7 kg ai /ha. are used for the same purpose. This is a grossly simplistic assumption but one worthy of consideration.

ICM practices are being promoted in all regions, and specialists, particularly in Rioja, believe that these will reduce the number of applications of fungicides. The PPS in Rioja has shown in farm-scale trials that almost a halving in the number of applications may be achieved. This supports the contention above that there appears some unnecessary use of fungicides (sulphur) in Rioja. Greater use of the warning systems, particularly in Verona, would appear to offer opportunities for closer targeting of applications.

6.0 INSECTS AND INSECTICIDES (INCLUDES MITES)

6.1 Target insects

Table 6.1 reflects farmers' opinions and is no doubt somewhat exaggerated in terms of generation number extremes (*Clysia* - 11 in Verona). In Rioja and Verona the tortrix moths *Lobesia* and *Clysia* were not well separated and farmers undoubtedly placed the two together.

From specialists' observations the grape berry moth, *Lobesia botrana*, was the main pest across all regions. In France leaf hoppers, *Empoasca* spp, were of similar importance.

Mites have declined in recent years. Specialists indicated that they are less of a problem than growers claimed in both France and Rioja, and are of very minor importance in Verona.

Table 6.1 Target insects - grower responses

Region	Bordeaux (F)			Rioja (E)			Verona (I)		
Insect species	Farms % (Base: 59)	No. of generations		Farms % (Base: 62)	No. of generations		Farms % (Base: 61)	No. of generations	
		Range	Average		Range	Average		Range	Average
Empoasca flavescens (leaf hopper)	62	1 - 3	1.85	-	-	-	38	1 - 3	1.76
Clysia ambiguella (grape berry moth)	55	1 - 3	1.55	97	1 - 5	2.56	60	1 - 11	2.10
Lobesia botrana (grape berry moth)	47	1 - 3	2.13	} -	-	-	37	1 - 3	1.86
Eulia (leaf roller)	3	1 - 5	3.00	-	-	-	-	-	-
Frankliniella occidentalis (thrips)	2	-	-	-	-	-	7	1	1.00
Caterpillars of night flying moths	9	1 - 3	1.75	-	-	-	-	-	-
Sparganothis pilleriana (pyralid moth)	8	1	1.00	37	1 - 3	1.52	-	-	-
Haltica lythri/Ampelophaga (grape leaf beetle)	2	1	1.00	-	-	-	-	-	-
Panonychus ulmi *Metatetrynichus* spp (spider mites) *Tetranychus urticae*	73	1 - 5	2.18	50	1 - 4	1.65	7	1 - 2	1.67
Eotetranychus carpini (spider mites)	42	1 - 3	1.92	27	1 - 2	1.20	2	-	-
Eriophyes vitis (Eriophyid mites)	9	1 - 2	1.50	8	1 - 2	1.25	-	-	-

6.2 Insects exhibiting resistance

Some growers in each of the samples noted that they had experienced resistant insects or mites - 10% in Bordeaux, 29% in Rioja, and 16% in Verona. There was no corroboration of these views from specialists except in the case of mites, *Panonychus* spp to the acaricide dicofol in Bordeaux.

6.3 Level of insect and mite control sought

Table 6.3 Level of insect and mite control sought

Region	Bordeaux (F)	Rioja (E)	Verona (I)
Number of farms	59	62	61
Level of control	Farms %		
< 70%	2	-	10
71 - 80%	-	-	7
81 - 90%	3	-	38
91 - 100%	83	98	25
No answer	12	2	21

In Bordeaux and Verona a few growers did not apply insecticides/acaricides in 1994, 8% and 26% respectively, whilst in Rioja all did. These degrees of need are reflected in the Table 6.3.

6.4 Insecticide and acaricide use

6.4.1 Bordeaux

Crop area treated 96%.

Table 6.4.1 Insecticide and acaricide active ingredients used in Bordeaux

Active ingredient	Activity	% of crop treated (Base area 1,420 ha)	No. of applications where used		Cumulative dose on crop receiving that ai g ai per ha		
			Range per farm	Ave per ha treated	min	max	ave
clofentezine	c/aca	31	1 - 2	1.0	99	352	186
flufenoxuron	igr/b	30	1 - 2	1.3	37	200	68
fenpropathrin	ci/b	24	1	1.1	15	199	85
quinalphos	ci/b	23	1 - 2	1.5	239	481	357
methomyl	ci/b	23	1 - 4	1.7	300	1,600	666
hexythiazox	ci/aca	22	1	1.0	5	50	11
lambda-cyhalothrin	ci/ins	21	1	1.0	6	29	16
propargite	c/*Tet*	19	1	1.0	570	1,425	740
chlorpyrifos-e	cif/ins	12	1 - 2	1.8	359	600	544
bromopropylate	c/*Ery+Tet*	10	1	1.0	500	562	505
acrinathrin	ci/b	9	1	1.0	29	300	230
deltamethrin	ci/ins	8	1	1.0	1	75	22
dicofol	c/aca	7	1 - 2	1.0	35	423	202
*Bacillus thuringiensis**	i/ins	6	1	1.0	1,500	1,500	1,500
cyhexatin	c/*Tet*	6	1	1.0	37	100	54
sulphur	c/*Ery+Tet*	5	1	1.0	899	1,349	1,007
fenbutatin-oxide	c/*Ery+Tet*	4	1	1.0	99	1,100	553
chlorpyrifos-methyl	cif/b	4	1	1.0	200	218	207
fenoxycarb	igr/b	3	1	1.0	150	150	150
thiodicarb	ci/ins	3	1 - 2	1.3	37	750	414
tetradifon	c/*Tet*	2	1 - 3	1.0	80	160	120
parathion-m	cif/ins	2	1	1.0	300	300	300
cypermethrin	ci/ins	2	1	1.6	16	20	17
tralomethrin	ci/ins	2	1 - 2	1.0	23	23	23
tebufenozide	igr/ins	1	1	1.0	95	144	133
bifenthrin	ci/b	1	1	1.0	30	30	30
fenitrothion	ci/ins	1	1	1.0	250	250	250
malathion	cif/b	1	1	1.0	250	250	250
dioxathion	c/b	<1	1	1.0	200	200	200
parathion-ethyl	cif/b	<1	1	1.0	300	300	300

* a biopesticide

Key to abbreviations - see next page

Key to abbreviations:

c	=	contact
f	=	fumigant
i	=	ingested
aca	=	acaricide
b	=	broad spectrum
Ery	=	*Eryiophyes* spp
igr	=	insect growth regulator
ins	=	insecticide
Tet	=	*Tetranychid*/red spider mites

6.4.2 Rioja

Crop area treated 99%.

Table 6.4.2 Insecticide and acaricide active ingredients used in Rioja

Active ingredient	Activity	% crop treated	No. of applications where used		Cumulative dose on crop receiving that ai g ai/ha		
		(Base area: 1,383 ha)	Range per farm	Ave per ha treated	min	max	ave
parathion-ethyl	cif/b	56	1 - 2	1.2	175	400	246
fenitrothion	ci/ins	43	1 - 4	1.4	250	2,250	476
thiodicarb	ci/ins	35	1 - 2	1.2	225	750	278
endosulfan	c/b+*Ery*	19	1 - 5	1.7	158	1,750	415
dicofol	c/aca	14	1 - 2	1.7	72	216	146
fenthion	cif/ins	13	1 - 2	1.4	1,200	2,400	1,686
deltamethrin	ci/ins	12	1 - 3	2.1	4	12.5	8
bromopropylate	c/*Ery+Tet*	10	1 - 2	1.6	262	900	517
chlorpyrifos-ethyl	cif/ins	10	1 - 2	1.5	174	500	295
sodium-arsenite	c/*Spar*	8	1	1.0	2,250	3,972	2,296
lambda-	ci/ins	7	2 - 4	3.5	12	40	30
cyhalothrin	c/*Ery+Tet*	5	2 - 3	2.3	40,000	72,000	49,509
sulphur	cif/ins	4	1 - 2	1.3	280	700	413
parathion-methyl	cif/b	2	2 - 4	3.0	2,000	3,000	2,381
malathion	ci/b	1	1 - 4	1.4	99	600	162
quinalfos	ci/b	1	1 - 2	1.4	268	855	488
methidathion	ci/ins	1	2	2.0	1,200	1,200	1,200
azinphos-methyl	c/b	1	2	2.0	600	600	600
phosmet	ci/ins	1	2	2.0	1,500	1,500	1,500
trichlorfon	s/b	0.1	2	2.0	340	340	340
acephate	adj	56	1 - 2	1.2	2,274	5,200	3,154
petroleum oil							

Key to abbreviations:

c = contact
aca = acaricide
f = fumigant
b = broad spectrum
i = ingested
Ery = Eriophyid mites
adj = adjuvant
ins = insecticide
s = systemic
Spar = *Sparganothis*
Tet = *Tetranychid*/red spider mite

6.4.3 Verona

Crop area treated 62%.

Table 6.4.3 Insecticide and acaricide active ingredients used in Verona

Active ingredient	Activity	% of crop treated	No. of applications where used		Cumulative dose on crop receiving that ai g ai/ha		
		(Base area: 412 ha)	Range per farm	Ave per ha treated	min	max	ave
fenitrothion	ci/ins	22	1 - 4	2.0	231	4,500	1,613
methidathion	ci/b	18	2 - 3	2.0	94	1,424	852
dimethoate	s/b	7	1 - 3	2.6	400	1,440	1,217
phosalone	ci/b	6	1 - 3	1.5	335	1,620	625
azinphos-methyl	ci/ins	5	1 - 3	2.2	449	1,728	1,233
parathion-methyl	cf/ins	4	1 - 5	2.2	399	1,620	874
parathion-ethyl	cif/b	3	1 - 2	1.1	342	1,008	706
quinalphos	ci/b	3	1 - 3	1.8	324	1,687	997
chlorpyrifos-	cif/b	2	1 - 4	2.6	331	1,325	857
methyl	s/b	2	2	2.0	917	1,223	1,019
acephate	ci/ins	1	1	1.0	12	12	12
deltamethrin	ci/ins	1	1	1.0	50	50	50
lambda-cyhalothrin	ci/ins	1	2 - 4	3.0	2,236	5,159	3,697
carbaryl	ci/ins	1	2	2.0	39	39	39
cyfluthrin	adj	1	1	1.0	1,975	1,975	1,975
petroleum oil							

Key to abbreviations:

c = contact
f = fumigant
i = ingested
adj = adjuvant
b = broad-spectrum
ins = insecticide

6.4.4 Insecticides and acaricides used - general commentary

Specialists said the lists of active ingredients used matched the target pests of the respective regions.

The list from Bordeaux had a very strong acaricidal bias with several specific acaricides amongst the top ten active ingredients which reflects farmers attitudes to mites. Some of the top insecticides such as flufenoxuron and fenpropathrin also have acaricidal activity. By and large it is a ‘modern’ list, comprised of active ingredients which are used in more sophisticated crop protection, but it includes considerable use of synthetic pyrethroids which have a negative effect on beneficial mite predators.

The active ingredients used in Rioja were comprised almost entirely of insecticides, there being only two specific acaricides mentioned apart from sulphur. In contrast with Bordeaux the list is more traditional, being headed by a parathion-ethyl/petroleum oil formulation. The heavy use of sulphur as a fungicide may account for the absence of acaricides.

Active ingredients used in Verona were all organophosphates except for very low usage of two synthetic pyrethroids and a carbamate. There were no specific acaricides used. It is a list indicative of IPM being practised, although specialists were disappointed in the high use of methidathion (in fact mostly used on one very large farm) and the low use of quinalphos and chlorpyrifos-methyl. Cumulative average dose rates of the main active ingredients were higher than those in the other two regions. Specialists mentioned that as a result of reduced insecticide usage because of IPM a scale insect, *Planococcus citri*/*Pulvinaria vitis*, had increased. Methidathion is particularly recommended for such pests.

6.5 Insecticide and acaricide use parameters

Table 6.5 Insecticide/acaricide applications

Region	Bordeaux (F)	Rioja (E)	Verona (I)
Crop area treated	96%	99%	62%
On vineyards using insecticides/acaricides			
No. of active ingredients used per farm No. of active ingredients used per hectare No. of product applications per hectare	2.7 2.8 2.5	2.4 3.0 3.7	1.3 0.8 2.0
Proportion of growers spraying part of their vineyard %	31%	21%	20%
Insecticide load kg ai/ha	1.0	4.6	0.9

More growers in Bordeaux sprayed only part of their vineyard than in the other two regions. The lower intensity of pest control in Verona is evident.

6.5.1 Application volumes

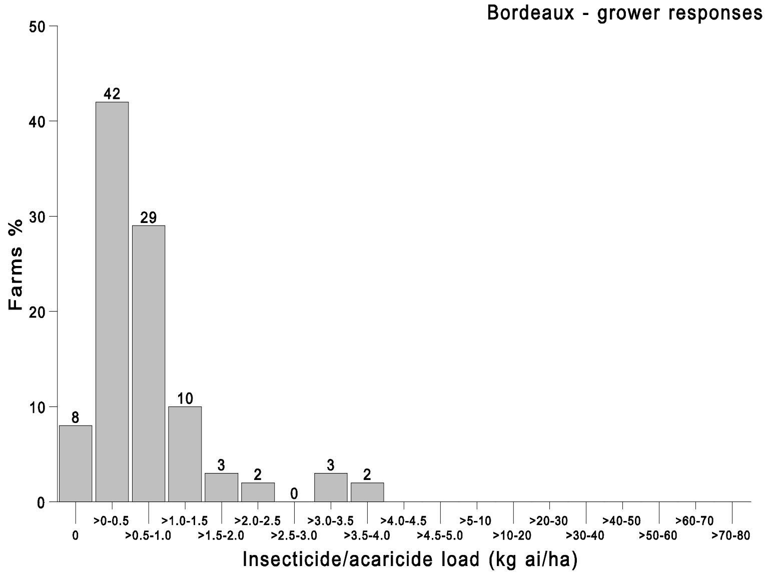
These varied in the same way as fungicides with the same consequences on varying the dose per hectare.

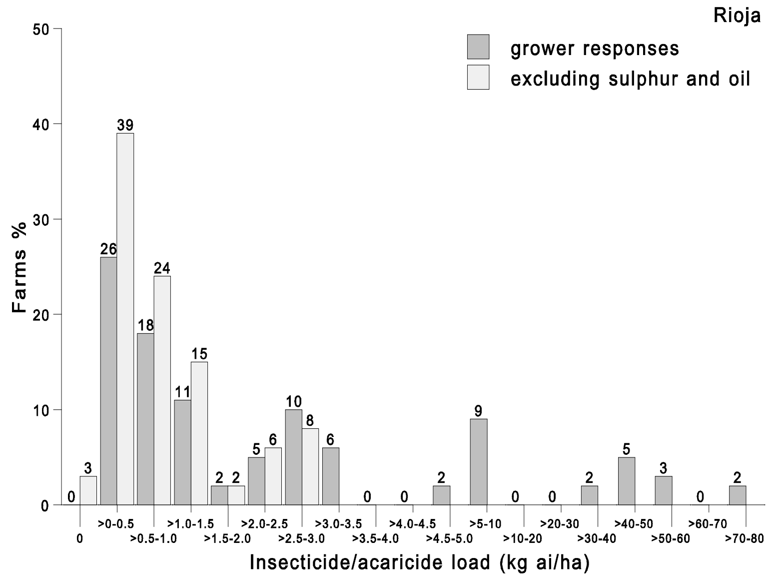
6.6 Insecticide/acaricide load per farm

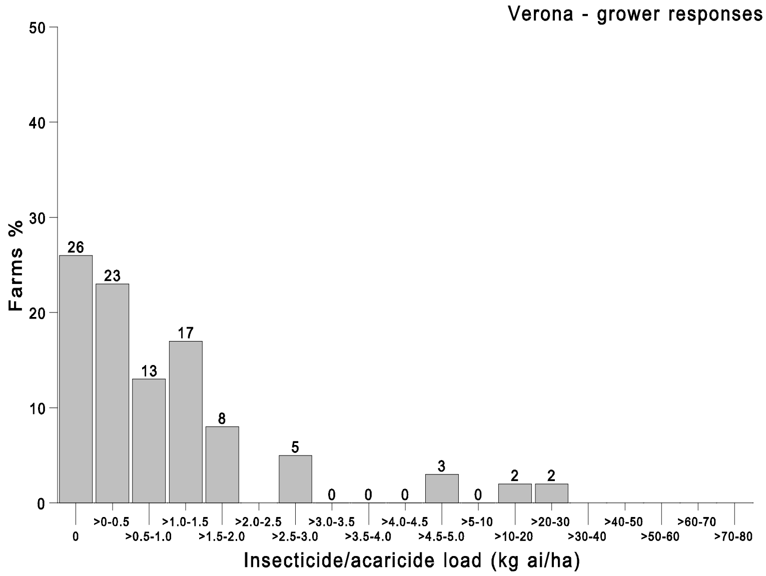
Table 6.6 Insecticide/acaricide load per farm

Region	Bordeaux (F)	Rioja (E)		Verona (I)
Number of farms	59	62		61
	Farms %			
Insecticide/acaricide load kg ai/ha	Grower responses	Grower responses	excl. sulphur and oil	Grower responses
0	8	0	3	26
>0 - 0.5	42	26	39	23
>0.5 - 1.0	29	18	24	13
>1.0 - 1.5	10	11	15	17
>1.5 - 2.0	3	2	2	8
>2.0 - 2.5	2	5	6	5
>2.5 - 3.0	0	10	8	0
>3.0 - 3.5	3	6		0
>3.5 - 4.0	2	0		0
>4.0 - 4.5		0		3
>4.5 - 5.0		2		0
>5 - 10		9		2
>10 - 20		0		2
>20 - 30		0		
>30 - 40		2		
>40 - 50		5		
>50 - 60		3		
>60 - 70		0		
>70 - 80		2		
Load kg ai/ha of crop grown Average Range	1.0 (0)0.02-3.6	4.6 0.01-72.0	1.3	0.9 (0)0.02-17.7

Chart 6.6 Insecticide/acaricide load per farm







Sulphur was uniquely used as an acaricide (in addition to its use as a fungicide) in Rioja and to allow better comparison with other regions it has been stripped from the data in Table 6.6. Petroleum oil, the carrier for parathion-ethyl, has also been stripped out.

On this basis the load per hectare **grown** is higher in Rioja than the other two regions. However, on the basis of load per hectare **treated** the load in Verona increases to about the same as Rioja - 1.4 kg ai/ha. The region with the lowest load per hectare treated was Bordeaux. This is interesting given the broadly similar pest problems and the fact that Bordeaux had the additional problem of mites. A perusal of the active ingredients used reveals that they are surprisingly different, even discounting the acaricides. Those used in Bordeaux were insecticides which are used at lower dose rates.

Reasons for variation in load vary from region to region. In Bordeaux the main reason for higher loads was the simple application of more products on more occasions, coupled with the use of low activity active ingredients. The latter was the only reason for higher loads in Rioja. In Verona, higher loads were the result of low activity active ingredients coupled with higher than average doses. The lighter loads were also achieved through the use of partial spraying.

The three regions appear to have quite different strategies for pest control. Ignoring the loading *per se*, which is not itself a good indicator of environmental impact, it is tempting to believe that the position in Verona is perhaps the most superior. If more IPM was practised in Bordeaux it is conceivable that mites would reduce and fewer products and sprays would be needed although specialists did indicate that mites were less of a problem than farmers believed.

6.7 Insecticide/acaricide use in the study year (1994) compared with an average year

Table 6.7 Insecticide/acaricide use inthe study year (1994) compared with an average year

Region	Bordeaux (F)	Rioja (E)	Verona (I)
Number of farms	59	62	61
	Farms %		
Lower use	20	13	17
Greater use	7	5	7
The same	64	77	61
No answer	8	5	16

All regions responded similarly, the same or lower use than in 1994.

6.8 Factors determining the start of insecticide/acaricide applications

There was a poor response to this question generally (see Table 6.8). Pests eliciting the most response from growers were the insects *Lobesia botrana* and *Empoasca* (the latter not in Rioja), and the mites *Eriophyes* and *Panonychus*.

Growers in Rioja appeared to use most factors for *Lobesia* control. They were the greatest users of a warning system and also considered plant stage and pest stage important. Growers in Bordeaux gave only moderate responses but the use of a warning system backed up by pest stage and pest pressure monitoring were most important. Interestingly the specialists in Verona said these practices were essential for a warning system to function but it appears that relatively few growers in Verona claimed to adhere to them.

For *Empoasca* control, some growers in Bordeaux used a warning system, whilst in Verona inspection of the crop for pest stage and pressure were important.

Mites produced most responses from Bordeaux and a warning system together with the date appeared to be most common factors used for both species. In Rioja, for tetranychid mites, a warning system and plant stage seemed to be the key factors.

Table 6.8 Factors determining the start of insecticide/acaricide applications (Farms %)

Factor	Date			Plant stage			Pest stage			Pest pressure			Warning system			Don't know		
Region	B	R	V	B	R	V	B	R	V	B	R	V	B	R	V	B	R	V
Insects																		
Empoasca spp	7	-	13	7	-	2	7	2	22	2	2	19	24	2	7	31	98	38
Haltica spp	7	-	-	5	-	-	5	-	8	-	-	-	14	-	-	24	-	74
Lobesia botrana	17	13	16	10	39	2	20	42	23	22	24	16	32	60	18	8	-	31
Sparganothis spp	8	2	-	5	10	-	5	11	8	3	5	-	19	24	-	25	65	74
Mites																		
Eriophyes vitis	17	6	-	10	5	8	10	2	8	7	-	-	29	5	-	-	24	74
Panonychus ulmi	25	19	-	12	26	-	15	18	10	14	8	5	42	27	-	-	15	69

Region abbreviations: B = Bordeaux, R = Rioja, V = Verona

6.9 Opportunities to reduce the insecticide/acaricide load

There appear to be three points of interest:

- the level of mite infestation and the use of acaricides in Bordeaux

- the use of parathion plus oil in Rioja, and the impact of high sulphur fungicide use on mite levels

- the low level of *Lobesia* control in Verona, and again the impact of high sulphur use on mite levels.

There is a simplistic conclusion to be drawn - that where sulphur is used throughout a region there are no or lower mite problems, in other words in both Rioja and Verona.

Parathion plus oil controls the overwintering stages of mites as well as *Lobesia botrana*. This is a contributory factor to the low levels of mites in Rioja.

The generally low level of pest incidence and pressure in Verona is likely to be the result of natural regional variation but also fostered by the use not only of IPM - growers did not convincingly indicate much use of it in this study - but also ICM.

IPM is practised in all regions, nevertheless there were indications in this study that insecticide and acaricide use could be further reduced in all three, particularly Rioja. Wide use of the warning system, particularly in Verona, would appear to offer possibilities of increasing the targeting of applications.

7.0 MISCELLANEOUS PESTS AND PESTICIDES

There were no other pests mentioned.

8.0 OTHER AGROCHEMICALS

Other agrochemicals represented by growth regulators were only applied in Rioja. They were applied by 6% of growers who have Garnacha variety grapes, covering only 1% of the area grown. The chemicals were a chlormequat-chloride/choline-chloride mixture and paclobutrazol used to enhance fruit formation.

9.0 TRENDS IN PESTICIDE USE

9.1 Variation in pesticide use over the last five years

9.1.1 Herbicides

Table 9.1.1 Variation in herbicide use over the last five years

Region	Bordeaux (F)	Rioja (E)	Verona (I)
Number of farms	59	62	61
Usage	Farms %		
Increased	12	40	21
The same	68	44	28
Reduced	14	16	31
No answer	7	0	20

The most static position on herbicides was held by growers in Bordeaux, who generally felt that usage had remained the same. Opinions were divided in Verona, although specialists there felt there had been a steady increase.

9.1.2 Fungicides

Table 9.1.2 Variation in fungicide load over the last five years

Region	Bordeaux (F)	Rioja (E)	Verona (I)
Number of farms	59	62	61
Usage	Farms %		
Increased	5	42	23
The same	76	47	51
Reduced	17	10	21
No answer	2	2	5

Bordeaux growers believed that fungicide usage had remained the same, with opinion in Verona again being divided. In Rioja about 40% felt there had been an increase, and specialists agreed, this apparently being the result of weather more suitable for diseases.

9.1.3 Insecticides/acaricides

Table 9.1.3 Variation in insecticide/acaricide use over the last five years

Region	Bordeaux (F)	Rioja (E)	Verona (I)
Number of farms	59	62	61
Usage	Farms %		
Increased	5	45	25
The same	64	48	39
Reduced	17	5	15
No answer	14	5	21

The comments made concerning fungicides are also appropriate for insecticide/acaricide use. Bordeaux growers mostly felt there had been no change, whilst those in Verona were fairly evenly divided. Specialists in Verona felt that although usage in 1994 had been higher the trend was downward. In Rioja, growers were evenly divided between those believing insecticide usage had been the same and those believing there had been an increase.

9.2 Plans to maintain or change pesticide use in vines

Table 9.2i Plans to maintain or change pesticide use in vines

Region	Bordeaux (F)	Rioja (E)	Verona (I)
Number of farms	59	62	61
	Farms %		
Will change	14	11	10
Possibly change	10	26	15
Will not change	75	58	67
Don't know	2	5	8

A large majority of growers did not plan to change their pesticide use in the near future, although up to 35% of growers in Rioja will or may possibly change.

Those who answered that they will or may change were asked in which sector would the change be and for what reason.

Table 9.2ii Agrochemical sector and reasons identified for change

Reasons	Better control			Distribution /availability			Economics			Environment		
	% of growers who will or may change Base B - 14, R - 23, V - 15											
Sector	B	R	V	B	R	V	B	R	V	B	R	V
Herbicides	14	65	27	0	4	0	7	0	7	0	17	0
Fungicides	29	100	87	0	9	3	7	4	7	7	26	7
Insecticides /acaricides	14	100	60	0	0	0	0	4	0	14	17	14

Region abbreviations: B = Bordeaux, R = Rioja, V = Verona

Insecticides and fungicides were the main sectors where change might take place, and the main reason was 'better control'. In Rioja, a significant minority included 'environment' as a reason for change in all chemical sectors. This was also the case for fungicides and insecticides/acaricides in Bordeaux and Verona. It may be that the high volume use of sulphur and of parathion and petroleum oil in Rioja has given rise to a feeling that there must be more effective/active chemicals which should therefore have less effect on the environment.

10.0 PESTICIDE/AGROCHEMICAL GENERALITIES

10.1 Sufficiency in choice of products

Table 10.1 Growers indicating satisfaction in the choice of products

Region	Bordeaux (F)	Rioja (E)	Verona (I)
Number of farms	59	62	61
Sector	Farms %		
Herbicides	93	92	79
Fungicides	95	97	92
Insecticides/acaricides	86	95	70

Most growers expressed satisfaction in the choice of products available to them. Least support was given to insecticides/acaricides in Verona.

10.2 Attitudes to developments in the agrochemicals market

Growers were asked to give their opinion on developments in the agrochemicals market with regard to availability of new products, improved efficacy, ease of application and lowered residue levels. They responded ‘good’ ‘satisfactory’ or ‘poor’. Table 10.2 shows the data for the ‘good’ and ‘satisfactory’ responses combined.

Table 10.2 Growers expressing satisfaction with agrochemicals developments

Region	Bordeaux (F)	Rioja (E)	Verona (I)
Number of farms	59	62	61
Attitude	Farms %		
Availability of new products	85	98	88
Improved efficacy	88	97	73
Ease of application	90	75	92
Lower residues	72	55	56

A generally favourable view was found in all regions. Concerning the low satisfaction about residue levels, there were 20%, 31% and 29%, respectively in Bordeaux, Rioja and Verona, answering ‘don’t know’, so it would seem that growers were generally unaware of the position. A significant minority in Verona questioned efficacy.

10.3 Attitudes to handling restrictions on the label

Growers were asked how important to their choice and use of products were the handling restrictions on the label. They were offered three responses - very important, important and not important. Table 10.3 presents those answering very important and important.

Table 10.3 Attitudes to handling restrictions on the label

Region	Bordeaux (F)		Rioja (E)		Verona (I)	
Number of farms	59		62		61	
Attitude	Farms %					
Importance	very imp	imp	very imp	imp	very imp	imp
On **choice** of products	37	58	52	47	72	23
On **use** of products	49	47	51	48	67	28

All growers in all regions believed handling restrictions were important to both their choice and use of product. Those in Verona were most emphatic about this.

10.4 Attitudes to environmental restrictions on the label

The same procedure of questioning was adopted as for 10.3.

Table 10.4 Attitudes to environmental restrictions on the label

Region	Bordeaux (F)		Rioja (E)		Verona (I)	
Number of farms	59		62		61	
Attitude	Farms %					
Importance	very imp	imp	very imp	imp	very imp	imp
On **choice** of products	34	56	42	55	54	43
On **use** of products	44	51	42	56	57	39

Environmental restrictions were important to all growers in all regions, but they were slightly less important in Bordeaux and more important in Verona.

Specialists in Bordeaux and Rioja said that growers were being polite to the interviewer and that in reality the 'environment' meant nothing to growers in terms of choice or use of product!

Comparing the results in Table 10.3 and Table 10.4, there was slightly greater emphasis on handling restrictions than environmental ones.

10.5 Sources of information

Growers were asked to indicate their sources of information on pesticides/agrochemicals and to attribute a score on a scale of 1 - 5, where 5 was most important.

Table 10.5 Information sources

Region	Bordeaux (F)		Rioja (E)		Verona (I)	
Number of farms	59		62		61	
Information source	Farms %	Score	Farms %	Score	Farms %	Score
Cooperative rep	66	3.9	74	3.8	72	4.4
Farming press	32	3.5	29	1.8	21	2.8
Manufacturer's rep	20	3.9	6	2.3	15	3.0
Merchant	22	3.6	69	3.6	43	4.3
Neighbour/colleague	27	3.7	27	3.5	15	3.0
Plant protection advisor	29	4.0	55	4.0	15	4.6
Private consultant	8	4.0	44	4.3	16	3.7
Other	15	2.6	2	5.0	0	0

In all three regions the most important source of information was the co-operative representative, particularly so in Bordeaux and Verona. In Rioja there was a wider spread of sources used, including agrochemical merchants, official plant protection advisors and private consultants - the latter two having high scores for the quality of the information they gave. In Verona larger farmers used merchants more than smaller because they tended not to be members of the local Cantine Sociali (cooperative), and it is of great significance that although the official plant protection advisors achieved high scores, they were not used by many growers - a situation which was also found in the wheat study in Piemonte, Italy (though not in the apple study in Trentino, Italy). It is understood that the coop rep is the channel for dissemination of advice from the plant protection advisors in these regions in Italy.

11.0 PROFITABILITY AND PESTICIDES

11.1 Profitability of the vine crop

Table 11.1 Profitability of the vine crop

Region	Bordeaux (F)		Rioja (E)		Verona (I)	
No. of farms	59		62		61	
	Farms %					
Profitability of vines	Study year (1994)	5 years ago	Study year (1994)	5 years ago	Study year (1994)	5 years ago
Very good	9	24	8	5	10	7
Good	30 } 69	33 } 89	56 } 90	23 } 50	36 } 77	51 } 83
Satisfactory	30	32	26	26	31	25
Poor	23	6	10	16	16	11
Very poor	8	2	0	3	3	3
No answer	-	3	0	27	3	3

The majority of growers in all regions felt that the profitability of their crop was satisfactory or above. In Rioja more growers were satisfied in 1994 than five years before. In Verona there was little change. In Bordeaux, a majority of those replying indicated satisfaction with profits in 1994. These were substantially fewer, however, than for five years previously.

The same question was also put to growers about the profitability of their farm as a whole, and the results were the same as their views on vines. Specialists in Bordeaux said that vines were the main source of income of growers in the region followed by the EC subsidised crops, cereals and oil-seeds.

11.2 Returns and costs of production

Models of returns and costs are presented in the individual region reports. The detail, terms and make up of the models vary considerably and do not bear comparison.

Table 11.2 Comparison of agrochemical costs

Agrochemical costs	Bordeaux (F)	Rioja (E)	Verona (I)
as % of variable costs	44	n/a	15
as % of gross income	8	9	4.5

These data tend to confirm the major differences in use of agrochemicals detailed in this report, particularly the low usage in Verona.

11.3 Influence of anticipated profit on pesticide use and choice

Farmers were asked the effect that anticipated profitability might have on aspects of their choice and use of products.

Table 11.3 Influence of anticipated profit on pesticide use and choice

Region	Bordeaux (F)		Rioja (E)		Verona (I)	
Number of farms	59		62		61	
	Farms %					
Anticipated profit	good	poor	good	poor	good	poor
Influence on use						
Price of product						
Use more expensive product	3	2	21	2	3	5
Use less expensive product	6	9	0	31	2	10
No influence	88	86	79	68	87	66
No answer	3	3	0	0	8	19
Dose rate						
Use higher dose	0	3	8	2	7	10
Use lower dose	14	11	0	16	8	7
No influence	85	85	92	82	77	66
No answer	2	2	0	0	8	18
Age of product						
Use newer product	2	2	2	0	26	26
Use older product	0	6	0	0	3	3
No influence	97	91	98	100	62	54
No answer	2	2	0	0	8	16

In all regions the great majority indicated that there would be no influence.

11.4 The effect of agrochemicals on profitability

Growers were asked which agrochemical sector had the greatest and least effect on profitability.

Table 11.4i Effect of agrochemicals on profitability

Region	Bordeaux (F)		Rioja (E)		Verona (I)	
Number of farms	59		62		61	
	Farms %					
Effect	greatest	least	greatest	least	greatest	least
Sector						
Herbicides	3	59	10	42	5	35
Fungicides	92	0	43	5	77	0
Insecticides	2	12	21	10	8	22
Plant growth regulators	0	9	0	2	2	13
Don't know	2	20	25	42	8	30

Most growers thought that fungicides had the greatest effect on profitability and herbicides the least.

Growers were then asked whether agrochemical inputs could be reduced while maintaining profitability and if so in which sector.

Table 11.4ii Possibility to reduce agrochemicals inputs without affecting profitability

Region	Bordeaux (F)	Rioja (E)	Verona (I)
Number of farms	59	62	61
Opinion	Farms %		
Yes	20	21	11
Possibly	18	8	15
No	55	58	53
No answer	8	13	21

Growers who answered either 'yes' or 'possibly' were asked to say in which sector reductions might be made.

Table 11.4iii Sector where reductions may be made without affecting profitability

Region	Bordeaux (F)	Rioja (E)	Verona (I)
Number of farms	22	18	16
Sector	Farms %		
Herbicides	32	48	19
Fungicides	64	100	56
Insecticides	32	57	6

Though sample numbers were small fungicides were the sector where most growers thought there could be reductions made. In Rioja this was the view of nearly a third of the total study sample.

12.0 ALTERNATIVE CROP PROTECTION SYSTEMS

12.1 Awareness of alternative systems

Growers were asked if they were aware of any alternative systems of crop protection which might be equally profitable to conventional methods. No prompts were given. Those not mentioning a system were then asked if they were aware of Integrated Crop Management (ICM), Integrated Pest Management (IPM), or Organic Production (OP).

Table 12.1 Awareness of alternative systems that might be equally profitable

Region	Bordeaux (F)	Rioja (E)	Verona (I)
Number of farms	59	62	61
Unprompted	Farms %		
IPM	12	37	34
ICM	44	19	18
OP	3	37	38
No answer	-	-	54
After prompting	Farms % Base - all growers		
IPM	35	8	12
ICM	34	4	8
OP	74	16	13

Growers in Bordeaux were proportionately most aware of ICM, and after prompting, of OP. It is understood that in France to some growers, ICM can mean just adhering to co-operative or SRPV programmes, and they were thought not to fully appreciate the terminology used in the questionnaire, even though the meanings were described. (Definitions in Appendix I.)

Awareness in the other two regions was less than in Bordeaux. The PPS in Rioja confirmed that there was little interest. In Verona there was a very low response level though amongst those reponding, awareness of IPM and OP was high. Local specialists confirmed that IPM/ICM techniques had been practised in the area for many years.

12.2 Interest in developing alternative systems

Farmers were asked for the level of interest in developing an alternative system on their farm.

Table 12.2 Interest in developing alternative systems

Region	Bordeaux (F)	Rioja (E)	Verona (I)
Number of farms	59	62	61
	Farm giving a positive response %		
IPM	23	16	15
ICM	57	10	10
OP	12	23	8

It is difficult to analyse these data because of the possible lack of awareness of the terminology, given that specialists say that many farmers were already practising ICM and IPM techniques. Nevertheless, the data show that there appears to be a significant proportion of growers in Bordeaux interested in ICM methods as they understood them. All the positive responses concerning IPM and ICM in Rioja were from larger growers, so that although only 16% of growers were interested in developing IPM they represented 47% of the crop area. The greatest interest in OP was in Rioja and this group of growers were of all crop sizes.

13.0 ENVIRONMENTAL ISSUES

13.1 Vineyards in restricted areas

Few farms were in areas with environmental restrictions. There was one in Bordeaux none in Rioja, but four in Verona. Three of the four in Verona mentioned that there were restrictions on the use of agrochemicals which made 'choice' difficult.

13.2 Considerations influencing the choice of chemicals

Growers were shown a list of suggested environmental considerations and asked which they took into account when choosing their agrochemicals.

Table 13.2 Environmental considerations influencing choice of chemicals

Region	Bordeaux (F)	Rioja (E)	Verona (I)
Number of farms	59	62	61
	Farms %		
Surface water	15	5	7
Ground water	17	6	15
Soil protection	21	8	42
Flora	21	8	12
Fauna	24	10	10
Produce quality	36	18	27
None of these	54	13	27
Don't know	1	40	20

Over half the growers in Bordeaux and Rioja and just under half in Verona said they were not influenced by any of the environmental considerations listed or could not answer this question. 'Produce quality' followed by absence of residues in the grapes, were the only two aspects which specialists in Bordeaux said growers were interested in. Growers in Verona may have been influenced by the publicity surrounding the ground water problems in the Po Valley in suggesting 'soil protection'.

APPENDIX I

DEFINITIONS AND CAVEAT

BACKGROUND

1 Ideally this study should have been conducted on an individual field basis. Economics and practical considerations, however, precluded this. Farmers were therefore asked about their treatments for the entire crop over their whole farm.

2 Typically fields were treated several times for any one pesticide sector (fungicides, insecticides, particularly). Occasionally on certain farms some fields were treated more times than others - though review of the data shows this to be limited.

3 Applications were made with agrochemical products containing one or more active ingredients. While data was collected from the farms at product level the results were required at active ingredient level for calculation of chemical load and to facilitate cross-country comparisons.

4 Presentation of the data as kg ai/ha has been used for simplification. This of course hides the great variation in inherent activity of different chemicals. Attempts are made to cover for this in the text.

DEFINITIONS

Regional level:

Base area treated (for a chemical sector)

That part of the crop which receives any treatment at all for the chemical sector in question. This is represented by Crop Area - Untreated Area = Base Area Treated.

Farm level:

Proportion of crop treated

This is defined as "That portion of crop receiving the active ingredient at least once". Where a series of treatments, of differing areas, had been made on a farm then the assumption has been made that the treatments were made sequentially on the largest area receiving that active ingredient. In practice the largest area was nearly always the complete area of crop on that farm so this is usually correct.

Average number of applications

For a given active ingredient this was calculated as the average number of times an active ingredient was applied on a given farm. Where an active ingredient is applied on different areas then the average number of applications/ha is calculated for the whole farm. This can occasionally underestimate the number of applications on a given field.

Cumulative dose

This is the total volume of an active ingredient used on a farm divided by the area of study crop grown on that farm. In situations where a chemical was not always used on the whole farm this has the effect of underestimating the dose - however, as already indicated these situations were limited.

Product applications

Products may be applied alone or in tank mixes. The latter were not catered for in the questionnaire. The term product applications has therefore been introduced meaning products x applications. As a consequence this can exaggerate the number of applications made on a farm where considerable use was made of tank mixes (possibly mixes of two products at low dose).

ALTERNATIVE CROP PROTECTION

Integrated Pest Management (IPM)

The objective here is control of pests (weeds, disease, insects etc) using a mix of the less aggressive chemicals available and the stimulation of the crop or beneficial organisms to control the pest. Such methods may involve choice of resistant varieties, modifying rotations, use of biological pesticides etc.

Integrated Crop Management (ICM)

The objective here is to manage the growing of crops in such a way as to reduce any negative effects on the environment, typically ground water. As such, the same methods may be used as with IPM, but taken further to include fertilisers and any other ‘contaminating’ inputs and cultural methods.

Organic Production (OP)

The objective here is to produce crops in which chemical pest control or fertilisers have played no part.

APPENDIX II

CONTACTS AND COLLABORATORS

FRANCE

Field survey:	Brule Ville Associés 191 avenue du Général Leclerc B P 59 78220 Viroflay
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