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

PES - A/PHASE 2

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

Provence/Languedoc/Rhône-Alps, France
Trentino, Italy
Lerida, Spain

Prepared by:

Landell Mills Market Research Limited
Columbus House
Trossachs Drive
Bath BA2 6RR
United Kingdom

Tel: (+44) 1225 444646
Fax: (+44) 1225 447937

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APPLES - CROSS REGIONAL REVIEW

SUMMARY

General

This study was conducted in mid-1995 on practices employed in 1994. Three regions were reviewed: Provence/Languedoc/Rhône-Alps (France), Trentino (Italy) and Lerida (Spain).

All regions were dominated by varieties of the 'Golden' group.

Trentino followed a well developed ICM/IPM system.

Chemical loads

The average volume of active ingredients applied per hectare of crop grown ranged between:

	Average	(Range)
- Provence/Languedoc/Rhône-Alps :	41.4 kg ai/ha	(0 - 9.6 kg ai/ha)
- Trentino :	33.7 kg ai/ha	(0 - 2.5 kg ai/ha)
- Lerida :	27.4 ka ai/ha	(0.1 - 7.2 kg ai/ha)

Though fungicides dominated, these were made up of many varying chemicals of differing intrinsic activity.

Weed control and herbicides

Weed species varied in degree by region but among the target species mentioned by farmers there were always a number of the more difficult to control perennial species.

Weed control was generally practised along the tree rows leaving the portion between the rows to grass or vegetation that was mowed.

Herbicide loads were modest in all regions with contact acting chemicals being used to the greatest degree. The heaviest loads were found in Provence/Languedoc/Rhône-Alps due to greater use of soil-acting residual herbicides. Targeted spraying, where farmers treated parts of their orchards with a given product, was most used in Lerida (22%) followed by Provence/Languedoc/Rhône-Alps (14%). Trentino practised this least (4%).

Diseases and fungicides

Venturia inaequalis (apple scab) was a major disease in all regions and seen as most important in Trentino. *Podosphaera leucotricha* (powdery mildew) was also present throughout but more prevalent in Lerida.

Fungicide loads dominated the overall chemical load and were highest in Provence/Languedoc/Rhône-Alps followed by Trentino and lowest in Lerida. These loads tended to be related to the high dose rate contact fungicides for *Venturia* control and sulphur for *Podosphaera* treatments. In Lerida where the latter disease is of greatest importance there was also widespread use of lower dose systemic broad spectrum products which include *Podosphaera* in their spectra. Resistance management limits the number of applications that can be made with these chemicals.

Fungicide label dose rates are given in concentration of spray liquid (grams per 100 litres etc), hence variation in volumes applied per hectare lead to variation in chemical load per hectare. Average volumes of spray liquid used varied by a factor of 10 between highest and lowest users within each region with consequential effect on dose rate per hectare. Most applications were at 1,000 l/ha in the French region and Lerida, and at 1,500 l/ha in Trentino.

Farmers used a number of parameters to determine when to start their spray programmes. An official warning system is available in all regions, particularly for *Venturia* treatments. This was most used by the farmers in Trentino.

Targeted spraying of parts of the orchards was most practised in Provence/Languedoc/Rhône-Alps (16%) and Lerida (14%). In Trentino this was only used on 3% of the farms.

Insects and insecticides

A wide range of target pests was mentioned by farmers. *Carpocapsa pomonella* (codling moth) and various aphid species were widely mentioned in all regions. *Quadraspidiotus perniciosus* (San Jose scale) was mentioned in all regions but was of major significance in Lerida. Mites were seen as important, particularly in Provence/Languedoc/Rhône-Alps and Lerida. They were of lesser consequence in Trentino where ICM/IPM techniques have reduced their prevalence.

A number of other insect pests including *Ceratitis capitata* (Mediterranean fruit fly) were more prevalent in Lerida.

Insecticide loads were lowest in Trentino and highest in Lerida, reflecting the ICM/IPM technique in Trentino but also the broader pest pressure in Lerida and the widespread use of petroleum oils.

Application volumes ranged in a similar manner to fungicides.

Among the factors used for determining the start of spraying, the official warning systems were followed by a majority in Lerida and Trentino. They had less of a following in Provence/Languedoc/Rhône-Alps where a substantial proportion of farmers, particularly for *Carpocapsa*, preferred to start spraying by a particular date regardless of whether the pest had been registered or not.

Targeted spraying of portions of the crop was practised most in Lerida (14%) followed by Trentino (9%) and Provence/Languedoc/Rhône-Alps (7%).

Miscellaneous pests and pesticides

Only a few farmers mentioned the use of rodenticides though this was felt to be understated in Trentino.

Other agrochemicals - plant growth regulators (PGRs)

PGRs were mostly used for fruit thinning and reduction of russetting of Golden Delicious and related varieties. Chemical loads were very low but growers in Lerida and Trentino made greatest use of them.

Trends in pesticide use

Trends in pesticide use over the five years prior to the study year (1994) showed use having largely remained the same in Provence/Languedoc/Rhône-Alps with a reduction in Trentino and Lerida.

General satisfaction was indicated by farmers on the choice of products available to them and their developments. However, farmers anticipating no change in their immediate future use of chemicals were in the majority in all countries. In Lerida this was less marked.

Farmers in all regions indicated that label restrictions on handling and environmental aspects were important, both in choice and in use of products. On balance, environmental aspects rated slightly lower than handling restrictions.

Profitability and pesticides

In Provence/Languedoc/Rhône-Alps and Lerida, substantially fewer farmers felt that their apple crops were profitable in 1994 compared with five years before. The reverse situation was experienced in Lerida.

The majority of farmers felt that anticipated profitability of the crop would not affect their choice of pesticides.

The agrochemical sector providing the greatest effect on profitability was seen as fungicides,

followed by insecticides in the French region and Trentino, while this was insecticides in Lerida. Herbicides were identified as providing the least effect in all regions.

Alternative crop protection systems

Farmers appeared generally well aware of the alternative crop protection systems though it is suggested that there may have been confusion in understanding the difference between integrated crop management and integrated pest management. A high level of interest was indicated in the responses to developing the techniques on their own farms which, in the case of Lerida in particular, conflicted with specialist experience.

Environmental considerations

Environmental considerations affected the choice of agrochemicals most in Trentino, reflecting the local protocol. These aspects were also considered in the other regions but less than a quarter of the respondents mentioned any one particular factor that they took into consideration.

Conclusion

The regions varied widely in their use of agrochemicals, from the ICM/IPM Trentino protocol to the heavier users of chemicals in Provence/Languedoc/Rhône-Alps.

Apples require considerable protection against diseases, insects and mites but opportunities are seen for some reduction in agrochemical use.

In all chemical sectors some farmers are taking a targeted approach to applying some of their treatments (part-crop spraying) and it is suggested that this might be extended.

Herbicide use has moved away from soil-acting chemicals to a large extent but this could probably be increased.

In disease and insect control wider use of the ICM/IPM systems as practised in Trentino could have beneficial effects elsewhere. In this context the increased use of warning systems would be of benefit. Optimisation of application volumes would also seem to be an area where unnecessary use might be reduced.

1.0 THE REGIONS, METHODOLOGY AND SAMPLES

1.1 The regions

Three regions were selected as being intensive producers of apples. Those chosen were:

France - Provence/Languedoc/Rhône-Alps
Italy - Trentino
Spain - Lerida

The Trentino region has practised widespread use of an integrated crop/pest management system for a number of years - the so-called Trentino protocol.

1.2 Methodology

The format followed consisted of two farmer group discussions held in Trentino and Lerida. These were used 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 the questions related to the use of agrochemicals in the previous season (1994). Results, having been obtained and partially analysed, were used as a basis for interviews with local specialists in the regions to discuss the findings and broaden the view.

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 crops 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 more common bases for variation in practice is that of enterprise size.

Budgetary restraint limited the sample size to around 60 in each 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 size distribution profile should be represented.

The statistics for the regions are presented in the individual regional reviews but are different in make-up and are not easily compared. The samples resulting were the following:

Table 1.3 Farm survey samples

Apple area per farm - ha	Provence/ Languedoc/ Rhône-Alps (France)		Trentino (Italy)		Lerida (Spain)	
	Farms %	Area %	Farms %	Area %	Farms %	Area %
0.3 < 1	-	-	10	1	-	-
1 < 2	-	-	27	9	-	-
1 < 5	-	-	-	-	38	9
2 < 5	27	6	42	32	-	-
5 < 10	32	15	12	20	23	15
10+	-	-	10	38	-	-
10 < 20	21	22	-	-	27	33
20+	19	57	-	-	12	44
Total No. ha	62	862	60	213	60	676
Average - ha	-	13.9	-	3.6	-	11.3
Regional average - ha	-	4.3	-	1.7	-	2.1

It will be noted that the average apple holding in the samples was larger than for the regions. This is a consequence of spreading the sample relatively evenly across the farm holding profile based on farm numbers.

2.0 GENERAL RESEARCH FINDINGS

2.1 Farming demographics

2.1.1 Land tenure

Table 2.1.1 Land tenure

Region	Provence/ Languedoc/ Rhône-Alps (F)	Trentino (I)	Lerida (E)
Number of farms	62	60	60
Total apple area - ha	862	213	676
Tenure category			
>60% owned	73	83	73
40-60% owned	11	8	13
<40% owned	16	9	13

The large majority of farmers in all three regions owned most of their land.

2.1.2 Occupational status

Table 2.1.2 Occupational status

Region	Provence/ Languedoc/ Rhône-Alps (F)	Trentino (I)	Lerida (E)
Number of farms	62	60	60
Occupational status	Farms %		
Full-time	95	73	90
Part-time	3	22	8
No reply	2	5	2

Most farmers were employed full-time on their farms. Local specialists indicated that in the Lerida region as a whole there was a larger proportion of part-time apple growers than in the sample - approximately 30%.

2.1.3 Farm enterprises

Table 2.1.3 Farm enterprises

Region	Provence/ Languedoc/ Rhône-Alps (F)	Trentino (I)	Lerida (E)
Number of farms	62	60	60
	Farms %		
Crops			
Cereals	27	-	58
Maize	6	2	33
Sorghum	8	-	-
Sugar Beet	-	-	-
Oilseed Rape	8	-	-
Sunflowers	13	-	5
Peas	-	-	-
Field Vegetables	18	2	7
Other Top Fruit	94	57	98
Soft Fruit	6	2	-
Temporary Grass	-	-	8
Permanent Grass	-	5	13
Animals			
Dairy	-	-	-
Beef	-	2	-
Veal	-	2	2
Pigs	-	-	7
Poultry	-	2	3
Other			
Tourism	2	-	-

For most of the farms, crops in the 'Other Top Fruit' category were the most widely grown. Arable crops such as cereals and maize were grown by many farmers in the French and Spanish region, but were unimportant in Trentino, Italy. Livestock were of little importance in all three regions.

2.2 Crop agronomy

2.2.1 Varieties

Table 2.2.1 Main varieties

Region	Provence/ Languedoc/ Rhône-Alps (F)		Trentino (I)		Lerida (E)	
	Farms 62	Area 862 ha	Farms 60	Area 213 ha	Farms 60	Area 676 ha
Variety	%					
Golden group						
Golden Delicious	92	57	98	77	59	6
Golden Supreme	-	-	-	-	24	47
Golden Smoothee	-	-	-	-	24	2
Golden	-	-	-	-	14	3
Gala group						
Gala	29	7	13	2	-	-
Royal Gala	15	1	-	-	19	2
Mundial Gala	-	-	-	-	10	1
Red group						
Top Red	-	-	-	-	41	8
Early Red One	-	-	-	-	24	3
Red Chief	-	-	-	-	20	3
Granny Smith	60	17	30	3	25	3
Starking group	19	1	69	7	19	1
Ozargold	13	1	-	-	-	-
Elstar	8	1	-	-	-	-
Fuji	6	1	-	-	-	-
Jonagold	6	1	-	-	-	-
Morgenduff	-	-	25	4	-	-

Golden Delicious and related varieties were by far the most widely grown apples in all three regions. They have become dominant due to handling, storage and disease resistance properties, although this latter property has been less strong in recent years. Several other varieties such as Granny Smith, Gala group and Starking group were grown on many farms, but do not represent a very large proportion of the crop. Gala types have the benefit of early maturation which enables farmers to commence picking sooner. This may also mean fewer pesticide sprays per season as less protection time is needed.

2.2.2 Soil types

Table 2.2.2 Soil types - main constituents

Region	Provence/ Languedoc/ Rhône-Alps (F)	Trentino (I)	Lerida (E)
Crop areas (ha)	862	213	676
	Area %		
Sand	31	53	3
Silt	51	7	8
Clay	27	19	9
Organic	7	10	10
Other	1	11	42
No Reply	-	-	30

Farmers had some difficulty in classifying their soils into such very broad categories. There was believed to be little direct influence of soil type on pesticide use for this perennial crop.

2.2.3 Irrigation

In Provence/Languedoc/Rhône-Alps most farms are irrigated to achieve good cropping, and where this water is applied overhead, it can increase the likelihood of some diseases occurring, particularly *Venturia inaequalis* (apple scab). In the other two regions most apples are grown under irrigated conditions. No observations were made as to the increased likelihood of disease as a consequence.

2.2.4 Fertiliser use

Table 2.2.4 Fertiliser use by region

Region			Provence/ Languedoc/ Rhône-Alps (F)	Trentino (I)	Lerida (E)
Crop area (ha)			862	213	676
Constituent		Specification kg/ka	Area %		
Nitrogen	High	>101	21	0	65
	Medium	51-100	57	13	19
	Low	1-50	15	28	6
	Nil	0	0	59	0
	No reply		6	0	9
Phosphorus	High	>51	32	0	58
	Medium	26-50	47	11	15
	Low	1-25	8	35	13
	Nil	0	5	55	3
	No reply		8	0	12
Potassium	High	>61	48	11	62
	Medium	31-60	30	25	16
	Low	1-30	9	14	11
	Nil	0	2	50	1
	No reply		11	0	12

Clearly Lerida (E) was the highest user of fertilisers and Trentino (I) the lowest. In recent years quantities have been reduced as apple growers have become more aware of the need to achieve the correct balance of nutrients in the crop in order to maximise yield, fruit quality and storage characteristics. In addition to N P K some farmers applied magnesium and calcium if these elements were insufficiently available from the soil.

Excess nitrogen and insufficient calcium can lead to the physiological disorder ‘bitter pit’, whereas insufficient nitrogen can lead to poor leaf development.

2.2.5 Yields

Apple yields are not reported on as they are so variable dependant on variety, training methods, age of orchard etc.

2.3 Commercial issues

2.3.1 Destination of produce by region

Region	Provence/ Languedoc/ Rhône-Alps (F)	Trentino (I)	Lerida (E)
Number of farms	62	60	60
Destination	Farms %		
Wholesaler/coop	76	93	93
Direct to consumer	11	7	12
Others undefined	13	0	2

Distribution of produce was similar for all three regions.

2.3.2 Contracts agreed in advance

There was some confusion among farmers in answering this question, particularly in Lerida where 96% of famers said they did or sometimes did agree contracts in advance. In Trentino and Provence/Languedoc/Rhône-Alps the corresponding figures were 10% and 8%. In discussion with local experts, it seems formal supply contracts were rarely set ahead of harvest in any of the regions, but there was often an understanding with local cooperatives or wholesalers that produce would be accepted from the farm at harvest.

2.3.2.1 Contracts restricting pesticides

Only three farmers in each region indicated that there were pesticide restrictions associated with supply contracts. Some of these contracts were thought by specialists to be for supply of apples for baby foods. Here specific residue tolerances were believed to apply.

2.3.2.2 Pesticides affected by restrictions

No specific pesticides were mentioned by farmers, but restrictions included all product sectors.

3.0 PESTICIDE USE

3.1 Summary of pesticide use

Regional totals and percentages by product type are shown in Table 3.1. In all regions the fungicides contributed the largest use, with insecticides/acaricides second largest. Nearly all of the crop area was treated with these product types in all three regions.

3.1.1 Herbicides

The pattern of use of these products was similar in all three regions. Treatment was predominantly along the row of the trees with the inter-row areas normally being untreated and maintained by regular mowing.

A slightly lower proportion of the orchards was treated with herbicides than with insecticides or fungicides, particularly in Trentino. Herbicide loading per hectare was substantially less than for fungicides and insecticides.

3.1.2 Fungicides

These products represented the largest volume of pesticides for all three regions. Disease control normally requires a season-long programme of sprays predominantly with protectant fungicides which have high recommended rates. The two most important diseases were *Venturia inaequalis* (scab) and *Podosphaera leucotricha* (mildew). The former was less important in Lerida than the other two regions as the climate was drier, hence the reduced fungicide load in Lerida. Conversely, *Podosphaera* was deemed to be more important in Lerida.

3.1.3 Insecticides

This category also included specific acaricides. This group of products contributed the second highest weight of pesticides per hectare for Provence Languedoc/Rhône-Alps. If spray oils are included with insecticides/acaricides then the ranking position for Lerida and Trentino would also be second. The key target pests were *Carpocapsa pomonella* (codling moth) and aphids. In Lerida, San Jose Scale was also very important. Good insect control is essential if fruit quality is to be achieved. Thus sprays are timed to coincide with pest atttacks. There were sustantial differences beween regions in the main types of product used. This will be discussed more fully in Section 3.5.

3.1.4 Spray oils

Although the main use for spray oils is for their insecticide/acaricide activity, they can also reduce some fungal attacks. Some oils are also used as adjuvants to enhance herbicide activity.

Lerida was the largest user of petroleum oil sprays, usually in combination with parathion or DNOC insecticides. These sprays were usually applied in the dormant season as they reduce the level of overwintering pests. They are predominantly used for insect/mite control, but there is some fungal activity as well. Volumes of oil are necessarily high to achieve the required effects. However, many farmers no longer use petroleum oil based products in their programmes.

3.1.5 Plant growth regulants (PGRs)

PGRs are used mainly to improve fruit skin finish, and to optimise fruit size. A higher proportion of farms used PGRs in Lerida and Trentino than in Provence/Languedoc/Rhône-Alps. Two main types of products were used, plant hormones and fruit finish products which contain sulphur. There was no clear pattern of use, although use of products to promote good skin finish is particularly important in Golden Delicious and related varieties.

3.1.6 Other pesticides

Minor use of rodenticides use was recorded on three farms in two regions. Provence/Languedoc/Rhône-Alps and Trentino.

Table 3.1 Summary of chemical use by region

Region	Provence/Languedoc/ Rhône-Alps (F)			Trentino (I)			Lerida (E)		
Area grown (ha)	862			213			676		
Chemical sector	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	
		Crop treated	Crop grown		Crop treated	Crop grown		Crop treated	Crop grown
Fungicides	98	33.20	32.57	99	27.70	27.56	96①	11.53	11.07
Herbicides	90	2.30	2.06	82	0.99	0.81	98	1.46	1.43
Insecticides/Acaricides	98	4.46	4.37	98	1.86	1.83	99	6.36	6.28
Plant growth regulators	18	8.10	1.49	64	0.31	0.20	75	0.52	0.39
Other pesticides	5	1.92	0.10	0.5	4.00	0.02	0	0	0
Spray oils	14	6.07	0.85	15	22.07	3.31	36	22.56	8.10
Total	99	*	41.44	100	*	33.73	100		27.35

* Treatments were not necessary applied to the same area of crop in each chemical sector so no total is provided in this column.

① Identified use, actual use believed close to 100%.

3.2 Variations in chemical load between farms and regions

Table 3.2 Variations in chemical load between farms and regions

Region	Provence/ Languedoc/ Rhône-Alps (F)	Trentino (I)	Lerida (E)
Number of farms	62	60	60
Chemical load kg ai/ha	Farms %		
<10	8	10	23
10<20	24	20	17
20<30	16	18	20
30<40	5	23	13
40<50	15	12	8
50<60	8	3	8
60<70	10	7	5
70<80	3	3	-
80<90	5	3	3
90<100	2	-	-
100<110	2	-	2
110<120	2	-	-
>120	2	-	-
Range kg ai/ha of crop grown	1.7 - 146.7	0.6 - 83.4	1.4 - 109.6

A large majority of farms in each region were using less than 50 kg ai/ha. The few farms in the higher categories correspond to the greater use of spray oils and/or contact fungicides.

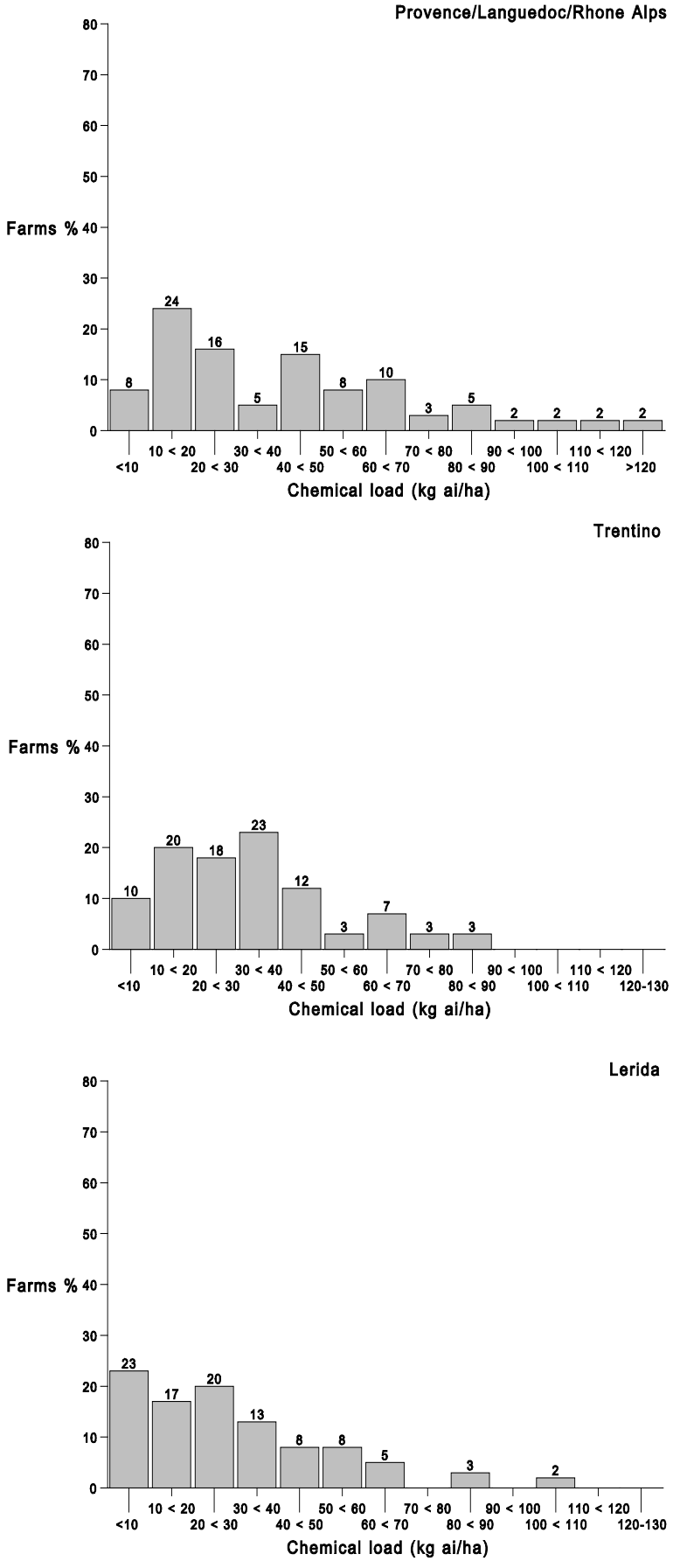


Figure 3.2 Variations in chemical load between farms and regions

4.0 WEEDS AND WEED CONTROL

4.1 Target weeds

Table 4.1 Main target weeds by region

Region	Provence/ Languedoc/ Rhône-Alps (F)	Trentino (I)	Lerida (E)
Number of farms	62	60	60
Target weeds	Farms %		
Dicotyledons			
Amaranthus spp	19	28	45
Artemisia spp	-	34	-
Cardaria draba	-	-	5
Chenopodium spp	13	21	5
*Cirsium arvensis**	55	62	-
Convolvulus spp*	76	-	7
Equisetum spp*	16	13	-
Malva spp	24	20	33
Polygonum aviculare	-	-	52
Portulaca oleracea	-	-	7
Rubia spp*	10	-	-
Rubus spp*	18	-	-
Rumex spp*	-	25	40
*Urtica dioica**	-	23	-
Monocotyledons			
*Agropyron repens**	68	-	-
*Cynodon dactylon**	5	67	73
Digitaria spp	10	-	5
Echinochloa crus-galli	19	-	-
Lolium spp*	44	-	-
Poa annua	-	11	-
*Sorghum halepense**	32	10	90

* = perennial

Most of these weeds are difficult to control and many are perennials. There were some similarities between the regions, but in general the dominant species varied.

Only *Amaranthus, Chenopodium, Malva* spp and *Sorghum halepense* had significant presence across all three regions.

4.2 Weeds claimed to be resistant to herbicides

Although some farmers cited a number of species which they believed were resistant to certain herbicides, this was refuted by the local specialists in this crop. The likely reasons for instances of poor weed control were incorrect timing, insufficient frequency of treatment, or use of reduced dose rates. Many of the weeds mentioned are known to be difficult to control. Some are perennials with underground roots or rhizomes.

4.3 Levels of weed control sought

Table 4.3 Levels of weed control sought

Region	Provence/ Languedoc/ Rhône-Alps (F)	Trentino (I)	Lerida (E)
Number of farms	62	60	60
Control sought	Farms %		
<70%	6	3	12
71-80%	16	17	12
81-90%	15	33	8
91-100%	52	43	63
Don't know	11	3	5

Responses were similar across regions, with more farmers seeking the highest level of control than any other category. Most farmers would expect broad-leaved weed control to be better than grasses.

4.4 Herbicide use by active ingredient

4.4.1 Provence/Languedoc/Rhône-Alps

Table 4.4.1 Herbicide active ingredients used in Provence/Languedoc/Rhône-Alps

Active ingredient	Activity	% of crop treated (Base: 862 ha)	No. of applications		Cumulative dose g ai/ha of crop receiving that ai		
			Range per farm	Ave per ha treated	min	max	ave
glyphosate	c	56	1 - 2	1.4	95	4,095	558
2.4-D	c	55	1 - 3	1.7	48	2,016	541
glufosinate	c	51	1 - 2	1.3	60	600	273
amitrole	sc	40	1 - 3	1.2	311	2,879	692
diuron	s	40	1 - 3	1.2	142	1,710	623
simazine	s	31	1 - 2	1.5	103	685	492
isoxaben	s	18	1 - 2	1.3	125	303	291
paraquat	c	16	1 - 3	1.7	51	679	249
ammonium thiocyanate	c	15	1 - 3	1.2	279	2,579	921
terbuthylazine	s	13	1 - 2	1.1	92	1,710	433
diquat	c	10	1 - 3	1.9	40	225	110
norflurazon	s	10	1	1.0	479	1,120	805
oryzalin	s	5	1	1.0	959	960	959
glyphosate-trimesium	c	5	1 - 2	1.7	384	1,200	866
atrazine	s	1	1 - 2	1.7	800	1,600	945
oil adjuvant	adj	15	1 - 2	1.1	234	1,511	745

Key to abbreviations:

c = contact post-emergence s = soil acting residual adj = adjuvant

4.4.2 Trentino

Table 4.4.2 Herbicide active ingredients used in Trentino

Active ingredient	Activity	% of crop treated (Base: 213 ha)	No. of applications		Cumulative dose g ai/ha of crop receiving that ai		
			Range per farm	Ave per ha treated	min	max	ave
glyphosate	c	63	1 - 3	1.9	30	2,001	775
MCPA	c	24	1 - 3	2.1	25	1,125	499
glufosinate	c	22	1 - 3	1.3	35	855	244
paraquat	c	9	1	1.0	35	240	158
dicamba	c	6	2	2.0	78	78	78
diquat	c	6	1	1.0	17	64	61
propyzamide	s	6	1 - 2	1.9	150	1,000	886
simazine	s	6	1	1.0	570	570	570
glyphosate-trimesium	c	4	2	2.0	736	736	736

Key to abbreviations:

c = contact post-emergence s = soil acting residual

4.4.3 Lerida

Table 4.4.3 Herbicide active ingredients used in Lerida

Active ingredient	Activity	% of crop treated (Base: 676 ha)	No. of applications		Cumulative dose g ai/ha of crop receiving that ai		
			Range per farm	Ave per ha treated	min	max	ave
glyphosate	c	72	1 - 5	2.4	126	5,039	696
MCPA	c	50	1 - 5	2.7	90	2,160	565
glufosinate	c	39	1 - 6	2.7	59	1,274	421
diquat	c	30	1 - 7	2.6	80	1,440	461
fluazifop-b	c	20	2	2.0	75	250	239
pendimethalin	s	17	1 - 2	1.4	164	1,517	412
simazine	s	16	1 - 3	1.5	400	3,000	760
paraquat	c	15	1 - 5	3.1	159	2,700	474
quinclorac	sc	3	1 - 2	1.1	335	2,592	855
fluroxypyr	c	2	3	3.0	180	180	180
cycloxydim	c	1	1	1.0	170	170	170
sethoxydim	c	1	2	2.0	279	279	279

Key to abbreviations:

c = contact post-emergence s = soil acting residual

Comparisons between regions

Glyphosate, a non-selective, non-residual, contact/post-emergence translocated herbicide was the most important product for weed control in apple orchards in all three areas. It is particularly effective against perennial weeds due to downwards translocation towards the root system.

There has been a move away from residual soil-acting products, such as simazine and diuron, in recent years. This change was most apparent in Trentino. However, several farmers in Lerida and Provence/Languedoc/Rhône-Alps still used substantial quantities of residual herbicides.

4.5 Herbicide use parameters

The following tables provide certain comparative summarised parameters.

Table 4.5.1 Herbicide applications

On farms using herbicides	Provence/ Languedoc/ Rhône-Alps (F)	Trentino (I)	Lerida (E)
Number of active ingredients used per farm	4.0	1.7	3.3
Number of active ingredients used per hectare	3.8	1.5	2.7
Number of product applications per hectare	1.3	2.1	6.0
Proportion of farmers spraying parts of their crop	13%	4%	22%
Average volume of active ingredients per hectare of crop treated (kg ai/ha)	2.30	0.99	1.46

Table 4.5.2 Herbicide placement

Region	Provence/ Languedoc/ Rhône-Alps (F)	Trentino (I)	Lerida (E)
Number of farms	62	60	60
Form of placement	Farms %		
Along the rows	73	80	97
Overall	5	-	3
Between rows	5	10	-
Spot treatment	2	3	-
None	16	10	-

Review of the parameters presented in Tables 4.5.1 and 4.5.2 broadly shows the following.

The number of active ingredients used per farm was greater in the French region due to their habit of using more soil-acting herbicides as well as the contact chemicals.

Product applications were highest in Lerida, however, the practice of only spraying parts of the orchards was also most developed there.

Herbicide placement shows that the habit of treating along the rows rather than spraying overall was widely practised and most used in Lerida. Herbicide placement was taken into account when determining herbicide doses.

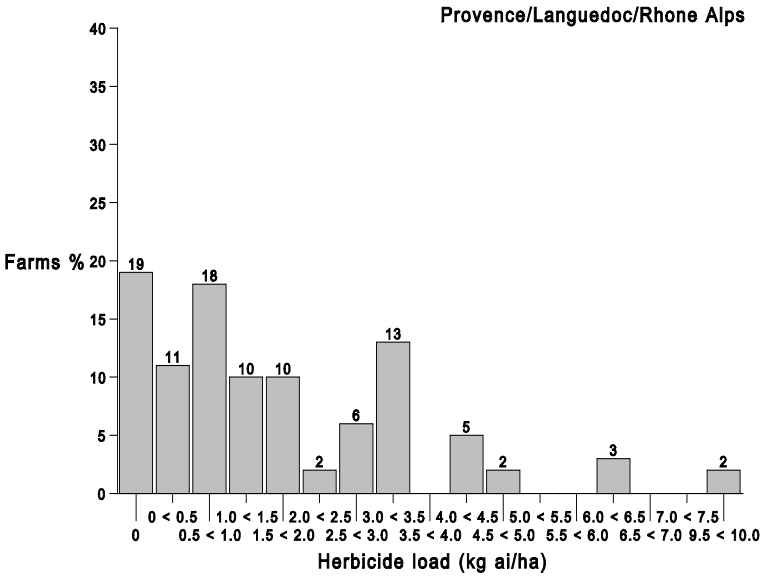
4.6 Herbicide load per farm

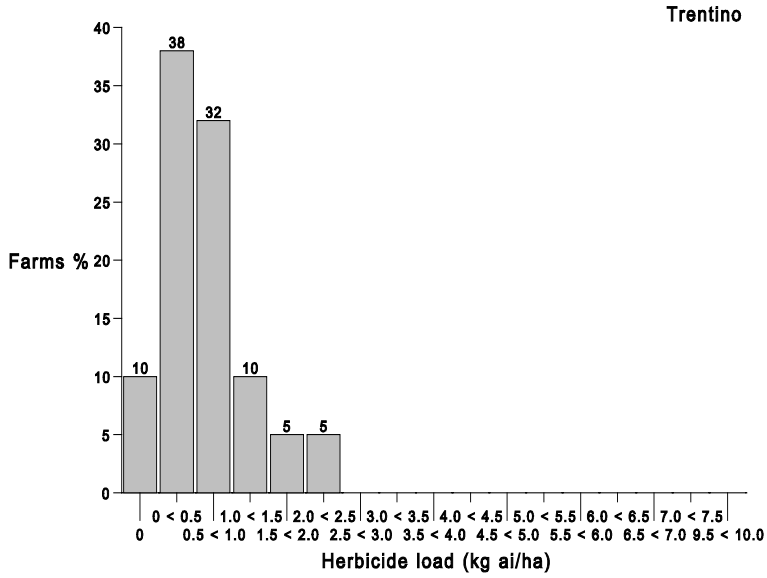
Table 4.6 Herbicide load by farm

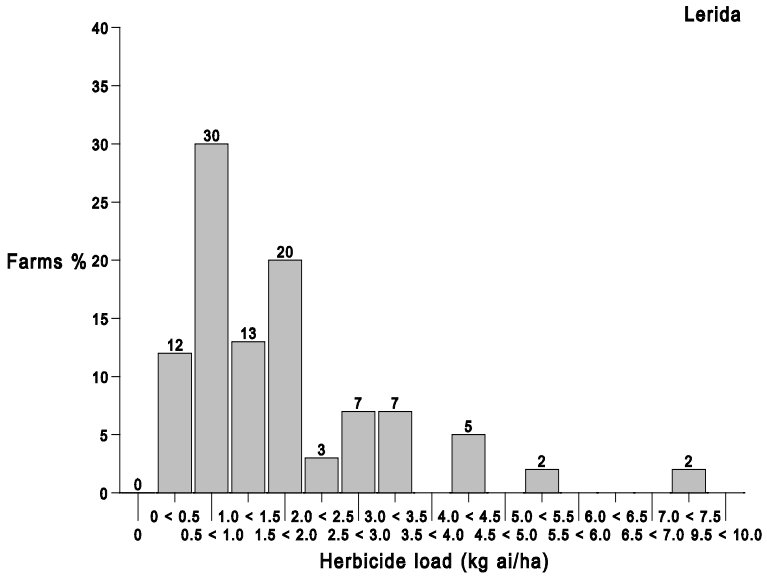
On farms using herbicides	Provence/ Languedoc/ Rhône-Alps (F)	Trentino (I)	Lerida (E)
Number of farms	62	60	60
Herbicide load kg ai /ha	Farms %		
0	19	10	0
0<0.5	11	38	12
0.5<1.0	18	32	30
1.0<1.5	10	10	13
1.5<2.0	10	5	20
2.0<2.5	2	5	3
2.5<3.0	6	-	7
3.0<3.5	13	-	7
3.5<4.0	-	-	-
4.0<4.5	5	-	5
4.5<5.0	2	-	-
5.0<5.5	-	-	2
5.5<6.0	-	-	-
6.0<6.5	3	-	-
6.5<7.0	-	-	-
7.0<7.5	-	-	2
9.5<10.0	2		
Range kg ai/ha crop grown	(0) 0.04 - 9.6	(0) 0.05 - 2.5	0.1 - 7.2

The slightly higher loading in some Provence/Languedoc/Rhône-Alps crops was due to the wider use of higher dose residual herbicides. Spray oils were also used on some farms in this region to enhance the performance of certain foliar applied graminicides. These quantities were also included in the spray oils total for that region in Table 3.1.

Chart 4.6 Variation in herbicide load by farm across regions







4.7 Mechanical weed control

Mechanical weed control was rarely practised in any region. The only type of mechanical activity was the mowing of the grass between tree rows, normally three to four times per year in most cases.

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	Provence/ Languedoc/ Rhône-Alps (F)	Trentino (I)	Lerida (E)
Number of farms	62	60	60
	Farms %		
Greater quantity	23	45	57
Lesser quantity	76	42	42
No reply	1	13	1

In Trentino and Lerida, farmers'opinions were almost evenly divided on use of herbicides compared with an average year. In Provence/Languedoc/Rhône-Alps most farmers believed they had used less in 1994 than in an average year.

4.9 Opportunities to reduce herbicide load

4.9.1 Comments from the regions

Most farmers in all regions only treated with herbicides within the tree row, so that about 25-30% of the surface area received chemicals. The rest was mown to keep vegetation down. Some spot application of difficult weeds was also carried out occasionally.

In recent years there has been a clear move away from higher dose residual herbicides, such as simazine, to post-emergence products such as glyphosate and glufosinate. This trend is likely to continue.

4.9.2 Further suggestions

A few farmers still carry out overall herbicide treatment, so have the opportunity for some reduction. Levels of control achieved within the tree row may be greater than is necessary to reduce crop competition, and may be somewhat 'cosmetic'. Selective treatment of orchard areas, maximised in Lerida at 22%, could probably be extended through judicious targeting.

The use of adjuvants and oils to enhance the performance of some post-emergence products is practised by some farmers, but could be extended in order to reduce chemical pesticide load.

5.0 DISEASES AND FUNGICIDES

5.1 Target diseases

Table 5.1 Target diseases

Region	Provence/ Languedoc/ Rhône-Alps (F)	Trentino (I)	Lerida (E)
Number of farms	62	60	60
Target diseases	Farms %		
Venturia inaequalis (scab, tavelure)	61	85	68
Podosphaera leucotricha (powdery mildew, oidium)	23	53	82
Fruit diseases	2	12	15
Don't know/no reply	14	2	5

Clearly *Venturia* was seen to be more important in Trentino. Specialists there indicated that this disease had increased in recent years, and indeed this region may be wetter than the others. It was also the most important disease in Provence/Languedoc/Rhône-Alps. Although *Venturia* was ranked high in Lerida, farmers believed *Podosphaera* to be more important. This is a drier region.

Specialists in Provence/Languedoc/Rhône-Alps said that *Podosphaera* infection was lower than normal in 1994. Specialists in Trentino felt that farmers over-estimated the importance of *Podosphaera.*

5.2 Diseases claimed to be resistant to fungicides

Some farmers in all three regions claimed experience with disease resistance to fungicides, mostly with *Venturia,* but farmers in Lerida also cited *Podosphaera*. Products mentioned included the ergosterol biosynthesis fungicides such as triazoles. Resistance to these types of fungicides is well documented by scientists, particularly for *Venturia*, but also for powdery mildew diseases such as *Podosphaera*.

Some farmers claimed resistance in *Venturia* to some broad-spectrum protectant fungicides such as the dithiocarbamates. There is no scientific evidence for this, and any poor control of disease is more likely to be due to non-optimum application methods or timing.

5.3 Levels of disease control sought

Table 5.3 Levels of disease control sought by farmers

Region	Provence/ Languedoc/ Rhône-Alps (F)	Trentino (I)	Lerida (E)
Number of farms	62	60	60
Control sought	Farms %		
<70%	-	-	2
71-80%	-	7	-
81-90%	3	30	8
91-100%	92	60	85
Don't know	5	3	5

Farmers in all regions hoped to achieve very high levels of disease control. The slightly lower figures for Trentino were refuted by local experts who considered farmers sought higher levels, but might be persuaded to accept less if fruit quality and finish were not directly threatened. Specialists indicated that high levels of control are necessary at the beginning of the season against primary infections so that the diseases, particularly *Venturia*, do not get a strong hold on the orchard.

5.4 Fungicide use by active ingredient

5.4.1 Provence/Languedoc/Rhône-Alps

Table 5.4.1 Fungicide active ingredients used in Provence/Languedoc /Rhône-Alps

Active ingredient	Activity	% of crop treated (Base: 862 ha)	No. of applications		Cumulative dose g ai/ha of crop receiving that ai		
			Range per farm	Ave per ha treated	min	max	ave
mancozeb	c/*Ven*	71	1 - 12	6.5	560	90,960	11,401
captan	c/*Ven*	52	1 - 10	4.4	474	44,820	6,914
sulphur	c/*Pod*	46	1 - 12	7.7	3,000	90,239	41,825
thiram	c/*Ven*	32	1 - 7	2.1	2,000	44,631	5,187
triadimefon	s/b	25	2 - 10	7.4	150	850	536
dithianon	c/*Ven*	20	1 - 5	2.4	187	6,750	1,788
copper products	c/b	17	1 - 7	1.6	120	35,000	3,814
cyproconazole	s/b	12	1 - 3	1.5	12	35	18
tolyfluanid	s/b	11	1 - 5	1.2	750	3,000	1,059
dichlofluanid	c/b	10	1 - 4	1.1	750	3,000	945
flusilazole	s/b	9	2 - 6	4.5	60	261	102
difenoconazole	s/b	8	1 - 5	2.1	37	250	137
pyrifenox	s/b	7	1 - 3	2.0	4	500	132
hexaconazole	s/b	7	2 - 6	2.6	25	90	52
nuarimol	s/b	5	1 - 5	1.2	6	18	17
penconazole	s/b	4	1 - 6	3.6	25	150	57
fenarimol	s/b	3	2 - 3	2.3	79	119	89
carbendazim	s/b	1.0	2 - 3	2.4	899	1,000	955
DNOC	c/b	1.4	1 - 2	1.5	50	644	248
myclobutanil	s/*Pod+Ven*	0.8	1	1.0	44	44	44
bupirimate	s/*Pod*	0.6	1	1.0	30	375	167
iprodione	c/b	0.5	2	2.0	1,500	1,500	1,500
thiophanate-m	s/b	0.5	2	2.0	1,350	1,350	1,350
triforine	s/*Pod+Ven*	0.5	2	2.0	665	665	665
ziram	c/b	0.5	1	1.0	2,160	2,160	2,160
dinocap	c/*Pod*	0.2	3	3.0	2,519	2,519	2,519
fosetyl-al	s/b	0.2	2	2.0	5,280	5,280	5,280
petroleum oil	c/b	5	1	1.0	720	23,750	7,150

Key to abbreviations: c = contact; s = systemic; b = broad spectrum; *Pod* = *Podosphaera*; *Ven* = *Venturia* (primary target)

5.4.2 Trentino

Table 5.4.2 Fungicide active ingredients used in Trentino

Active ingredient	Activity	% of crop treated (Base: 213 ha)	No. of applications		Cumulative dose g ai/ha of crop receiving that ai		
			Range per farm	Ave per ha treated	min	max	ave
metiram	c/*Ven*	70	1 - 15	5.1	1,281	38,448	10,756
dithianon	c/*Ven*	59	1 - 10	4.6	691	10,368	3,741
captan	c/*Ven*	55	2 - 8	3.3	375	9,172	3,292
dodine	c/*Ven*	48	1 - 4	2.7	389	5,250	2,661
mancozeb	c/*Ven*	47	1 - 12	5.4	575	34,560	10,162
ziram	c/*Ven*	38	1 - 10	3.9	774	23,219	8,998
penconazole	s/b	38	1 - 10	4.2	54	1,175	458
hexaconazole	s/b	37	1 - 6	3.1	7	261	88
sulphur	c/*Pod*	35	1 - 15	7.4	1,200	31,199	13,631
myclobutanil	s/b	35	1 - 8	4.7	15	714	359
copper oxychloride	c/b	22	1 - 7	1.3	299	35,000	4,132
bitertanol	s/b	19	1 - 7	4.1	209	2,100	1,217
benomyl	s/b	10	1 - 3	1.4	240	899	479
flusilazole	s/b	6	4	4.0	432	432	432
carbendazim	s/b	5	1 - 2	1.5	479	599	545
zineb	c/*Ven*	3	2	2.0	2,099	2,099	2,099
vinclozolin	s/b	2	3	3.0	1,500	1,500	1,500
fenarimol	s/b	1	2 - 13	5.7	83	467	211
nuarimol	s/b	1	2	2.0	115	143	129
thiram	c/*Ven*	1	3	3.0	7,500	7,500	7,500

Key to abbreviations:

c = contact
s = systemic
b = broad spectrum
Pod = *Podosphaera*
Ven = *Venturia* (primary target)

5.4.3 Lerida

Table 5.4.3 Fungicide active ingredients used in Lerida

Active ingredient	Activity	% of crop treated (Base: 676 ha)	No. of applications		Cumulative dose g ai/ha of crop receiving that ai		
			Range per farm	Ave per ha treated	min	max	ave
captan	c/*Ven*	65	1 - 8	4.0	750	12,600	5,734
triadimenol	s/b	61	1 - 4	1.6	49	800	346
pyrifenox	s/b	50	1 - 6	2.2	19	475	160
ziram	c/*Ven*	39	1 - 8	1.7	899	16,200	6,773
thiram	c/*Ven*	29	1 - 8	2.9	800	18,000	4,483
cyproconazol	s/b	26	1 - 4	1.2	4	70	27
e	c/*Pod*	17	2 - 7	3.8	4,000	42,000	14,325
sulphur	s/b	15	1 - 5	2.4	115	1,562	638
carbendazim	s/b	15	1 - 4	2.2	12	1,200	130
flusilazole	s/b	14	1 - 6	1.7	43	234	124
myclobutanil	s/*Ven*	9	1 - 2	1.4	125	700	333
bitertanol	s/b	8	1 - 3	1.9	14	59	46
hexaconazole	s/b	7	1 - 4	2.4	29	120	75
fenarimol	c/b	6	1 - 3	1.1	1,125	1,312	1,138
chlorothalonil	s/b	6	1 - 3	1.8	35	187	72
diniconazole	s/b	5	2 - 3	2.5	1,620	3,037	2,260
thiophanate-m	c/*Ven*	3	2 - 3	2.3	2,799	6,000	3,773
mancozeb	c/b	3	3	3.0	6,750	6,750	6,750
copper	s/b	3	1 - 3	2.3	59	299	200
difenconazole	s/b	3	1	1.0	337	337	337
triadimefon	s/*Pod*	2.4	1	1.0	5	5	5
nuarimol	s/b	2.1	1 - 5	3.1	375	2,343	1,352
benomyl	s/*Pod*	1.8	1 - 3	2.3	125	300	241
bupirimate	s/*Ven*	1.3	2	2.0	921	4,000	3,657
maneb	s/b	0.7	1 - 4	2.2	75	219	137
penconazole							

Key to abbreviations:

c = contact
s = systemic
b = broad spectrum
Pod = *Podosphaera*
Ven = *Venturia* (primary target)

5.4.4 Fungicide active ingredients used - general commentary

The most commonly used contact/protectant fungicides for *Venturia* control were the dithiocarbamates and captan. There were regional differences as to which specific dithiocarbamate dominated. Mancozeb was important in Provence/Languedoc/Rhône-Alps but metiram was used most in Trentino. Captan was the most widely used active ingredient in Lerida. Dithianon and dodine, which are relatively low dose contact fungicides, were very widely used against *Venturia* in Trentino.

The main contact/protectant fungicide for *Podosphaera* was sulphur. It was used in all regions but to a greater extent in Provence/Languedoc/Rhône-Alps. Dose rates for this active ingredient are higher than for most other fungicides.

Use of systemic fungicides varied between farms within regions. Although these are lower dose products than the protectants, for resistance management reasons, growers should not rely on them alone for disease control. Lerida was a large user of this type of product, because their activity includes good control of *Podosphaera*, the most highly cited disease.

5.5 Fungicide use parameters

The following tables contain comparative summarised parameters.

Table 5.5.1 Fungicide applications

On farms using fungicides	Provence/ Languedoc/ Rhône-Alps (F)	Trentino (I)	Lerida (E)
Number of active ingredients used per farm Number of active ingredients used per hectare Number of product applications per hectare Proportion of farmers spraying parts of their crop	4.2 3.5 13 16%	5.3 5.5 21 3.4%	4.5 3.9 11 14%
Average volume of active ingredients per hectare of crop treated (kg ai/ha)	33.20	27.70	11.53

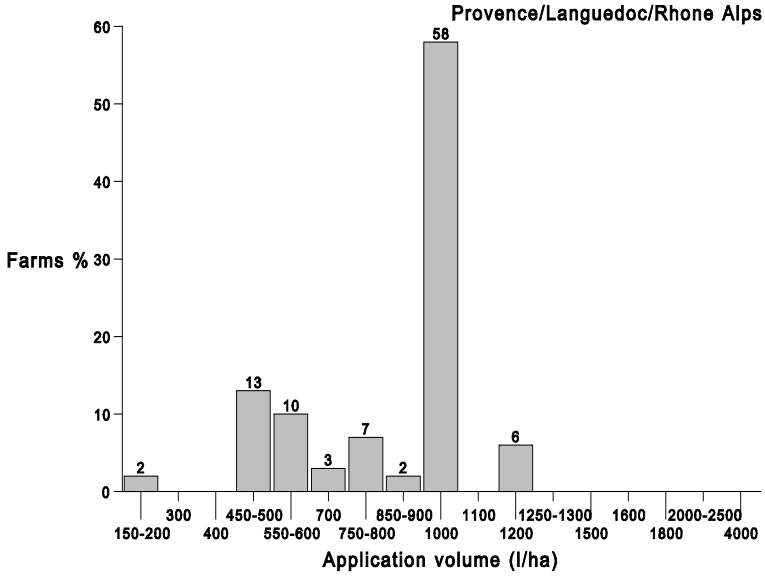
The number of active ingredients used may be seen relative to the chemical load in Table 5.5.1. The French region is the heaviest due to substantial use of the high dose contact fungicides such as mancozeb, captan and sulphur. Against this, however, they appeared to target their crops more than in Trentino and similarly to Lerida. This latter aspect is no doubt linked to crop size per farm.

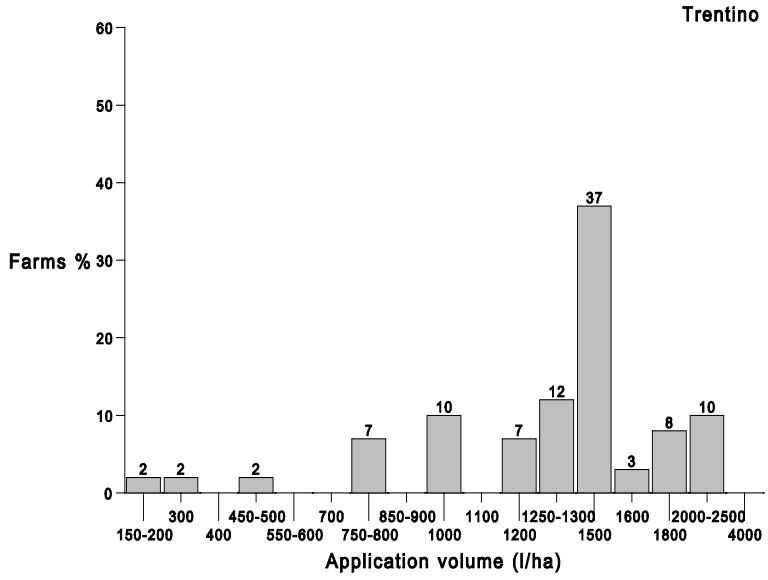
Table 5.5.2 Application volumes

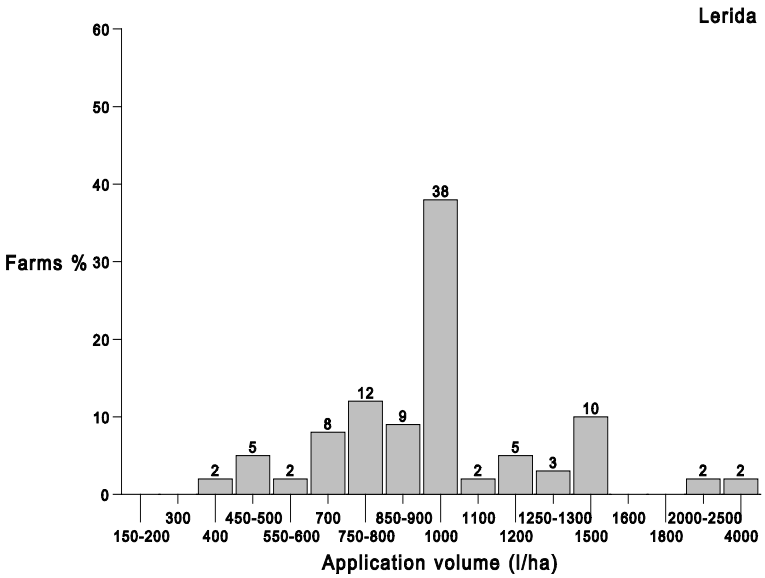
Region	Provence/ Languedoc/ Rhône-Alps (F)	Trentino (I)	Lerida (F)
Number of farms	62	60	60
Average application volume l/ha	Farms %		
150 - 200	2	2	-
300	-	2	-
400	-	-	2
450 - 500	13	2	5
550 - 600	10	-	2
700	3	-	8
750 - 800	7	7	12
850 - 900	2	-	9
1,000	58	10	38
1,100	-	-	2
1,200	6	7	5
1,250 - 1,300	-	12	3
1,500	-	37	10
1,600	-	3	-
1,800	-	8	-
2,000 - 2,500	-	10	2
4,000	-	-	2

Application volumes increase through the season as leaf canopy develops. However these figures represent the average used for fungicides during the season. Variation between farms is substantial and will relate in some cases to the form of tree planting (size, number etc). However, given that dose rates are given in concentrations per volume of spray, eventual dose rates per hectare will vary as a consequence of spray volume. It is suspected also that spray run off will occur at some of the heavier volumes applied (Trentino) hence unnecessary use of chemical.

Chart 5.5.2
Application volumes



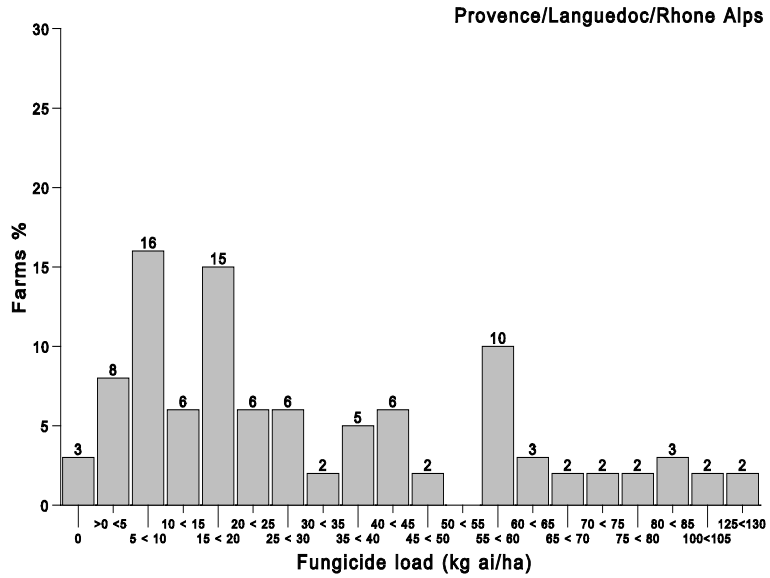


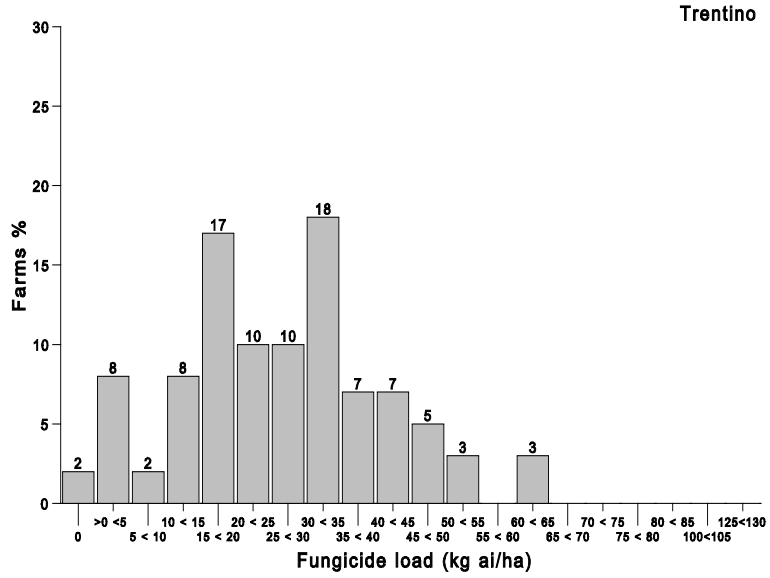


5.6 Fungicide load per farm

Table 5.6 Fungicide load by farm

Region	Provence/ Languedoc/ Rhône-Alps (F)	Trentino (I)	Lerida (E)
Number of farms	62	60	60
Fungicide load kg ai /ha	Farms %		
0	3	2	3
>0<5	8	8	25
5<10	16	2	30
10<15	6	8	17
15<20	15	17	7
20<25	6	10	8
25<30	6	10	2
30<35	2	18	2
35<40	5	7	2
40<45	6	7	3
45<50	2	5	2
50<55	-	3	-
55<60	10	-	-
60<65	3	3	-
65<70	2	-	-
70<75	2	-	-
75<80	2	-	-
80<85	3	-	-
100<105	2	-	-
125<130	2	-	-
Range kg ai/ha of crop grown	(0) 1.3 - 125.2	(0) 0.1 - 62.0	(0) 0.3 - 42.9





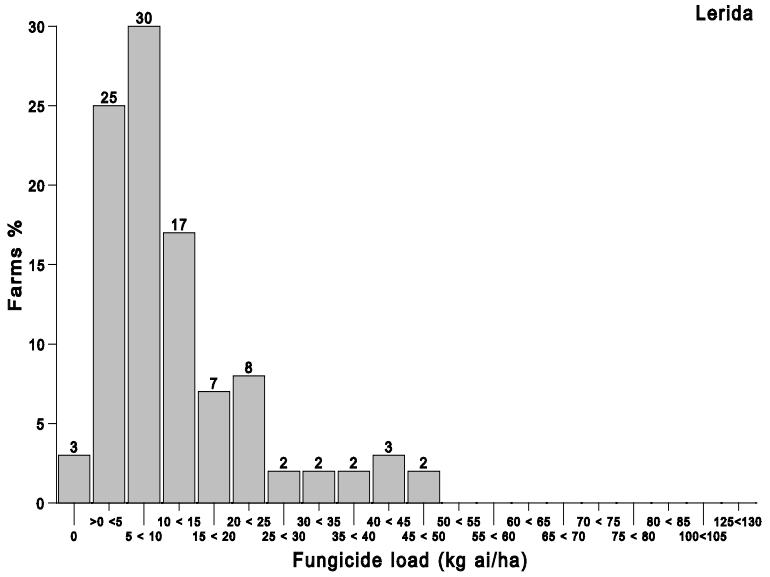


Chart 5.6 Variation in fungicide load by farm across regions

Many farmers in Provence/Languedoc/Rhône-Alps used high quantities of sulphur for control of *Podosphaera* and also to improve fruit finish. Sulphur was used in the other regions, but to a lesser degree.

As noted earlier, the French region also used the high dose contact fungicides widely as did Trentino.

The Lerida region, however, showed less frequent use of the contact products used primarily for *Venturia* because of lower pressure from this disease compared with the other two regions. Where *Podosphaera* was the more important disease, farmers in the Lerida region resorted more to systemic chemicals for its control.

5.7 Fungicide 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	Provence/ Languedoc/ Rhône-Alps (F)	Trentino (I)	Lerida (E)
Number of farms	62	60	60
Fungicide use	Farms %		
Greater quantity	24	17	12
Lesser quantity	6	22	13
Same quantity	65	60	70
No reply	5	2	5

Most farmers used the same quantity of fungicides in 1994 compared with an average year.

5.8 Factors determining the start of fungicide application

The factors that farmers claimed to use to determine fungicide application are presented in Table 5.8.

Many farmers in all regions were not really clear on which factors were considered before starting spraying for diseases.

Warning systems for determining spray timing for *Venturia inaequalis* are well established as part of IPM or ICM programmes. These systems are based on a

combination of plant stage, weather conditions and leaf surface moisture. Specialists advised that there were no warning systems *per se* for *Podosphaera leucotricha,* but the farmers may be advised when to spray by advisors.
Many farmers who do not use the full warning system for *Venturia* appear to make the decision to commence spraying based on a combination of the other factors. This seemed particularly the case in the Provence/Languedoc/Rhône-Alps region.

It is noted that calendar date spraying is not a major feature in spray timing in Trentino, which is the most IPM/ICM conscious region of the three. Here much greater use of the warning system was made.

Greater use of warning systems does seem possible for some farmers, particularly those in the Provence/Languedoc/Rhône-Alps region.

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

Factor	Calendar dates			Plant stage			Disease stage			Weather conditions			Warning system			Don't know			Don't have disease		
Region Factor	Pro	Tre	Ler	Pro	Tre	Ler	Pro	Tre	Ler	Pro	Tre	Ler	Pro	Tre	Ler	Pro	Tre	Ler	Pro	Tre	Ler
Podosphaera Powdery mildew	55	3	43	26	12	28	10	12	23	40	33	40	21	43	53	-	2	-	-	35	2
Venturia Scab	45	3	35	26	25	15	13	27	17	48	60	45	27	65	55	-	2	-	-	8	15
Fruit diseases	34	2	17	13	-	12	8	2	8	18	3	10	29	8	15	5	-	5	13	83	65
Other	10	-		3	-		2	-		3	-		11	-	15	13	-	-	24	-	-

Regions: Pro = Provence/Languedoc/Rhône-Alps (F)
Tre = Trentino (I)
Ler = Lerida (E)

5.9 Opportunities to reduce fungicide load

5.9.1 Comments by region

With present products, specialists from all three regions felt there was little scope for substantial further reductions in the use of fungicides in apple growing. Most of the protectant non-systemic fungicides are high dose rate products and require frequent applications to protect the foliage and fruit during the growing season.

5.9.2 Further suggestions

Despite the specialists comments there may be opportunity to reduce the number of protectant *Venturia* sprays applied on some farms if warning systems were more fully utilised. This probably applies more to Provence/Languedoc/Rhône-Alps than the other regions.

There was more use of the contact fungicide dithianon for *Venturia* control in Trentino than in Provence/Languedoc/Rhône-Alps and no use recorded in Lerida. Similarly another *Venturia* product dodine, was only recorded in Trentino. Both products have lower recommend rates than dithiocarbamates and captan. Dithianon tends to be used in the early part of the season, but is more expensive. Similarly captan has slightly lower dose rates than the dithiocarbamates.

Sulphur is a high dose product but there is no real protectant fungicide alternative for *Podosphaera* control. Many lower dose systemic products such as the ergosterol biosynthesis inhibitors (EBI's), which include triazoles, do control *Podosphaera* and *Venturia* well, but their sole use for these diseases is not good resistance management strategy.

Many newer EBI's, such as later triazoles, have even lower dose rates than earlier ones and as they become further established slight reduction of fungicide load will be possible.

Attention to optimising application volumes could also be of benefit in reducing any unnecessary use of fungicides that might occur.

6.0 INSECTS, MITES, INSECTICIDES AND ACARICIDES

6.1 Target pests

Table 6.1 Main target pests by region

Region	Provence/Languedoc /Rhône-Alps (F)			Trentino (I)			Lerida (E)		
Pests	Farms %	No. of generations		Farms %	No. of generations		Farms %	No. of generations	
	(Base 62)	Range	Av	(Base 60)	Range	Av	(Base 60)	Range	Av
Aphids									
Dysaphis plantaginea	79	1 - 3	1.63	90	1 - 3	1.61	82	1 - 6	2.67
Aphis pomi	53	1 - 5	1.97	67	1 - 5	2.16	88	1 - 12	3.06
Eriosoma lanigerum	35	1 - 2	1.24	48	1 - 4	1.39	57	1 - 4	1.80
San Jose scale									
Quadraspidiotus perniciosus	10	1 - 3	2.00	2	2	2.00	82	1 - 5	2.59
Mites	73	1 - 3	2.07	52	1 - 7	3.30	75	1 - 7	3.21
Panonychus ulmi etc									
Codling moth	100	1 - 10	3.33	80	1 - 4	2.02	77	1 - 9	2.54
Carpocapsa pomonella									
Leaf blister moth	-	-	-	13	1 - 4	1.63	55	1 - 3	1.87
Leucoptera scitella									
Apple clearwing moth	10	1 - 6	2.67	25	1 - 2	1.20	57	1 - 6	2.10
Synathedon myopiformis	13	1 - 6	3.25	67	1 - 4	1.89	45	1 - 4	2.56
Tortrix moths various									
Apple weevil	2	1	1	2	1	1.00	-	-	-
Anthonomous pomorum									
Med fruit fly	2	1	1	-	-	-	43	1 - 3	1.73
Ceratitis capitata									
Ermine moth	-	-	-	-	-	-	-	-	-
Hyponomeuta padellus									
Lepoard moth	37	1 - 6	2.00	-	-	-	3	1 - 3	1.50
Zeuzera pyrina									
Psylla	8	2	2.00	2	4	4.00	3	3	3.00
Psylla spp	6	1 - 6	3.00	-	-	-	-	-	-
Leaf miners various									
Green leaf hopper	-	-	-	2	n/a	n/a	-	-	-
Empoasca decipiens									
Goat moth	-	-	-	-	-	-	2	6	6.00
Cossus cossus									

The above table shows the relative importance of the pests in the eyes of the farmers. Specialists generally agreed on the importance of *Carpocapsa* and *Dysaphis. Aphis pomi* was believed to be less important in Trentino than some farmers thought. A number of insects were more prevalent in Lerida than in the other two regions.

6.2 Insects exhibiting resistance

About half of the farmers in each region believed there was pest resistance to some products, and most species were cited. Specialists in each region agreed that there were some resistance problems, but the phenomenon may not be as widespread as farmers indicated.

Mite resistance to several products such as clofentezine, hexathiazox and organo-phosphates were recognised particularly in the French region, and the official recommendation is to alternate the use of acaricides to avoid build up of resistance to the different acaricide groups.

Cases of resistance in *Carpocapsa* to insect growth regulators are also well documented in the French region and Trentino. There are also reports of resistance to pyrethroids and organophosphates with this pest.

Aphid resistance was seen to be a problem in Lerida, dimethoate being cited. There was also a decline in efficacy in controlling *Dysaphis* in Trentino with some of the older insecticides, but local specialists could not confirm whether this was true resistance.

6.3 Levels of pest control sought

Table 6.3 Levels of pest control sought

Region	Provence/ Languedoc/ Rhône-Alps (F)	Trentino (I)	Lerida (E)
Number of farms	62	60	60
Control sought	Farms %		
71-80%	2	7	4
81-90%	12	35	10
91-100%	84	50	85
Don’t know	2	8	1

This demonstrates that farmers expected a high degree of pest control in apples. The slightly lower figures for Trentino may take into account the importance of IPM in that region. However, although they may accept lower control for mites and *Aphis*, local specialists believed farmers in Trentino would expect full control of the most damaging pests such as *Dysaphis* and *Carpocapsa.*

6.4 Insecticide and acaricide use

6.4.1 Provence/Languedoc/Rhône-Alps

Table 6.4.1 Insecticide and acaricide use by active ingredient in Provence/ Languedoc/Rhône-Alps

Active ingredient	Activity	% of crop treated (Base: 862 ha)	No. of applications		Cumulative dose g ai/ha of crop receiving that ai		
			Range per farm	Ave per ha treated	min	max	ave
chlorpyrifos-e	cif/b	72	1 - 5	2.3	208	2,362	945
azinphos-methyl	ci/b	62	1 - 5	2.3	299	3,125	1,029
deltamethrin	ci/b	56	1 - 10	3.6	3	175	58
dimethoate	ci/b	56	1 - 5	3.1	166	2,087	1,076
fenoxycarb	ci/igr	46	1 - 5	1.9	37	900	239
vamidothion	s/aph	40	1 - 2	1.1	250	1,728	565
cyfluthrin	ci/b	37	1 - 6	2.4	14	899	98
lambda-cyhalothrin	ci/b	35	1 - 3	1.3	<1	90	20
tau-fluvalinate	ci/b	31	1 - 6	1.6	71	576	204
bifenthrin	ci/b	27	1 - 5	1.4	14	300	49
tebufenpyrad	aca	26	1 - 2	1.1	50	800	136
pyridaben	c/aph-aca	25	1	1.0	144	239	155
omethoate	s/b	24	1 - 4	1.2	625	2,500	812
demeton-s-methyl	c/aph-aca	21	2 - 4	2.7	90	600	409
propargite	c/aca	18	1 - 2	1.1	569	3,000	1,643
parathion-methyl	cif/b	16	1 - 3	1.6	100	1,080	526
carbaryl	ci/b	16	1 - 3	2.1	382	2,039	1,167
beta-cyfluthrin	ci/b	11	1 - 7	1.5	2	52	8
oxydemeton-m	cs/b	11	1 - 2	1.2	59	399	189
phosalone	ci/b	10	1 - 6	2.0	599	5,099	1,661
phosphamidon	s/aph	8	1 - 4	1.7	251	1,600	513
imidacloprid	s/aph	7	1 - 2	1.1	19	839	102
fenitrothion	c/b	3	2 - 1	2.0	500	5,000	3,192
cyhexatin	c/aca	4	1 - 3	2.2	125	750	538
fenvalerate	ci/b	4	2 - 3	2.2	150	1,000	862
phosmet	c/b	3.9	2 - 3	3.7	1,000	4,500	2,355
fenazaquin	c/aca	3	1	1.0	20	150	112
Trichogramma	bio	2.8	2 - 3	2.8	4,000	6,000	5,666
hexythiazox	ci/aca	2.1	1	1.0	50	50	50
parathion-ethyl	ci/b	2.1	1	1.0	239	1,350	1,226
methomyl	ci/b	2.0	1 - 5	2.4	740	2,500	1,361
methidathion	ci/b	1.5	1 - 4	1.8	694	1,852	973
methamidophos	s/b	1.4	2	2.0	767	1,119	1,031
amitraz	ci/b	1.3	1 - 2	1.7	800	1,600	945
diflubenzuron	i/igr	1.3	1	1.0	100	100	100
naled	ci/b	1.2	1	1.0	95	2,400	1,017

continued/

Table 6.4.1 Insecticide and acaricide use by active ingredient in Provence/Languedoc/Rhône-Alps (continued)

Active ingredient	Activity	% of crop treated (Base: 862 ha)	No. of applications		Cumulative dose g ai/ha of crop receiving that ai		
			Range	Ave	min	max	ave
fenpropathrin	ci/b	1.0	5	5.0	839	839	839
endosulfan	ci/b	0.9	1 - 2	1.6	839	1,225	1,080
pirimicarb	s/aph	0.9	1 - 2	1.3	16	100	37
teflubenzuron	i/igr	0.8	1 - 2	1.6	54	90	74
Bacillus thuringiensis	bio	0.7	5	5.0	225	225	225
dichlorvos	cif/b	0.7	1	1.0	1,800	1,800	1,800
tebufenozide	i/igr	0.3	1	1.0	230	230	230
DNOC	ci/b	0.3	1	1.0	1,000	1,000	1,000
dicofol	c/aca	0.2	1	1.0	252	252	252
petroleum oil	c/b	3	1	1.0	649	28,500	10,516

Key to abbreviations:

c = contact
f = fumigant
i = ingestion
s = systemic

b = broad spectrum
aca = acaricide
aph = aphicide
igr = insect growth regulator
bio = biological pesticide

6.4.2 Trentino

Table 6.4.2 Insecticide and Acaricide use by active ingredient in Trentino

Active ingredient	Activity	% of crop treated (Base: 213 ha)	No. of applications		Cumulative dose g ai/ha of crop receiving that ai		
			Range per farm	Ave per ha treated	min	max	ave
vamidothion	s/aph	62	1 - 2	1.1	140	1,875	749
pirimicarb	sf/aph	53	1 - 4	1.1	104	2,099	533
diflubenzuron	ci/igr	39	1 - 3	1.8	37	600	287
ethiofencarb	s/aph	22	1 - 2	1.1	165	1,766	713
hexythiazox	c/aca	22	1 - 2	1.0	35	100	68
teflubenzuron	ci/igr	22	1 - 2	1.2	16	217	93
methidathion	b/ci	19	1	1.0	684	712	693
chorpyrifos-	b/cif	18	1 - 2	1.0	132	1,325	676
methyl	b/s	17	1 - 3	1.7	152	1,720	862
acephate	c/aca	11	1	1.0	320	600	485
benzoxymate	c/aca	11	1	1.0	150	300	232
clofentezine	ci/igr	10	1 - 3	1.3	39	3,199	404
triflumuron	ci/agr	6	1 - 2	1.2	75	180	146
fenoxycarb	ci/b	6	1 - 2	1.5	356	944	592
azinphos-methyl	cf/b	6	1	1.0	647	647	647
amitraz	c/aca	6	1	1.0	450	450	450
azocyclotin	ci/b	3	1	1.0	880	880	880
diazinon	c/aca	2	1	1.0	740	740	740
propargite	ci/b	2	1	1.0	791	791	791
phosalone	c/aca	1.4	1	1.0	462	462	462
dicofol	c/aca	1.4	1	1.0	228	228	228
tetradifon	cif/b	0.9	1	1.0	370	796	583
chlorpyrifos-ethyl	c/aca	0.9	1	1.0	344	344	344
cyhexatin	ci/igr	0.9	2	2.0	79	79	79
flufenoxuron	c/aca	0.5	1	1.0	1,440	1,440	1,440
sulphur	c/b	15	1	1.0	11,199	36,000	22,190
petroleum oil							

Key to abbreviations:

c	= contact	b	= broad spectrum
i	= ingestion	aca	= acaricide
f	= fumigant	aph	= aphicide
s	= systemic	igr	= insect growth regulator

Table 6.4.3 Lerida

Table 6.4.3 Insecticide and Acaricide use by active ingredient in Lerida

Active ingredient	Activity	% of crop treated (Base: 676 ha)	No. of applications		Cumulative dose g ai/ha of crop receiving that ai		
			Range per farm	Ave per ha treated	min	max	ave
imidacloprid	s/aph	61	1 - 3	1.4	44	2,000	162
dimethoate	ci/b	53	1 - 4	2.9	150	9,600	4,350
deltamethrin	ci/b	38	1 - 8	1.7	5	128	59
fenoxycarb	ci/igr	37	1 - 2	1.3	99	899	229
diflubenzuron	ci/igr	36	1 - 2	1.5	125	1,200	715
diazinon	ci/b	36	1 - 4	2.0	449	6,000	1,696
vamidothion	s/aph	32	1 - 2	1.0	48	1,919	818
chlorfenvinphos	ci/b	28	1 - 3	1.5	167	2,180	530
pyridaben	c/aca+aph	28	1 - 3	1.2	105	449	189
DNOC	c/b	25	1	1.0	500	2,000	1,223
azinphos-m	ci/b	21	1 - 5	2.5	250	3,750	1,469
fenitrothion	c/b	20	1 - 6	2.1	500	4,500	1,494
hexythiazox	c/aca	20	1 - 2	2.0	12	120	116
parathion-ethyl	cif/b	19	1 - 3	1.3	87	10,000	1,795
phosmet	ci/b	16	1 - 5	2.5	800	9,375	3,096
phosalone	ci/b	14	1 - 3	1.3	455	1,469	786
demeton-s-m	sc/aca+aph	11	1 - 2	1.5	175	500	370
parathion-m	cif/b	11	1 - 4	1.7	300	3,000	946
omethoate	s/b	11	1 - 2	1.0	500	5,000	738
cypermethrin	ci/b	10	1 - 4	1.7	75	400	131
amitraz	cf/b	10	1 - 3	1.6	200	2,250	727
cyfluthrin	ci/b	9	1 - 2	2.0	50	100	66
azocyclotin	c/aca	8	1	1.0	218	1,125	325
resmethrin	ci/b	7	1 - 3	1.4	2	17	8
methidathion	c/b	6	1 - 4	2.0	419	2,700	1,214
fenpropathrin	ci/b	6	1	1.0	100	135	101
tau-fluvalinate	ci/b	6	1	1.0	95	95	95
oxydemeton-m	cs/b	5	1 - 3	1.9	12	52	32
alphacypermethrin	ci/b	5	1 - 3	1.5	44	562	445
hexaflumeron	ci/igr	4	1 - 2	1.4	100	160	122
fenvalerate	ci/b	3	2 - 6	4.9	450	450	450
fenazaquin	c/aca	3	1	1.0	48	150	59
methamidophos	cs/b	3	1	1.0	450	450	450
permethrin	ci/b	3	2	2.0	229	229	299
chlorpyrifos-m	cif/b	2	1	1.0	442	497	465

continued/

Table 6.4.3 Insecticide and acaricide use by active ingredient in Lerida

(continued)

Active ingredient	Activity	% of crop treated (Base: 676 ha)	No. of applications		Cumulative dose g ai/ha of crop receiving that ai		
			Range per farm	Ave per ha treated	min	max	ave
isoxathion	c/b	2	1	1.0	875	875	875
methomyl	c/b	2	1	1.0	279	279	279
quinalphos	ci/b	2	1	1.0	360	360	360
dicofol	c/aca	1.0	1	1.0	480	1,600	640
pirimiphos-ethyl	cf/b	1.0	2	2.0	2,500	2,500	2,500
tetradifon	c/aca	1.0	1	1.0	180	600	240
pirimiphos-methyl	cf/b	0.4	1	1.0	50	50	50
chlorpyrifos-ethyl	cif/b	0.4	1	1.0	625	625	625
cyhexatin	c/aca	0.1	1	1.0	360	360	360
endosulfan	ci/b	0.1	1	1.0	360	360	360
ethiofencarb	cis/aph	0.3	1	1.0	350	350	350
ethion	c/b	0.3	1	1.0	937	937	937
petroleum oil	c/b	36	1 - 4	1.5	593	57,000	22,404

Key to abbreviations:

c	= contact	b	= broad spectrum
f	= fumigant	aca	= acaricide
i	= ingestion	aph	= aphicide
s	= systemic	igr	= insect growth regulator

6.4.4 Insecticide active ingredients used - general commentary

The major pests were similar across all three regions though with variation in relative importance. *Carpocapsa pomonella* is one of the most important pests to control if fruit quality is to be ensured. Improvement in timing of applications for control of *Carpocapsa* in recent years has led to reduced treatments in all regions.

There were differences between the three areas in the types of insecticide and acaricides used. Trentino has adopted ICM/IPM methods more widely than the other two regions, thus there was no use of pyrethroid insecticides as they are known to cause mite resurgence on top fruit crops. Organophosphate insecticides were used but to a lesser extent than the other regions. The predominant insecticides in Trentino were insect growth regulators. Specific aphicides and acaricides were used in all three regions. With the increased use of ICM/IPM techniques, acaricide use is declining.

6.5 Insecticide and acaricide use parameters

Table 6.5 Insecticide and acaricide applications

On farms using insecticides	Provence/ Languedoc/ Rhône-Alps (F)	Trentino (I)	Lerida (E)
Number of active ingredients used per farm	5.6	3.7	6.8
Number of active ingredients used per hectare	6.9	3.6	6.5
Number of product applications per hectare	10.8	4.6	9.4
Proportion of farmers spraying parts of their crop	7%	9%	14%
Average volume of active ingredients per hectare of crop treated kg ai/ha			
- insecticides	4.46	1.86	6.36
- petroleum oils	6.1*	22.1	22.6

* including weed control

Volumes of application vary similarly to fungicides and are not presented separately here.

From the comparison in Table 6.5 the differences between the regions is apparent with Trentino standing out in its reduced use of insecticides and acaricides. Farms in Lerida appear to spray their orchards with a more targeted approach with 14% of the farmers spraying parts of their crop.

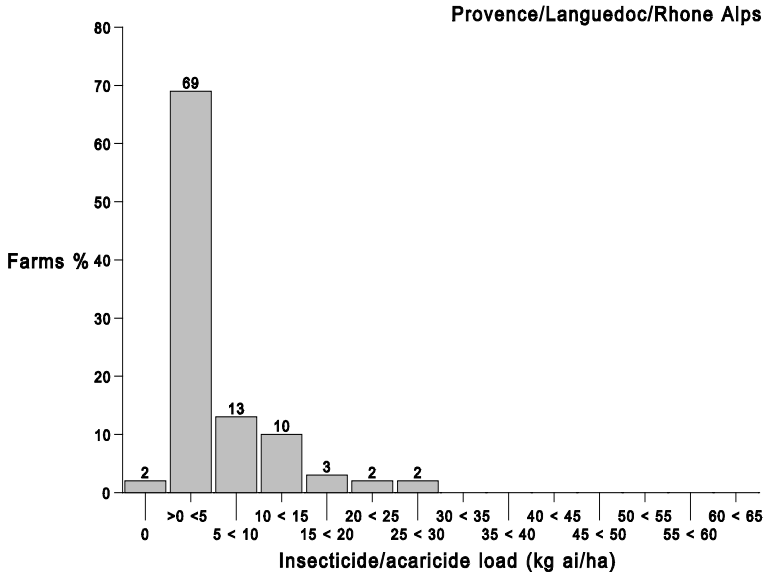
6.6 Insecticide load per farm

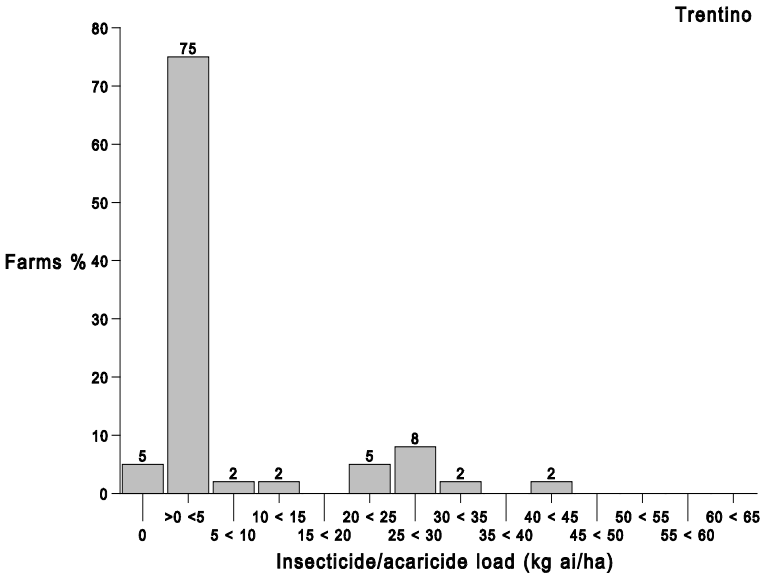
Table 6.6 Insecticide and acaricide load per farm

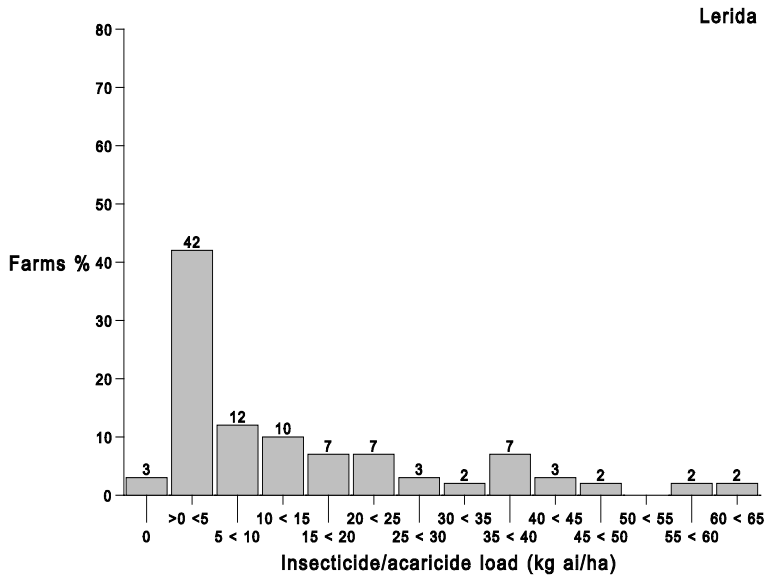
Region	Provence/ Languedoc/ Rhône-Alps (F)	Trentino (I)	Lerida (E)
Number of farms	62	60	60
Insecticide/acaricide load kg ai /ha	Farms %		
0	2	5	3
>0<5	69	75	42
5<10	13	2	12
10<15	10	2	10
15<20	3	-	7
20<25	2	5	7
25<30	2	8	3
30<35	-	2	2
35<40	-	-	7
40<45	-	2	3
45<50	-	-	2
50<55	-	-	-
55<60	-	-	2
60<65	-		2
Range kg ai/ha of crop grown	(0) 0.06 - 28.5	(0) 0.06 - 42.3	(0) 0.1 - 64.6

The farms with higher insecticide/acaricide loads in Trentino and Lerida were due to the high volumes of petroleum oil or petroleum oil/insecticide mixtures being sprayed, typically up to 20-25 kg oil/ha. In Lerida 26 farms adopted this practice, in Tretino 11 and in Provence/Languedoc/Rhône-Alps only four used this method.

Chart 6.6 Variation in insecticide and acaricide load by farm







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

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

Region	Provence/ Languedoc/ Rhône-Alps (F)	Trentino (I)	Lerida (E)
Number of farms	62	60	60
Insecticide/acaricide use	Farms %		
Greater quantity	33	8	11
Lesser quantity	4	8	20
Same quantity	58	78	69
Don't know/No reply	5	5	-

Most farmers indicated similar use of these products in 1994, compared with an average year, although quite a few farmers in Provence/Languedoc/Rhône-Alps indicated greater use.

6.8 Factors determining start of insecticide or acaricide applications

The factors considered by farmers are presented in Table 6.8.

Calendar date was less used in Trentino than other regions. Warning systems through the use of pheromone traps are particularly relevant to *Carpocapsa* and there seems to be good utilisation in Trentino and Lerida. The local specialists in Provence/Languedoc/Rhône-Alps indicated that there was widespread use of pheromones in their region but many farmers begin spraying by calendar date even if traps have not yet registered a catch as they were unwilling to risk an uncontrolled attack.

Table 6.8 Factors determining start of insecticide or acaricide application (farms %)

	Calendar dates			Plant stage			Pest stage			Pest Pressure			Warning system			Don't know /no reply		
Region	Pro	Tre	Ler	Pro	Tre	Ler	Pro	Tre	Ler	Pro	Tre	Ler	Pro	Tre	Ler	Pro	Tre	Ler
Aphis pomi green aphid	11	2	22	11	17	17	13	30	30	21	12	43	8	45	40	21	28	4
Carpocapsa pomonella codling moth	47	2	38	19	15	5	11	30	20	29	10	18	27	55	63	11	22	5
Ceratitis capitata Med fruit fly	8	-	27	3	-	5	-	-	12	5	-	23	2	-	57	45	100	17
Dysaphis plantaginea grey aphid	16	2	22	13	22	10	23	42	32	37	18	38	16	57	43	13	10	7
Leucoptera scitella leaf miner	6	-	35	2	-	10	3	2	17	2	2	15	-	3	55	48	87	10
Mites	23	2	15	6	12	10	13	20	38	40	10	40	8	35	42	10	42	4

Pro = Provence/Languedoc/Rhône-Alps Tre = Trentino Ler = Lerida

6.9 Opportunities to reduce insecticide and acaricide load

6.9.1 Comments by region

In Trentino specialists confirmed that most growers were adopting ICM procedures in close collaboration with their cooperatives and thus the art of correct spray timing was well developed. The frequency of spray application is therefore close to optimum, although further fine tuning could lead to minor reductions in pesticide load.

As indicated by some of the pesticides used, full ICM/IPM seems to be less well developed in the other regions. Further improvement in using warning systems and greater adoption of IPM/ICM approved products could lead to reduced spraying.

6.9.2 Other suggestions

Use of certain products such as pyrethroids should be minimised as they are known to cause mite resurgence in some situations which may necessitate further spraying of specific acaricides.

.

The largest volume (heaviest dose rate) products used to control pests are petroleum oil-based sprays. Some Lerida growers were particularly high users of these traditional products. Their use has been more common in other regions but has declined in recent years with the introduction of more modern, but more expensive, insecticides and acaricides. There is a place for spray oils in the apple orchard, but it is suggested that some very high users could consider reduction without major impairment of performance.

Some newer insecticides and acaricides require less frequent treatment and have lower dose rates. This trend is likely to continue with emerging products. Most newer molecules have a better environmental profile than many of the older products. Their disadvantage is price.

7.0 MISCELLANEOUS PESTS AND PESTICIDES

In Lerida specialists claimed widespread use (32% of area) of fosetyl-al and similar products as a root drench for diseases such as *Phytophthora*, a problem that increases with the age of the trees. The survey only found one farmer claiming use on two hectares.

Three farms across all regions indicated that they used rodenticides as part of their apple production system. Some specialists believed that rodenticide use may have been understated in Trentino.

8.0 OTHER AGROCHEMICALS

The only types of products mentioned in this group were plant growth regulators which were mainly used to improve fruit size and quality. They fell into two main categories:

1 High dose products such as sulphur-based sprays or carbaryl which also have other properties (fungicide or insecticide)

2 Low dose plant hormones such as gibberellic acid or naphthylacetic acid.

8.1 Plant growth regulator active ingredient use

8.1.1 Provence/Languedoc/Rhône-Alps

Table 8.1.1 Plant growth regulators used in Provence/Languedoc/Rhône-Alps

Active ingredient	% of crop treated (Base: 862 ha)	No. of applications		Cumulative dose g ai/ha of crop receiving that ai
		Range per farm	Ave per ha treated	Average
Russetting control				
Sulphur+trace elements	13	2 - 8	4.8	11,201
Gibberellic acid	4	1 - 4	3.3	12
Fruit thinning				
2,4-DP	2	1	1.0	31
Alpha-naphthylacetic acid	<1	1	1.0	14
Carbaryl	<1	1	1.0	600

8.1.2 Trentino

Table 8.1.2 Plant growth regulators used in Trentino

Active ingredient	% of crop treated (Base: 213 ha)	No. of applications		Cumulative dose g ai/ha of crop receiving that ai
		Range per farm	Ave per ha treated	Average
naphtoxy-2-acetamide	39	1	1.0	167
naphthalacetic acid	20	1	1.0	9
gibberellic acid	10	1 - 4	2.9	81
carbaryl	10	1	1.0	696
benzyl adenine	1	1	1.0	9
2,4-D	1	1	1.0	14

8.1.3 Lerida

Table 8.1.3 Plant growth regulators used in Lerida

Active ingredient	% of crop treated (Base: 676 ha)	No. of applications		Cumulative dose g ai/ha of crop receiving that ai
		Range per farm	Ave per ha treated	Average
gibberellic acid	58	1 - 4	2.7	38
benzyl adenine	54	1 - 4	2.8	46
amino acid	37	2 - 8	3.1	425
2,4-DP	25	1 - 3	1.2	29
naphtoxy-2-acetamide	3	1 - 2	1.5	23
paclobutrazol	3	1 - 2	1.3	638
alpha-naphthylacetic acid (ANA)	2	1 - 2	1.7	4
chlormequat chloride	2	2 - 4	1.3	2,109
sulphur + trace elements	<1	7	7.0	42,008

There was a higher use of plant growth regulators in Lerida and Trentino than in the French region. Farmers look towards these chemicals to partially replace some of the labour-intensive horticultural operations such as pruning.

Golden Delicious and related varieties are often sprayed with products which reduce russetting as they are very susceptible to this problem. These varieties dominated in all three regions. Several farmers in Provence/ Languedoc/Rhône-Alps regularly used 'Golclair' products which contain sulphur and trace elements to combat this problem. In the other regions, plant hormone materials were used more than 'Golclair'. However, some farmers who used sulphur for *Podosphaera* control it is believed did so in the knowledge that sulphur can reduce russetting.

8.2 Opportunities to reduce plant growth regulator load

Market demand for blemish-free fruit of optimum size determines the use of these products. The dominant variety (Golden Delicious group) needs fruit thinning and russet control. Variety diversification and consumer education could reduce the need for this sector.

9.0 TRENDS IN PESTICIDE USE

9.1 Variation in pesticide use over the last five years

Table 9.1 Variation in pesticide use over the last five years

Region	Provence/Languedoc/ Rhône-Alps (F)				Trentino (I)				Lerida (E)			
Crop area - ha	862				213				676			
Trend	Area %											
	herb	fung	insec	pgr	herb	fung	insec	pgr	herb	fung	insec	pgr
Increased	6	15	31	3	16	28	12	27	20	18	15	30
The same	80	74	47	19	44	30	14	26	11	27	24	37
Reduced	10	9	14	-	30	38	70	2	49	33	39	10
No reply	4	2	8	84	10	4	4	45	19	21	21	23

Farmers' opinions on use trends varied between countries and product types. For insecticides, fungicides and herbicides there was a tendency towards a reduction in Lerida and Trentino, whereas in Provence/Languedoc/Rhône-Alps more farmers felt use had remained the same compared with five years ago. Views on plant growth regulators were less clear, indicating their lower level of use than the other product types.

9.2 Plans to continue or change pesticide use in apples

Table 9.2 Plans to continue or change pesticide use in apples

Region	Provence/ Languedoc/ Rhône-Alps (F)	Trentino (I)	Lerida (E)
Number of farms	62	60	60
Plans	Farms %		
Will change	15	8	10
Possibly change	11	15	20
No change	68	75	57
Don't know	6	2	12

Those farmers who would or possibly would change were questioned on the chemical sectors where they would change and for what reasons.

In the French region, insecticides were cited on grounds of better control followed by fungicide for both better control and economics.

In Italy fungicides, followed by insecticides, would be changed on grounds of better control.

In Lerida all chemical sectors were mentioned by about half these farmers on grounds of economics followed by better control. In order of citation the chemical sectors were:

- Fungicides
- Insecticides
- Herbicides
- PGRs

Though environmental reasons were among the alternatives offered, only in Lerida would a small proportion plan changes on these grounds, here in insecticides and PGRs (11%).

9.3 Change in agrochemical use across all crops in the last five years

Questioned as to broad changes in agrochemical use across all their crops farmers gave the following replies:

Table 9.3 Change in agrochemical use across all crops in the last five years

Region	Provence/ Languedoc/ Rhône-Alps (F)	Trentino (I)	Lerida (E)
Number of farms	62	60	60
	Farms %		
More intensive	24	18	18
The same	63	13	42
Less intensive	11	50	38
No answer	2	18	2

This broadly agreed with the specific views on the apple crop and was generally supported by local specialists. With the marked exception of Trentino, and to a lesser extent Lerida where farmers have reduced their intensity of agrochemicals, the majority have remained the same.

The Trentino responses evidently reflect the success of the local protocol on IPM/ICM methods.

10.0 PESTICIDE/AGROCHEMICAL GENERALITIES

10.1 Sufficiency of choice of products

Table 10.1 Farmers who believed there was sufficient choice of products

Region	Provence/ Languedoc/ Rhône-Alps (F)	Trentino (I)	Lerida (E)
Number of farms	62	60	60
	Farms %		
Fungicides	95	88	92
Herbicides	81	87	93
Insecticides	77	87	93
Plant growth regulators	39	50	83

Apart from plant growth regulators, which were less widely used than the other sectors of agrochemicals, most replies indicated that current product choice was sufficient.

10.2 Attitudes to developments in the pesticide market

Farmers were asked to comment on developments in the pesticide market with regard to availability of new products, increasing efficacy, ease of application and lowering of residue levels. They responded as good, satisfactory or poor. Table 10.2 compares the results of the good and satisfactory results combined.

Table 10.2 Farmers who considered pesticide developments to be good or satisfactory

Region	Provence/ Languedoc/ Rhône-Alps (Fr)	Trentino (I)	Lerida (E)
Number of farms	62	60	60
	Farmers %		
Availability of new products	82	68	92
Increasing efficacy	69	35	88
Ease of application	86	93	95
Lower residue	70	80	75

The only poor response was 'increasing efficacy' from Trentino growers. Does this reflect the view that IPM/ICM systems do not achieve complete control of all pests?

10.3 Attitudes to handling restrictions on the label

Farmers were asked how important handling restrictions on the label were with regard to choice and use of products. They were offered three answers - very important, important and not important. Table 10.3 presents the farmers' answers to these two questions.

Table 10.3 Attitudes to handling restrictions on the label

Region	Provence/ Languedoc/ Rhône-Alps (F)		Trentino (I)		Lerida (E)	
Number of farms	62		60		60	
Attitude	Farmers %					
Importance	very	imp	very	imp	very	imp
On **choice** of product	47	37	73	20	75	23
On **use** of product	60	27	72	23	77	23

Although all farmers felt these aspects were important, there appears a greater degree of importance given to them in Trentino and Lerida.

10.4 Attitudes to environmental restrictions on the label

The same procedure as Section 10.3 was taken with regard to environmental restrictions.

Table 10.4 Attitudes to environmental restrictions on the label

Region	Provence/ Languedoc/ Rhône-Alps (F)		Trentino (I)		Lerida (E)	
Number of farms	62		60		60	
Attitude	Farmers %					
Importance	very	imp	very	imp	very	imp
On **choice** of product	55	31	58	33	72	27
On **use** of product	58	29	57	33	72	27

Considering farmers responses in Sections 10.3 and 10.4, clearly nearly all farmers said they took notice of labelling when making product choice.

In Trentino, farmers' positive attitudes on labelling probably reflected their knowledge of actual ICM protocol restrictions, often it is the cooperatives who advise on choice.

In Lerida, specialists views were that although farmers were very 'correct' in their responses on labelling, their main concern was whether products were registered for the intended uses, their effectiveness, crop safety and cost.

In Provence/Languedoc/Rhône-Alps, specialists were pleasantly surprised at farmers positive attitudes to labelling restrictions.

10.5 Sources of information

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

Table 10.5 Information source

Region	Provence/ Languedoc/ Rhône-Alps (F)		Trentino (I)		Lerida (E)	
Number of farmers	62		60		60	
Information source	Farms %	Average score	Farms %	Average score	Farms %	Average score
Coop representative	61	4.0	30	4.6	28	4.4
Farming press	24	3.7	8	2.1	22	3.6
Manufacturer's rep	16	4.0	2	5.0	15	2.9
Merchant	32	3.6	8	3.0	42	3.2
Neighbour/colleague	16	4.0	3	3.5	23	3.2
Plant protection	27	3.5	63	4.3	57	4.1
advisor	26	4.2	2	3.0	35	4.6
Private consultant	50	2.8	2	5.0	5	3.3
Others						

Plant protection advisors and Cooperative representatives featured highly as information sources for agrochemical advice.

11.0 PROFITABILITY AND PESTICIDES

11.1 Profitability of the apple crop

Farmers were asked how they assessed the profitability of their apple crop last year (1994), and five years ago.

Table 11.1 Profitability of apples

Region	Provence/Languedoc/ Rhône-Alps (F)		Trentino (I)		Lerida (E)	
Number of farms	62		60		60	
Profitability	Study year 1994	5 years ago	Study year 1994	5 years ago	Study year 1994	5 years ago
Very good	2	5	0	5	3	2
Good	16	15	10	18	15	3
Satisfactory	15	42	22	53	40	35
Total positive response	33	62	32	76	58	40
Poor	32	15	52	8	33	28
Very poor	35	6	2	0	5	15
Don't know/no reply	0	18	15	15	4	17

For 1994, only in Lerida did the majority of farmers think profitability was reasonable and then only just. Five years ago the situation was reversed with a large proportion of the farmers in the French region and Trentino claiming profits were satisfactory or above.

11.2 Return and costs of production

Models of returns and costs of production are presented in the individual regional reports. Satisfactory models proved difficult to obtain within the context of this project. The details and terms used vary considerably and comparison is not very satisfactory. Agrochemical costs within the total context are presented in Table 11.2.

Table 11.2 Comparison of agrochemical costs

Agrochemical cost	Provence/ Languedoc/ Rhône-Alps (F)	Trentino (I)	Lerida (E)
As a proportion of variable costs	n/a	14%	n/a
As a proportion of total costs	10%	n/a	10%
As a proportion of gross income	n/a	6%	7%

11.3 Influence of anticipated profit on pesticide use

Farmers were asked to predict their reactions in terms of pesticide use when good or poor profitability was to be anticipated for the crop. A number of choices were offered.

Table 11.3 Influence of anticipated profit on pesticide use

Region	Provence/ Languedoc/ Rhône-Alps (F)		Trentino (I)		Lerida (E)	
Number of farms	62		60		60	
	Farms %					
Anticipated profit	Good	Poor	Good	Poor	Good	Poor
Price of product						
Use more expensive products	10	3	8	7	28	-
Use less expensive products	8	26	5	30	2	18
No influence	79	71	36	30	68	80
Don't know/no reply	3	-	50	35	3	2
Dose rate of product						
Increase dose	5	6	-	-	5	-
Decrease dose	-	6	5	3	-	7
No influence	95	87	49	70	93	92
Don't know/no reply	-	-	46	26	2	2
Age of products						
Use newer products	16	23	-	48	18	5
Use older products	6	5	34	3	3	12
No influence	74	73	20	23	77	82
Don't know/no answer	3	-	46	26	2	2

'No influence' was the most common response to all three categories in Lerida and Provence/Languedoc/Rhône-Alps. In Trentino 'no influence' featured strongly in replies but there was also a large number of 'don't know' or 'no reply'.

11.4 The effects of pesticides on profitability

Table 11.4 Effects of pesticides on profitability

Region	Provence/ Languedoc/ Rhône-Alps (F)		Trentino (I)		Lerida (E)	
Number of farms	62		60		60	
	Farms %					
Effect	Greatest	Least	Greatest	Least	Greatest	Least
Sector						
Fungicides	53	2	40	2	13	3
Herbicides	-	71	-	52	8	17
Insecticides	32	3	32	2	33	7
Plant growth regulators	2	15	2	17	3	8
Other	10	5	23	25	-	-
Don't know/no reply	5	5	3	3	41	65

As to be expected, farmers believed herbicides to have less influence on profitability than fungicides or insecticides. Fungicides were more important in the Trentino and Provence/Languedoc/Rhône-Alps region than in Lerida. Insecticides were more important in Lerida. This is reflected in the product use patterns seen earlier in the report.

11.5 Possibility to reduce pesticide use without lowering profitability

Farmers were asked if it would be possible to reduce pesticide use without lowering profitability.

Table 11.5i Possibility to reduce pesticide use without lowering profitability

Region	Provence/ Languedoc/ Rhône-Alps (F)	Trentino (I)	Lerida (E)
Number of farms	62	60	60
	Farms %		
Yes	19	32	27
Possibly	8	5	18
No	61	38	48
Don't know/no reply	11	25	5

In each region more farmers indicated that they could not reduce pesticide than thought otherwise. However, others did feel they could or possibly could lower pesticide use without lowering profitability particularly in Trentino and Lerida. These farmers were asked to indicate in which sectors they felt they could make savings. Responses were limited and poor but their replies are recorded for information.

Table 11.5ii Sector where reductions might be possible without affecting profitability

Region	Provence/ Languedoc/ Rhône-Alps (F)	Trentino (I)	Lerida (E)
Number of farms	17	22	27
Sector	Farms %		
Fungicides	53	32	11
Herbicides	24	9	7
Insecticides	65	23	11
PGRs	-	5	4

12.0 ALTERNATIVE PEST CONTROL SYSTEMS

12.1 Awareness of alternative systems that might be equally profitable to conventional methods

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

Definitions were given to farmers for the different regions (see Appendix I) but local terms and understandings also played a role in these answers. The results need to be interpreted with care.

Table 12.1 Awareness of alternative systems that might be equally profitable to conventional methods (unprompted)

Region	Provence/ Languedoc/ Rhône-Alps (F)	Trentino (I)	Lerida (E)
Number of farms	62	60	60
Unprompted	Farms %		
ICM	61	43	53
IPM	20	77	80
OP	2	57	75
None	8	10	12
Don't know/no reply	9	8	8
After prompting	Awareness amongst farmers which had not mentioned the system Proportion of total sample %		
ICM	19	5	8
IPM	56	5	5
OP	72	3	15

The level of response was highest in Provence/Languedoc/Rhône-Alps. Specialists in this region believed that most farmers would not clearly differentiate between ICM and IPM. ICM (agriculture raisonnée) is what they felt most farmers of this region believed they were practising by following recommendations of cooperatives and officials. From the high level of response it is suspected that farmers may not have understood that the question related to systems that were equally profitable to conventional systems.

Specialists in Trentino were surprised at the low response for ICM as most growers join the cooperative system and follow the recommendations developed by the local fruit growing committee which are ICM compatible. It seems many farmers may be confusing ICM with IPM.

There are very few Organic Production growers in any of the regions though high awareness was demonstrated.

12.2 Interest in developing alternative systems

Farmers were asked for their level of interest in developing the various alternative systems discussed.

Table 12.2 Interest in developing alternative systems

Region	Provence/ Languedoc/ Rhône-Alps (F)	Trentino (I)	Lerida (E)
Number of farms	62	60	60
	Farms giving positive response %		
ICM	63	27	65
IPM	47	66	75
OP	16	23	48

In view of the specialists' comment in Section 12.1 it is difficult to interpret these answers as many farmers, particularly in Trentino, are practising ICM.

Though terminology and definitions were evidently somewhat confusing across countries, there seems a majority interest in developing systems along ICM/IPM principles.

Specialist views were that in the French region farmers were open minded to IPM/ICM systems and were taking up IPM procedures as they became available.

In Trentino, the responses show a somewhat confused picture against the background of most growers following ICM/IPM procedures under the Trentino protocol - perhaps not fully understanding the names of the techniques they are employing.

In Lerida, specialists believed that the interest alleged by farmers was high relative to their experience in trying to enlist farmers into an IPM system that the local advisors have been promoting for five years. This view was supported by the group discussion.

13.0 ENVIRONMENTAL ISSUES

13.1 Farms in restricted areas

In Lerida and Provence/Languedoc/Rhône-Alps very few farmers indicated that they were in restricted areas (2 and 4 farmers respectively). Three of the total (1 and 2 respectively) claimed to be in an environmentally sensitive area. The form of product restriction was not given. Only one farmer indicated difficulties in making pesticide choices.

In Trentino, 25 farms claimed to fall into restricted areas, in all cases environmentally sensitive areas. In addition one farmer said he was in an area of special scientific interest. Eleven farmers of the group said it was difficult or very difficult in choosing products as a consequence of the restriction.

13.2 Considerations influencing the choice of pesticides

Farmers were asked what considerations, from a list of suggestions, they took into account when choosing pesticides.

Region	Provence/ Languedoc/ Rhône-Alps (F)	Trentino (I)	Lerida (E)
Number of farms	62	60	60
Consideration	Farms %		
Soil protection	23	58	17
Ground water	23	55	18
Surface water	11	47	22
Produce quality	35	40	23
Fauna	26	37	22
Flora	19	33	20
None of these	48	12	57
Others Bees	2	-	-
Operator protection	2	2	-
Profitability and product	2	-	-
appearance	-	18	-
Local protocol	-	2	9
Don’t know			

Some farmers considered environmental factors when choosing pesticides, but produce quality also ranked high in influencing pesticide choice, as might be expected.

Farmers in the Trentino area appeared to consider a higher proportion of environmental factors than in the other regions reflecting the influence of the local

protocol.

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

COLLABORATORS AND CONTACTS

France

Discussion group and field survey:

BVA Agriculture
191 avenue du Général-Leclerc
BP 59
78220 Viroflay
France

Local specialists:

M G Jimenez
Service Technique
Co-operative COVIAL
Manduel
Gard (30)

M Thierry Favier
Service Agronomique
Co-operative Agricole Provence Languedoc (CAPL)
Sorgues
Vaucluse (84)

M J-N Reboulet
Direction technique
ACTA
Saint-Marcel-les-Valence
Drome (26)

M Speich
SRPV Provences-Alpes-Cote d'Azur
Montfavet (84)

M Patrick Bergounioux
Chambre d'Agriculture de Vaucluse
Cavaillon (84)

Italy

Group discussions and field survey:

Motivaction
Viale Bianca Maria 23
20122 Milan
Italy

Local specialists:

Dr Michele Pontalti
Head of Plant Protection Department
Ente de Sviluppo Assistenza Agricola Trentino (ESAT)

Prof Diego Forti
Stazione Agreria Sperimentale
San Michele all'Adige
i/c Development for Trento

Drs Beniamina Venturelli
Istituto Italiano della Mela
Responsible for Trento

Spain

Field work:

Intercampo SA
Gta Quevedo
6 2º Dcha
Madrid
Spain

Local specialists:

Joaquin Garcia de Otazo
Ingeniero Agrónomo (PhD in Agronomy)
Director of the Plant Protection Service of the Generalitat de Catalunya, Lérida

Alfonso Herrero
Ingeniero Agrónomo (PhD in Agronomy)
Researcher of the IRTA (Instituto of Agronomic Research) and Technical manager of a group of 15 fruit cooperatives

Jose Luis Trilla
Ingeniero Agrícola (Agronomist)
Manager of ACTEL (Cooperatives Association for the purchases and distribution of pesticides)
Advisor of the Cooperatives members of the group

Pedro Moliné and Joaquin Llardén
Ingenieros Agrícolas (Agronomists)
Sales representatives of two agrochemical firms
Farms advisors for agrochemical use