Annex 7

Pesticide Usage in Moldova

Annex 7: Pesticide Usage in Moldova

Pesticide usage in Moldova has dropped significantly since the mid 1980s. Reported usage in 1984 was about 38,400 tons and in 1989 about 11,200 tons. Table 28 shows that use in 2002 was about 2,600 tons.

While the total usage decreased between 2000 and 2002 from ca. 2,800 tons to ca. 2,600 tons the treated area rose from 563,000 ha to ca 715,100 ha. This is an increase of 27%. This could mean that farmers used reduced application rates, or that there were considerable reporting errors and/or illegal trade contributed to erroneous sales figures.

However, the 715,100 ha represent only 28% of the total 2.54 million ha total agricultural land.

The State Inspectorate for Plant Protection of the Ministry of Agriculture and the Food Industry estimated the quantity of priority pesticides which were used by farmers in the 2000 – 2002 period.

Table 31 shows the use of priority pesticides in kg or litre active ingredient in the years 2000 – 2002. The data clearly indicate an increasing usage of synthetic pesticides and a decline in the use of copper. Use of priority pesticides, however account for almost the half of the total pesticide use.

The detailed results can be found in Table 33 at the end of the Annex.

Table 31: Pesticides Use (active ingredient) in Moldova 2000-2002

	2000			2001			2002		
Use Type	Tons Applied	Treated Area (ha)	kg/ha	Tons Applied	Treated Area (ha)	kg/ha	Tons Applied	Treated Area (ha)	kg/ha
Fungicides	2,352	341,900	6.88	2,343	418,342	5.60	2,001	390,656	5.12
Insecticides	248	162,200	1.53	225	201,419	1.11	239	209,091	1.14
Herbicides	134	58,900	2.28	171	64,540	2.65	224	115,352	1.94
Total	2,872	563,000	5.10	2,872	684,300	4.20	2,619	715,100	3.66

Table 32: Use of Priority Pesticides in Moldova 2000-2002

	Use in kg or litre active ingredient		
Pesticide	**2000**	**2001**	**2002**
Atrazine	-	-	-
2,4-D	30,229	35,716	39,772
Chlorpyrifos	238	4,413	7,608
Copper hydroxide	-	-	20,983
Copper oxychloride	54,969	66,941	45,159
Copper sulphate	1,629,790	1,546,588	1,129,530
Malathion	-	-	4,526
Trifluralin	300	125	3,560
Total	1,715,526	1,653,783	1,251,138

Estimations on the use density (see Table 33) suggest that only a small percentage of the crops are sprayed. The given estimations are, however hard to interpret, because one farmer may use different products on the same field over the season.

Problems Associated with Pesticide Use

Problems associated with pesticide use were generally described as:

- Cleaning of spray equipment in the environment, near or in ponds and rivers
- Poor storage of pesticides

- Spray drift problems due to the use of old spraying equipment, and
- Application too closely to water sources, especially in case of field vegetable treatment.
- Stocks of obsolete pesticides are a major thread to ground and surface waters in Moldova, approximately 6.000 tons obsolete pesticide are stored in various location in Moldova

Table 33 : Pesticide Registration and the Percentage Treated Crops in Moldova

Name of Product containing Active Ingredients	Main Crops Applied to	Typical Application Rate (kg or litre per ha)	Typical Number of Applications per Year	% Crops Grown Treated with Pesticide
2,4-D containing products				
Buctril D	Wheat, barley, maize	1.25 – 1.5 litres formulated product per ha according to crop	1	Currently only 0.5-1.5%
2,4-D "BASF"	Wheat, barley, maize	1.2 – 2 litres formulated product per ha	1	Currently only 4- 6%
Dezormone	Wheat, barley, maize	0.7–1.5 litres formulated product per ha	1	Currently only 0.01%
Dialen	Wheat, barley, maize	1.5 – 2 litres formulated product per ha	1	Currently only 1-2%
Dialen Super SC	Wheat, barley, maize	0.5-1.5 litres formulated product per ha	1	Currently only 5%
Dicopur F 60	Wheat, barley, maize	0.7-1.2 litres formulated product per ha	1	Currently only 1-2%
Pilar	Wheat, maize	0.8 – 1.25 litres formulated product per ha	1	Currently only 0.1%
SDMA-6	Wheat	1.2 litres formulated product per ha	1	Currently only 1%
Valsamin 720	Wheat, barley	1 - 1.4 litres formulated product per ha	1	Currently only 2%
Atrazine containing products				
Laddok	Maize	3 – 4 litres formulated product per ha	1	Currently not treated
Lentagran-combi	Maize	3.5 –5 litres formulated product per ha	1	Currently not treated
Copper containing products				
Champion WP	Vineyards	3 kg formulated product per ha	4	Currently only 3-5%
Kocide 2000	Fruit trees, vineyards	2 – 3 kg formulated product per ha	2 - 4	Currently only 3%
Copper oxychloride WP	Fruit trees, vineyards, potatoes, field vegetables	3 – 6 kg formulated product per ha	2 - 4	Currently only 5-7%
Oxihom WP	Vineyards, potatoes, field and glasshouse vegetables	1.9 - 2.1 kg formulated product per ha	3 - 4	Currently only 5-7%
Bouillie Bordelaise	Fruit trees, vineyards, field and glasshouse vegetables	5 – 10 kg formulated product per ha	2 - 5	Currently only 1-9%
Copper sulphate (basic)	Fruit trees, vineyards, potatoes, field and glasshouse vegetables	3 – 20 kg formulated product per ha	2 - 6	Currently only 20 – 30%
Cuproxat SC	Fruit trees, vineyards, tobacco	3 – 7 kg formulated product per ha	2 - 6	Currently only 8-16%

Name of Product containing Active Ingredients	Main Crops Applied to	Typical Application Rate (kg or litre per ha)	Typical Number of Applications per Year	% Crops Grown Treated with Pesticide
Chlorpyrifos containing products				
Cipi Plus EC	Fruit trees	0.7 litres formulated product per ha	2	Currently only 4%
Dursban E-48	Sugar beet, fruit trees	0.8–2.5 litres formulated product per ha		Currently only 4-7%
Nurelle D 50/500 EC	Fruit trees	0.5- 0.7 litres formulated product per ha	3	Currently only 7-10%
Phenomen 530 EC	Fruit trees	1.0 litre formulated product per ha	2 - 3	Currently only 0.5%
Pyrinex 48 EC	Fruit trees	2 – 2.5 litres formulated product per ha	2	Currently only 0.1 – 1%
Pyrinex 250 ME	Sugar beet, fruit trees	3.5 – 4 litres formulated product per ha		Currently only 1%
Fufanon 570 EC	Fruit trees	1 – 2 litres formulated product per ha	3 - 4	Currently only 8%
Trifluralin Tcontaining products				
Treflan	Sunflower, tobacco, field vegetables	2 – 4 litres formulated product per ha	1	Currently only 1.5%
Triflurex	Sunflower, tobacco, field vegetables	1.5 – 4 litres formulated product per ha	1	Currently only 0.3%

Table 34: Amounts of Pesticide Products Sold in Moldova 2000 - 2002

Pesticide	Product Name	% Active ingredient	Amounts Use per Year in Moldova
2,4-D	Buctril D	22.5%	5,810 litres (2000) 10,180 litres (2001) 4,005 litres (2002)
2,4-D	2,4-D "BASF"	50%	50,950 litres (2000) 45,340 litres (2001) 38,760 litres (2002)
2,4-D	Dezormone	72%	70 litres (2002)
2,4-D	Dialen	36%	3,840 litres (2000) 16,460 litres (2002)
2,4-D	Dialen Super SC	29%	22,290 litres (2001)
2,4-D	Dicopur F 60	60%	3,440 litres (2000) 8,050 litres (2001) 4,970 litres (2002)
2,4-D	Pilar	72%	420 litres (2002)
2,4-D	SDMA-6	60%	5,450 litres (2002)
2,4-D	Valsamin 720	72%	8,920 litres (2002)
Atrazine	Laddok	20%	0.0
Atrazine	Lentagran-combi	15%	0.0
Copper carbonate, basic			
Copper hydroxide - $Cu(OH)_2$	Champion WP	77%	13,650 kg (2001) 21,600 kg (2002)
Copper hydroxide	Kocide 2000	35%	12,430 kg (2002)
Copper oxychloride – $Cu_2Cl(OH)_3$	Copper oxychloride WP	90%	53,310 kg (2000) 51,280 kg (2001) 38,460 kg (2002)

Copper oxychloride	Oxihom WP	66,7%	10,480 kg (2000) 15,410 kg (2001) 15,810 kg (2002)
Copper sulphate (basic) – $CuSO_4$ $5H_2O$	Bouillie Bordelaise	26,4%	8,100 kg (2001) 69,770 kg (2002)
Copper sulphate (basic)	Copper sulphate (basic)		1,607,500 kg (2000) 1,511,450 kg (2001) 1,066,690 kg (2002)
Copper sulphate (basic)	Cuproxat SC	34,5%	64,610 kg (2000) 95,650 kg (2001) 128,755 kg (2002)
Chlorpyrifos	Cipi Plus EC	48%	100 litres (2001) 2,660 litres (2002)
Chlorpyrifos	Dursban E-48	48%	240 litres (2000) 3,490 litres (2001) 5,430 litres (2002)
Chlorpyrifos	Nurelle D 50/500 EC	50%	0,030 litres (2000) 3,940 litres (2001) 6,200 litres (2002)
Chlorpyrifos	Phenomen 530 EC	48%	370 litres (2002)
Chlorpyrifos	Pyrinex 48 EC	48%	224 litres (2000) 1,500 litres (2001)
Chlorpyrifos	Pyrinex 250 ME	25%	1,790 litres (2002)
Malathion	Fufanon 570 EC	57%	7,940 litres (2002)
Trifluralin	Treflan	24%	1,250 litres (2000) 400 litres (2001) 14,335 litres (2002)
Trifluralin	Triflurex	24%	120 litres (2001) 500 litres (2002)

Annex 8

Pesticide Usage in Romania

Annex 8: Pesticide Usage in Romania

There are no detailed pesticide use data in Romania. The percentage of the crop treated by individual crop was estimated as follows:

2,4-D: In 2001, 35-40 % from the cereal crops were treated with 2,4 D products.

Alachlor: 20-30 % of the crops are treated with Alachlor.

Atrazine: 25-30 % of the maize crops.

Cooper hydroxide: 5-10 % of the fruit trees crops, 15-20 % of vegetables crops.

Cooper oxychlorides: 60-70 % of the vineyards, 30-35 % of the vegetables crops.

Chlorpyrifos: 15-20 % of the cereal crops and 10-15 % of fruit trees.

Diuron: 1-5 % vineyard and fruit trees

Lindane: 60-70 % of seed of cereal crops are treated with a lindane product.

Endosulfan: 7-10 % of vineyard and fruit trees area

Malathion: 5-10 % of fruit trees

Isoproturon: 1-3 % of the wheat and barley crops

Simazine: 3-5 % of the fruit trees and vineyards

Trifluralin: 60-70 % of sunflower crops and vegetables

Registration data for products containing priority pesticides and information on the treated area by crop can be found in Table 36 and Table 37.

Problems Associated with Pesticide Use

- Affecting the neighbouring crops due to pesticide application in unfavourable meteorological conditions, like wind stronger than 4 m/s. (e.g. 2,4-D).
- The pesticides which are not applied during the most favourable crop vegetation periods.
- Certain herbicides remain in the soil and affect post emergently crops (e.g. Atrazine).
- The use of some products out of the guarantee period (expired).
- The use of some larger doses of pesticides in order to increase their efficiency.
- The use of some pesticides from toxicity groups 2 and 3 for some crops, especially vegetable, close to running waters or lakes (e.g. Malathion).
- The use of some non-recommended pesticides, especially insecticides from toxicity groups 2 and 3, for vegetables crops (e.g. Lindane or Carbofuran).
- Lindane utilization for seeds or other crops treatments where it was prohibited. At present, the products containing Lindane are accepted in Romania only for wheat and barley seeds treatments, very efficient in wireworms (Agriotes SPP).
- The pesticides applied by non-instructed persons in this field.
- The cleaning of the pesticide equipments in lakes and running waters.

Table 35 shows that a large percentage of the agricultural land is limited by several factors. Drought, waterlogging, erosion and low content of nutrients/humus are major problems. 6.1% of the agricultural land is limited for agricultural production due to chemical pollution.

Especially organochlorine insecticides of DDT and HCH types seem to contribute to this soil pollution with chemicals. In Romania, they have been prohibited since 1985. However, their occurrence, but also

their **illicit use in the last years**, determined their presence in soil at content levels higher than the allowable maximum limits. Research carried out in two vegetable growing areas emphasized the high contents in soil and ground water, as well as in vegetables.

For instance, the total HCH contents detected in the Vidra area reached values up to 41 times higher than Maximum Allowed Level (MAL), as the mean value in the two areas was only 1.4 times higher than MAL. The maximum values of the two HCH isomers (α-HCH and β-HCH) are over 70 times higher than MAL, and the mean values - over twice.

High contents of pesticide residues were also detected in the drinking water wells being 28 times higher than MAL in the Brăneşti-Islaz and over 3 times in the Vidra area[10].

Table 35: Limiting Factors for Agricultural Production

	Affected Agricultural Land Area	
Limiting Factor	Thousand ha	% of agricultural land area[11]
Drought	7,100	47.8
Temporary moisture excess (waterlogging)	3,781	25.4
Water soil erosion	6,300	42.4
Wind soil erosion	378	2.5
Excessive gravel at soil surface	300	2
Soil salinisation	614	4.1
Strong and moderate acidity	3,424	23
Strong alkalinity	223	1.5
Low to extremely low humus reserve	7,485	50.4
Low nitrogen supply	5,110	34.4
Low and very low mobile phosphorus supply	6,330	42.6
Low and very low mobile potassium supply	787	5.3
Deficiency of microelements (especially Zn)	1,500	10.1
Chemical pollution, of which:	900	6.1
Excessive pollution	200	1.3

[10] Lăcătuşu R., Cârstea, S., Lung, M. (2001): Soil Quality - Guiding Factors of Food Quality, Research Institute for Soil Science and Agrochemistry, Bucharest, Romania

[11] Agricultural land area of Romania on December 31, 2000 14.856.845 ha

Table 36: Pesticide Registration Data of Pesticide Products Containing Priority Pesticides

Name of Product containing Active Ingredients	Main Crops Applied to	Typical Application Rate (kg or litre per ha)	Typical Number of Applications per Year
2,4-D containing products			
2,4 D SARE DIMETILAMINA	Wheat , barley, maize	1	1
2,4 D SARE DMA 600	Wheat, maize	1	1
2,4 D DMA 810 SL	Wheat, barley	0.8-1	1
2,4 D SARE DE AMINE	Wheat, barley, maize	1.5-2	1
DICOPUR D	Wheat, maize	1	1
DICOPUR M	Wheat, barley	1	1
DMA 6	Wheat, maize	1	1
OLTEST	Maize, wheat	1.5	1
ICEDIN SUPER RV	Wheat, barley	1	1
ICEDIN SUPER	Wheat	1	1
LANCET	Maize, wheat	1-1.25	1
LANCET RV	Maize, wheat	1-1.5	1
LOTUS D	Wheat	0.6-1	1
LOGRAN D/RV	Wheat	1	1
MUSTANG	Wheat, barley	0.4-0.6	1
OLTIDIN SUPER	Wheat, barley, maize	1	1
OLTISAN M	Wheat, barley, maize	1	1
SANROM 375	Maize	1	1
WEEDMASTER	Wheat, barley, maize	0.9-1	1
Alachlor containing products			
ALANEX 48 EC	Maize, sunflower, soia	4-6	1
LACORN 48 EC	Maize	6-10	1
LASSO 48 CE RV	Maize, sunflower, soia	4-6	1
MECLORAN 35 CE	Maize, soia	8-14	1
MECLORAN 48 CE	Soia, sunflower, maize	4-10	1
AGROCHLOR	Maize	4-6	1
ALAZINE 33/14 SE	Maize	4-6	1
LACORN COMBI	Maize	6	1
Atrazine containing products			
ALANEX 48 EC	Maize, sunflower, soia	4-6	1
LACORN 48 EC	Maize	6-10	1
LASSO 48 CE RV	Maize, sunflower, soia	4-6	1
AGROCHLOR	Maize	4-6	1
ALAZINE 33/14 SE	Maize	4-6	1
LACORN COMBI	Maize	6	1
BUTIZIN 40 SC RV	Maize	6-10	1
BUTIZIN 60 SE	Maize	6-10	1
PRIMEXTRA GOLD	Maize	2-3.5	1
SANOLT COMBI	Maize	1-1.5	1
TAZASTOMP 500 WP	Maize	4-5	1
Copper containing products			
CHAMPION 50 WP	Fruit trees, vineyards, and	3	2
FUNGURAN OH 50 WP	Field vegetables	4	2
KOCIDE 101	Idem	4	1
SUPER CHAMP FL	Idem	3	1
OXICIG 50 PU	Vineyards and fields vegetables	6	1
TURDACUPRAL 50 PU	Idem	4	1
ALIETTE C	Fruit trees	5	1
CUPROZIR 50 PU	Vineyards and vegetable	2-4	2
CURZATE CUMAN	Idem	3.5	2
CURZATE MANOX	Idem		

Name of Product containing Active Ingredients	Main Crops Applied to	Typical Application Rate (kg or litre per ha)	Typical Number of Applications per Year
CURZATE PLUS T	Idem	2.5-3	2
GALBEN M	Vineyards	2.5-3	1
MANCUVIT PU	Vineyards and vegetable	2	1
MICAL B		3	1
RIDOMIL GOLD PLUS 42,5		3	1
RIDOMIL PLUS 48 WP		2.5	2
BOILLIE BORDELAISE	Vineyards and fruit trees	5	1
CUPROFIX F		5	1
Chlorpyrifos containing products			
CHLOROFET 480 EC	Potatoes	1.5	1
DURSBAN 48 CE	Potatoes	1.5	1
DURSBAN 480 EC	tatoes, fruit trees	1.5-2	1
PILOT 480 EC	Vineyards, sugar beet	1.5	1
PYRINEX 20 EC	Potatoes	3	1
PYRINEX 48 EC	Fruit trees, vegetables	1.5	1
RELDAN 40 EC	Fruit trees	1	1
Diuron containing products			
VEGEPRON DS	Vineyards and fruit trees	6	1
Endosulfan containing products			
THIODAN 35 EC	Fruit trees vegetables	1.5	1
THIONEX ULV	Wheat ,barley, potatoes	2-3	1
THIONEX 35 EC	Glasshouse vegetables	1-2	1
THIONEX 50 WP		1.5	1
Lindane containing products			
LINDAN HC	Wheat, barley	1.35/t	1
LINDAN 400 SC	Wheat,barley	2.25/t	1
LORSBAN L 16 EC	Maize	5	1
SINOLINTOX 5 G	Vegetable	30	1
SUMIDAN	Wheat, barley	1.8/t	1
CHINODINTOX 55 PTS	Wheat	2.5/t	1
GAMAVIT	Wheat, barley	3/t	1
MASTERLIN	Wheat, barley	2/t	1
MICLODAN 50 PTS	Wheat	2.5/t	1
MICLODAN EXTRA 45 PTS	Wheat	2.5/t	1
MICLODAN EXTRA 45 PUS	Wheat, barley	2.5/t	1
PROCARB L	Wheat	3/t	1
PROTILIN AL 81 PUS	Wheat, barley	3/t	1
PROTILIN 81 PTS	Wheat	3/t	1
SUPERCARB T 585 SC	Wheat	3.75/t	1
SUPERCARB T 80 PSU	Wheat	3/t	1
TIRAMETOX 625 SC	Wheat	3.75/t	1
TIRAMETOX 90 PTS	Wheat	3.75/t	1
TRIALIN 50	Barley	2.5/t	1
TRIALIN MT	Wheat	2.5/t	1
VITALIN 85 PTS	Wheat, barley	3/t	1
Malation containing products			
CARBETOX 37 CE	Fruit trees, vegetables	3-4	1
CARBETOVUR 50 EC	Fruit trees	2	1
CARBETOX 50 CE	Fruit trees	3	1
ODORIZAT	Fruit trees	2	1
CARBETOX 50 CE	Fruit trees, vegetables	2-3	1
DIGRAIN STOCK	Storage products	4/100t	1
PROSTORE 157 UL	Storage products	4/100t	1
PROSTORE 210 EC	Storage products	12.5/1000m^2	1

Name of Product containing Active Ingredients	Main Crops Applied to	Typical Application Rate (kg or litre per ha)	Typical Number of Applications per Year
PROSTORE 420 EC	Storage products	10/1000m^2	1
SINTOGRIL 5 G	Vegetables	30	1
Isoproturon containing products			
ARELON 75 WP	Wheat	3	1
ISOFLO 500 SC	Wheat	3-5	1
IZOGUARD 500 SC	Wheat, barley	5	1
TURONEX 500 SC	Wheat	3-5	1
Simazine containing products			
SIMADON 50 PU	Fruit trees	8-10	1
SIMANEX 50 SC	Fruit trees, vegetables	3.5	1
SIMANEX 50 WP	Fruit trees	4.5	1
SIMANEX 80 WP	Fruit trees, vineyards	6-8	1
Trifluralin containing products			
DIGERMIN 24 EC	Vegetables	3.5-5	1
EFLURIN 24 EC	Sunflower	3.5-5	1
EFLURIN 48 EC	Sunflower	2	1
TREFLAN 24 EC	Vegetables,Sunflower	3.5-5	1
TREFLAN 24 CE	Vegetables, Sunflower	3.5-5	1
TREFLAN 48 CE	Soia, Sunflower	1.5-2	1
TREFLAN 48 EC	Sunflower, soia	1.75-2.5	1
TRIFLUREX 24 CE	Soia	3.5-5	1
TRIFLUREX 48 CE	Soia, sunflower	1.75-2.5	1
TRIFLUREX 48 EC	Sunflower, vegetable	1.75-2.5	1
TRIFLUROM 24 CE	Sunflower, soia	3.5-4	1
TRIFLUROM 48 CE	Soia, sunflower	1.75-2.5	1
TRIFSAN 480 EC	Sunflower, vegetable	1.75-2.5	1

Table 37: With Priority Pesticides Treated Areas by Crop in 2001 in Romania

Name of Formulated Product containing AI	% AI contained in Product	Treated Area (Estimate)
2,4-D containing products		
2,4 D SARE DIMETILAMINA tip 600 2,4 D SARE DMA 600 2,4 D DMA 810 SL 2,4 D SARE DE AMINE DICOPUR D DICOPUR M DMA 6 OLTEST ICEDIN SUPER RV ICEDIN SUPER LANCET LANCET RV LOTUS D LOGRAN D/RV MUSTANG OLTIDIN SUPER OLTISAN M SANROM 375 WEEDMASTER	50 60 67.5 33 60 75 66 50 30 28 45 45 42 59.6 30 30 32.5 10 33.4	In 2001, 35-40 % from the cereal crops were treated with 2,4 D products.
Alachlor containing products		
ALANEX 48 EC LACORN 48 EC LASSO 48 CE RV MECLORAN 35 CE MECLORAN 48 CE AGROCHLOR ALAZINE 33/14 SE LACORN COMBI	48 48 48 35 48 33.6 33.6 33.6	Currently, only 20-30 % of the crops.
Atrazine containing products	-	
ALANEX 48 EC LACORN 48 EC LASSO 48 CE RV AGROCHLOR ALAZINE 33/14 SE LACORN COMBI BUTIZIN 40 SC RV BUTIZIN 60 SE PRIMEXTRA GOLD SANOLT COMBI TAZASTOMP 500 WP	48 48 48 14.4 14.4 14.4 20 20 32 10 20	25-30 % of the maize crops.
Copper containing products	-	-
CHAMPION 50 WP FUNGURAN OH 50 WP KOCIDE 101 SUPER CHAMP FL	50 50 50 25	5-10 % of the fruit trees crops with a Cooper hydroxide 15-20 % of vegetables crops with Cooper hydroxide
OXICIG 50 PU TURDACUPRAL 50 PU ALIETTE C CUPROZIR 50 PU CURZATE CUMAN CURZATE MANOX CURZATE PLUS T GALBEN M MANCUVIT PU	50 50 25 34 19.3 50 40 33 46	60-70 % of the vineyard crops with a Cooper oxychlorides 30-35 % of the vegetables crop with a Cooper oxychloride products

Name of Formulated Product containing AI	% AI contained in Product	Treated Area (Estimate)
MICAL B	25	
RIDOMIL GOLD PLUS 42,5	40	
RIDOMIL PLUS 48 WP	40	
BOILLIE BORDELAISE	20	5-10 % of the fruit trees crops
CUPROFIX F	12	3-5 % of the vegetables crops
Chlorpyrifos containing products	-	-
CHLOROFET 480 EC	48	15-20 % of the cereal crops and 10-15 % of fruit trees area
DURSBAN 48 CE	48	
DURSBAN 480 EC	48	
PILOT 480 EC	48	
PYRINEX 20 EC	20	
PYRINEX 48 EC	48	
RELDAN 40 EC	40	
RELDAN 50 EC	50	
Diuron containing products	-	-
VEGEPRON DS	16.5	1-5 % vineyard and fruit trees
Endosulfan containing products		
THIODAN 35 EC	35	7-10 % of vineyard and fruit trees area
THIONEX ULV	25	
THIONEX 35 EC	35	
THIONEX 50 WP	50	
Lindane containing products		
LINDAN HC	66.6	60-70 % of seed of cereal crops are treated with a lindane products
LINDAN 400 SC	40	
LORSBAN L 16 EC	16	
SINOLINTOX 5 G	5	
SUMIDAN	50	
CHINODINTOX 55 PTS	40	
GAMAVIT	35	
MASTERLIN	50	
MICLODAN 50 PTS	40	
MICLODAN EXTRA 45 PTS	40	
MICLODAN EXTRA 45 PUS	40	
PROCARB L	33	
PROTILIN AL 81 PUS	35	
PROTILIN 81 PTS	35	
SUPERCARB T 585 SC	25	
SUPERCARB T 80 PSU	35	
TIRAMETOX 625 SC	25	
TIRAMETOX 90 PTS	35	
TRIALIN 50	40	
TRIALIN MT	40	
VITALIN 85 PTS	35	
Malathion containing products	-	
CARBETOX 37 CE	37	5-10 % of fruit trees
CARBETOVUR 50 EC	50	
CARBETOX 50 CE ODORIZAT	50	
CARBETOX 50 CE	50	
DIGRAIN STOCK	50	
PROSTORE 157 UL	20	
PROSTORE 210 EC	15	
PROSTORE 420 EC	20	
SINTOGRIL 5 G	40	
	0.3	
Isoproturon containing products		
ARELON 75 WP	75	1-3 % of the wheat and barley crops

Name of Formulated Product containing AI	% AI contained in Product	Treated Area (Estimate)
ISOFLO 500 SC	50	
IZOGUARD 500 SC	50	
TURONEX 500 SC	50	
Simazine containing products	-	-
SIMADON 50 PU	50	3-5 % of the fruit trees and vineyards
SIMANEX 50 SC	50	
SIMANEX 50 WP	50	
SIMANEX 80 WP	80	
Trifluralin containing products		
DIGERMIN 24 EC	24	60-70 % of sunflower crops and vegetables
EFLURIN 24 EC	24	
EFLURIN 48 EC	48	
TREFLAN 24 EC	24	
TREFLAN 24 CE	24	
TREFLAN 48 CE	48	
TREFLAN 48 EC	48	
TRIFLUREX 24 CE	24	
TRIFLUREX 48 CE	48	
TRIFLUREX 48 EC	48	
TRIFLUROM 24 CE	24	
TRIFLUROM 48 CE	48	
TRIFSAN 480 EC	48	

Annex 9

Pesticide Usage in Serbia & Montenegro

Annex 9: Pesticide Usage in Serbia & Montenegro

The sales data provided by the national experts are summarised in Table 38. These data show that copper is the priority pesticide with the highest use in Serbia & Montenegro.

More detailed use information was not available. Registration data and amounts sold by product can be found in Table 39.

Table 38: Amounts of Priority Pesticides Sold in 2002 in Serbia & Montenegro

Pesticide	Sold amounts in kg (active ingredient)	Sold amounts in kg (product)
Copper oxychloride	162,500	
Malathion	123,600	
Atrazine	114,850	
Trifluralin	96,000	
Copper hydroxide	10,000	
Simazine	10,000	
Endosulfan	7,000	
Chlorpyrifos		80,000
Zinc phosphide		50,000

Problems Associated with Pesticide Use

Regarding problems associated with pesticide use following information was given:

2,4-D: Farmers don't respect time of application given in instructions, they apply pesticides after deadline given in instructions.

Atrazine: Farmers apply higher dosage than the proposed one, even 2-3 times higher in some cases. They do not respect proposed time of application, they apply pesticides later than it is proposed.

Trifluralin: Farmer use pesticide in production of early vegetables: (root vegetables, tuberous vegetables, bulbiferous vegetables). There is restriction because of the crop rotation.

Pesticides in general: Very often farmers don't respect time of application given in instructions and they apply pesticides later than it is proposed. They apply higher dosage than it is proposed in instruction. This common bad practice among farmers is due to insufficient skill and education concerning pesticides application.

Table 39: Pesticide Registration Data of Pesticide Products Containing Priority Pesticides, Percentage Treated Crops and Amounts Sold in Serbia & Montenegro

Name of Formulated Product containing AI	AI contained in Product	National Sales (kg or lres) of Formulated (2002)
2,4-D containing products		
DIKAMIN-600	600 g/l	1,000,000 kg
HERBOXONE	500 g/l	
DEHERBAN-A	464 g/l	
AGROSAN		
DIKOCID		
DIHLORIN		
HERBISAN		
HERBIZOR		
KOROVICID		
MONOSAN HERBI		
MONOZOR SL-50		
POLJOSAN 2,4-D		
TIMKOR		
MATON	600 g/l	
HERBITON	600 g/l	
ESTERON	564 g/l	20,000 l
LENTEMUL-D	449,5 g/l	17,600 l
LANCET (2,4-D + FLUROKSIPIR-BUTOKSIPROPIL)	450g/l	-
MUSTANG (2,4-D+ FLORASULAM)	300g/l	6,000 l
Alachlor containing products		
AGROHLOR 480-EC	480 g/l	80,000 tons
ALAHERB EC-48		
ALAHLOR-48		
ALAHLOR-480		
ALAHLOR E-48		
ALAHLOR-EC		
ALAHLOR 48-EC		
ALAHLOR EC-48		
ALANEX 48-EC		
SAVAHLOR		
ZORAL 48-EC		

Name of Formulated Product containing AI	AI contained in Product	National Sales (kg or lres) of Formulated (2002)
Alachlor & Atrazine containing products		
ALAZINE-LM	336+144 g/l	-
ALAHLOR-ATRAZIN KS	336+144 g/l	50,000 l
LINUCHLOR 367-EC		
ALAHOR KOMBI	262+105 g/l	90,000 l
Alachlor & Linuron containing products		
GALOLIN KOMBI		
LIRON KOMBI		
LASSO LINURON	300+100 g/l	
ATRAZIN S-50		
ATRAZIN-500		
ATRAZIN-SC		200,000 tons
ATRAZIN SC-50		
ATRAZIN-TS ZUPA	500 g/l	
Atrazine containing products		
ATRAZOR 500-SC		
RADAZIN T-50		4,600 l
ATRANEX 50-SC		-
ATRANEX 80-WP	800 g/l	-
GESAPRIM 90-WG	900 g/l	-
ATRANEX 90-WDG	900 g/l	33,300 l
Atrazine, Amthrin & Amitrol containing products		
ZORAMAT S-47	270+120+80 g/kg	
ATPROM-500		33,000 kg
ATRAPROM	340+160 g/l	
Atrazine & Prometryne containing products		
INAKOR		
INACOR-T		4,000 l
Copper carbonate containing products		
SEMESAN PRAH	200 g/kg	
SEMESAN PASTA		
BAKAR BLAU WP-50		-
BLAUVIT	500 g/l	20,000 l
FUNGURAN-OH		-

Name of Formulated Product containing AI	AI contained in Product	National Sales (kg or lres) of Formulated (2002)
Copper hydroxide containing products		
SAMPION	250 g/l	-
BLAUVIT TECNI	240 g/l	-
KOCIDE-2000	538 g/l	
CUPRABLAU-Z	350 g/l	
Copper oxychloride containing products		
BAKARNI KREC-25	250 g/kg	
BAKARNI OKSIHLORID-25		
BAKROCID S-25		
BAKARNI KREC-50	500 g/kg	280,000 kg
BAKROCID-50		
BAKARNI OKSIHLORID-50		
BORSKI BAKARNI KREC S-50		
BEVEBLAU KREC		
CURZATE R-WG (Copper oxychloride + Cimoksanil)	397,5+42 g/kg	40,000 kg
TIOZIN-A (Copper oxychloride + Zineb)	360+140 g/kg	
BAKARNI KREC SUPER (Copper oxychloride + Cimoksanil)		
BEVEBLAU SUPER (Copper oxychloride + Zineb)	330+90 g/kg	-
BAKARNI EKSTRA KREC (Copper oxychloride + Zinc carbonate)	330+90 g/l	20,000 kg
Copper sulphate (basic) containing products		
CUPROXAT	190 g/l	
Chlorpyrifos containing products		
PIRICID	480g/l	
PYRINEX 48-EC		80,000 l
CHROMOREL-D	18 g/kg	
CHROMOREL P-2		
HLORPIRIFOS G-7,5	75 g/kg	
PIRICID G-7,5		
Endosulfan containing products		
BEVETICID	350 g/l	20,000 l
TIOCID E-35		
THIODAN E-35		
TIONEX E-35		

Name of Formulated Product containing AI	AI contained in Product	National Sales (kg or lres) of Formulated (2002)
Malathion containing products		
DASTICID PRAH	50 g/kg	
ETIOL PRAH-5		2,000 kg of FP
ETIOL TECNI	500 g/l	
INSEKTIN		2,000 kg
MALATION E-50		150,000 l
ETIOL -ULV		
INSEKTIN-ULV		
MALATION-ULV	950 g/l	50,000 l
WEBETION-ULV		
DASTICID SPECIAL		
ETIOL SPECIAL	10 g/kg	
AMBARIN		100,000 kg
Isoproturon containing products		
no products registered		
Simazine containing products		
SIMAZIN S-50	500g/kg	20,000 kg
TETEZIN		
Trifluralin containing products		
AGROTREF	480 g/l	96,000 l
HERBITREF EC-48		
LALAZIN		
POLJOTREF EC-48		
SUTREF-48		
TREFGAL		
TREFLAN-EC		
TRIFLUREX 48-EC		
ZUPILAN		
Zinc phosphide containing products		
CINKOSAN	20 g/kg	50,000 kg
CINKFOSFID MAMAK		
CINKFOSFID PRAH	840 g/kg	
FACIRON PRAH		

Active Ingredients (AI)	Name of Product containing Active Ingredients	Main Crops Applied to	Typical Application Rate (kg or litre per ha)	Typical Number of Applications per Year
2,4-D	DIKAMIN-600	Wheat, Barley, Maize	0.75-2.5	1
	HERBOXONE			
	DEHERBAN-A			
	AGROSAN			
	DIKOCID			
	DIHLORIN			
	HERBISAN			
	HERBIZOR			
	KOROVICID			
	MONOSAN HERBI			
	MONOZOR SL-50			
	POLJOSAN 2,4-D			
	TIMKOR			
	MATON			
	HERBITON			
	ESTERON			
	LENTEMUL-D			
2,4-D + FLUROKSIPIR-BUTOKSIPROPIL	LANCET	Wheat, Barley, Maize	1-1.2	1
2,4-D+ FLORASULAM	MUSTANG	Wheat, Barley, Maize	0.4-0.6	1
Alachlor	AGROHLOR 480-EC	Maize, Sunflower, Soyabean	4-6	1
	ALAHERB EC-48			
	ALAHLOR-48			
	ALAHLOR-480			
	ALAHLOR E-48			
	ALAHLOR-EC			
	ALAHLOR 48-EC			
	ALAHLOR EC-48			

Active Ingredients (AI)	Name of Product containing Active Ingredients	Main Crops Applied to	Typical Application Rate (kg or litre per ha)	Typical Number of Applications per Year
	ALANEX 48-EC			
	SAVAHLOR			
	ZORAL 48-EC			
Alachlor + ATRAZIN	ALAZINE-LM	Maize	5-7	1
	ALAHLOR-ATRAZIN KS			
Alachlor + LINURON	LINUCHLOR 367-EC	Maize	6-9	1
	ALAHOR KOMBI	Sunflower		
	GALOLIN KOMBI	Soyabean		
	LIRON KOMBI			
	LASSO LINURON			
Atrazine	ATRAZIN S-50	Maize	2	1
	ATRAZIN-500			
	ATRAZIN-SC	Fruit trees	4-6	
	ATRAZIN SC-50	Vineyards		
	ATRAZIN-TS ZUPA			
	ATRAZOR 500-SC			
	RADAZIN T-50			
	ATRANEX 50-SC			
	ATRANEX 80-WP			
	GESAPRIM 90-WG			
	ATRANEX 90-WDG			
Atrazine+AMETRIN+AMITROL	ZORAMAT S-47	Maize	2.5-3	1
Atrazine+PROMETRIN	ATPROM-500		2-3	1
	ATRAPROM			
	INAKOR			
	INACOR-T	Maize		
Copper carbonate, basic	SEMESAN PRAH	Wheat	200gr on 100kg of seed	1
	SEMESAN PASTA			
Copper hydroxide	BAKAR BLAU WP-50	Fruit trees	1-7	2
	BLAUVIT	Vineyards	1-4	
	FUNGURAN-OH	Potatoes	1-4	
	SAMPION	Field vegetables	3-5	

Active Ingredients (AI)	Name of Product containing Active Ingredients	Main Crops Applied to	Typical Application Rate (kg or litre per ha)	Typical Number of Applications per Year
	BLAUVIT TECNI			
	KOCIDE-2000			
Copper hydroxide + KALCIJUM HLORID DVOJNA SO	CUPRABLAU-Z	Vineyards	3	2
Copper oxychloride	BAKARNI KREC-25	Fruit trees	5-15	2
	BAKARNI OKSIHLORID-25	Vineyards, Potatoes, Field vegetables		
	BAKROCID S-25			
	BAKARNI KREC-50			
	BAKROCID-50			
	BAKARNI OKSIHLORID-50			
	BORSKI BAKARNI KREC S-50			
	BEVEBLAU KREC			
Copper oxychloride + CIMOKSANIL	CURZATE R-WG			
Copper oxychloride + CINEB	TIOZIN-A	Vineyards, Potatoes	3	1
Copper oxychloride + CINK-KARBONAT	BAKARNI KREC SUPER	Fruit trees, Vineyards	4-5	1
	BEVEBLAU SUPER	Potatoes		
	BAKARNI EKSTRA KREC	Field vegetables		
Copper sulphate (basic)	CUPROXAT	Fruit trees Vineyards Potatoes Field vegetables	4-6 2.5-3.5 2	1
Chlorpyrifos	PIRICID	Wheat Maize	1-1.5 lit foliarly 6-8 lit through soil	2 1
	PYRINEX 48-EC	Potato		

Active Ingredients (AI)	Name of Product containing Active Ingredients	Main Crops Applied to	Typical Application Rate (kg or litre per ha)	Typical Number of Applications per Year
	CHROMOREL-D	Sugar beet	20-35 kg through dusting	1
	CHROMOREL P-2	Sunflower		
	HLORPIRIFOS G-7,5	Fruit trees		
	PIRICID G-7,5	Vegetables		
Endosulfan	BEVETICID	Fruit trees	1-3	1
	TIOCID E-35	Sugar beet	2.5-3.5	
	THIODAN E-35	Potatoes	1.5-2	
	TIONEX E-35			
Malathion	ETIOL TECNI	Fruit trees Vineyards Wheat, Barley	1.5-3	2
	INSEKTIN	Sugar beet Vegetables		
	MALATION E-50			
Isoproturon	-	-	-	-
Simazine	SIMAZIN S-50	Fruit trees	4-6	1
	TETEZIN	Vineyards		
Trifluralin	AGROTREF	Soyabean	1-2.5	1
	HERBITREF EC-48	Sunflower		
	LALAZIN	Vegetables		
	POLJOTREF EC-48			
	SUTREF-48			
	TREFGAL			
	TREFLAN-EC			
	TRIFLUREX 48-EC			
	ZUPILAN			
	CINKOSAN	Fruit trees	5-10gr/per bait hole	2
	CINKFOSFID MAMAK	Wheat		

Annex 10

Pesticide Usage in Slovakia

Annex 10: Pesticide Usage in Slovakia

The Republic of Slovakia is one of very few countries that maintain a Pesticide Use Reporting System. Article 3 of Law on Plant Health Care states:

'Anyone who works either agricultural land to produce food of plant origin intended for public consumption and feeding stuffs to be placed on the market or works forest land for the purpose of enterprising while using thereby plant protection products shall, apart from the duties referred to in the first paragraph of the present Article, keep records on the consumption and ways of application thereof and on official request to submit them to the Central Control and Testing Institute of Agriculture).

Details on the keeping records on the consumption and on the manner of application of plant protection products according to the second paragraph of the present Article will be dealt with in a generally binding regulation that will be issued by the Ministry of Agriculture of the Slovak Republic (hereinafter referred to as "the Ministry").'

In Decree 3322/3/2001-100 the details are described:

Article 2

Keeping of records on the applied amount(s) and the method(s) of application of products

(1) The records concerning the applied amount(s) and the method (s) of application of products shall be kept by persons as referred to in Article 3 (2) of the Act.

(2) The records as referred to in the first paragraph of the present Article shall be archived for ten years from the end of the year of their application. A model form for the keeping of records is given in Annex 3 to the Decree.

(3) The cumulative data on the applied amount(s) of products in course of a given calendar year recorded in the form whose model is given in Annex 4 to the Decree shall be submitted to the Central Control and Testing Institute of Agriculture (hereinafter referred as "the Control Institute") by the person accountable for keeping records on the applied amount(s) and the method (s) of application of products through competent officials of plant health care bodies (hereinafter referred to as "phytosanitary inspector(s)") no later than by 15th November of the relevant calendar year. The natural persons and legal persons carrying out the treatment of ware potatoes, seeds and planting stock shall submit the required data no later than by 20th December of the relevant calendar year.

In addition to the PUR system, the Slovak Republic started a pesticide sales reporting system in 1999. All traders manufacturer, importer, distributors and retailers are required to report annually sales data. They are required to report name and amounts of formulated products for agricultural and for non-agricultural pesticides. Sales data are supposed to be publicly available by amounts active ingredient, chemical class, use type and by postal code[12].

Overall usage data are shown in the next figure. Figure 8 shows that usage between 1997 and 2001 was around 3,500 ton active ingredients per years. Only in 1999 usage was below 3000 tons. Data for 2000 were not provided.

[12] Communication with Martin Hajas (Central Control and Testing Institute of Agriculture) and Jozef Kotleba (Ministry of Agriculture)

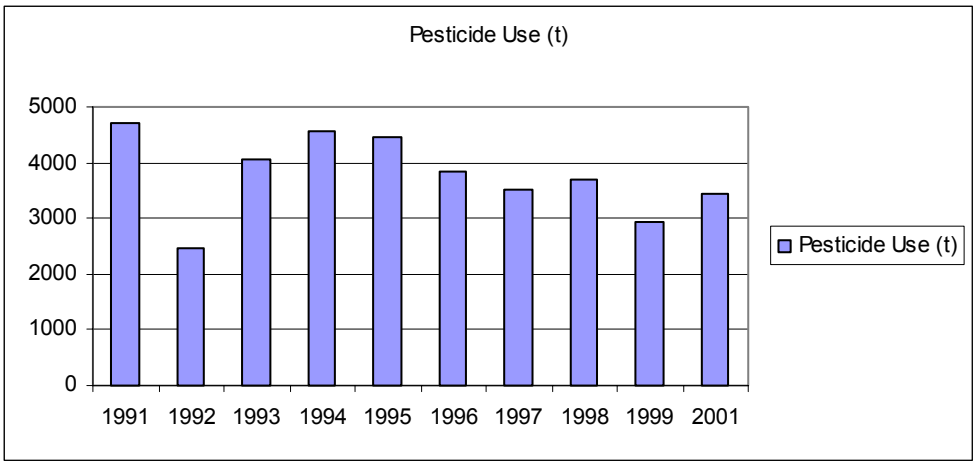

Figure 8 Pesticide Use in Slovakia (tons AI) 1991-2001

The intensity of pesticide use is presented in Figure 9 below. In 1996, 1997, 1998 and 2001 around 1.5 kg/ha pesticide were applied on average. In 1999 intensity was lower. Data for 2000 were not provided.

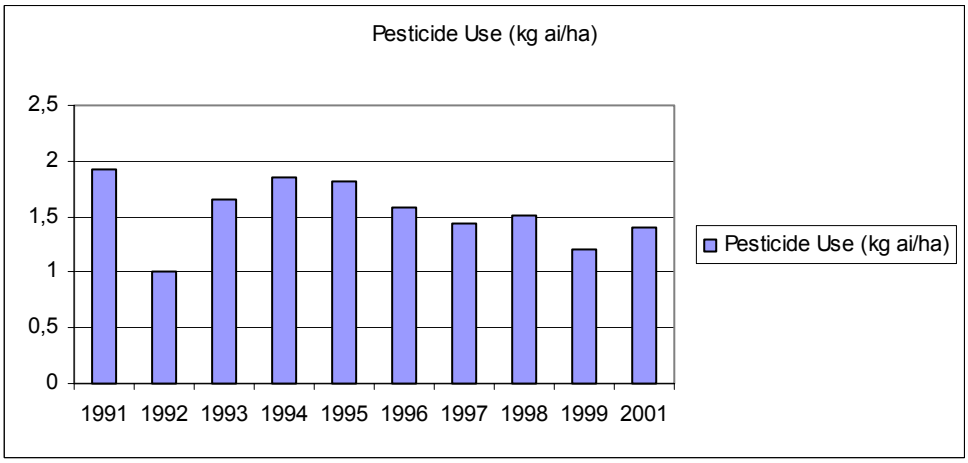

Figure 9: Intensity of Pesticide Use 1991-2002 (kg/ha)

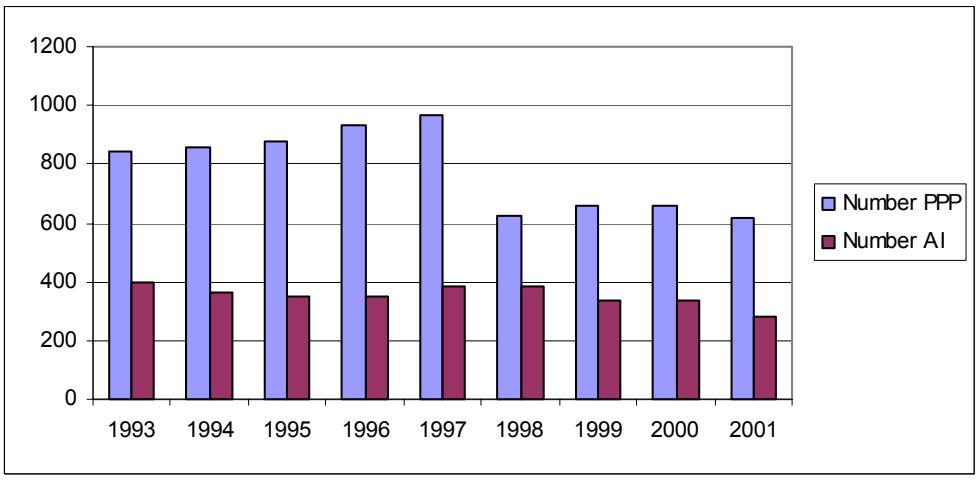

Figure 10 Number of Authorised Plant Protection Products and Active Ingredients in Slovakia

Figure 11 shows the total pesticide use by county. Nitra, Trnava and Kosice are the county with the highest pesticide use. These figures shows separately biological agents such as Bacillus thuringensis, Trichoderma spec. and Amblyseius cucumeris.

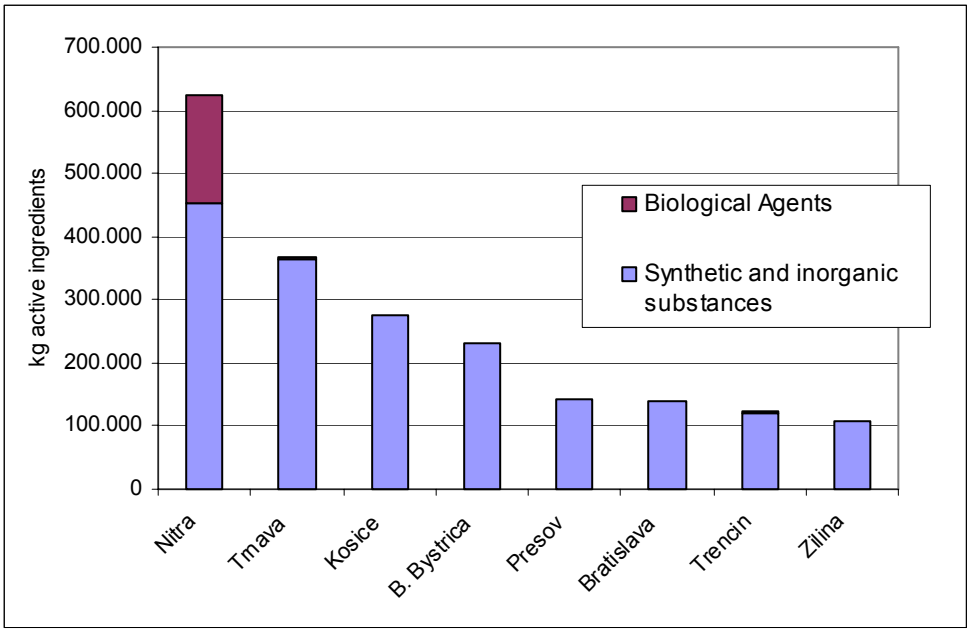

Figure 11 Pesticide Use in 2002 by County

The next table shows the Top 25 pesticides used in Slovakia in 2002. Six priority pesticides belong to the Top 25 pesticides (bold).

Table 40: Top 25 Pesticides Used in Slovakia in 2002

No.	Active ingredient	kg Used in Slovakia
1	ACETOCHLOR	211,008
2	REPELENTNE LATKY	148,098
3	GLYPHOSATE	87,963
4	MCPA	86,747
5	**ATRAZINE**	**84,964**
6	**ALACHLOR**	**80,297**
7	CHLORMEQUAT	67,402
8	CARBOXIN	61,221
9	THIRAM (TMTD)	59,387
10	MANCOZEB	59,101
11	SULFUR	47,953
12	**CHLORPYRIFOS**	**38,349**
13	**2,4-D-EHE**	**35,824**
14	CHLORIDAZON	29,899
15	CARBENDAZIM	29,474
16	METOLACHLOR	28,036
17	**TRIFLURALIN**	**25,274**
18	PROMETRYN	21,546
19	METAZACHLOR	20,712
20	PENDIMETHALIN	18,654
21	**COPPER OXYCHLORID**	**18,523**

No.	Active ingredient	kg Used in Slovakia
22	MON 4660	14,977
23	PINOLENE	14,744
24	MCPA-NA-K-DMA	14,018
25	PROPISOCHLOR	13,954

Priority Pesticide Use

Table 41 shows the amounts priority substances use in Slovakia counties in 2002. Atrazine and Alachlor are the pesticides with the highest amounts used. Altogether priority pesticides account for 17% of the total pesticide use in 2002 (without biological agents). Nitra, Trnava and Kosice are the county with the highest use of priority pesticides.

Table 41: Amounts Use of Priority Pesticide in Slovakia Counties 2002 in kg

Active ingredient	Slovakia	Nitra	Trnava	Kosice	Bystrica	Presov	Trencin	Bratislava	Zilina
Atrazine	84,964	19,241	22,489	10,251	14,061	5,695	5,727	4,025	3,476
Alachor	80,297	8,436	8,894	27,740	12,798	18,183	2,088	259	1,898
Chlorpyrifos	38,349	11,904	9,052	4,533	4,504	3,199	3,321	1,251	585
2,4-D-EHE	35,824	8,470	6,713	4,713	3,174	4,769	4,758	1,263	1,965
Trifluralin	25,274	11,980	5,236	2,496	2,928	257	714	1,496	168
Copper oxychloride	18,523	3,998	2,211	1,425	547	85	1,636	8,494	128
Copper hydroxide	9,096	5,371	891	811	244	55	378	1,343	3
Isoproturon	8,598	1,241	823	588	2,034	796	1,934	824	359
2,4-D	7,148	2,287	2,853	168	240	1,074	118	213	194
2,4 D-DMA	4,244	705	1,597	292	732	75	448	141	256
Zinc phosphid	1,508	920	272	23	0	172	122	0	0
Simazine	213	93	50	2	0	5	46	0	18
Chlorpyrifos-ethyl	5	0	0	0	0	0	0	0	4
Total	**314,043**	**74,646**	**61,081**	**53,042**	**41,262**	**34,365**	**21,290**	**19,309**	**9,054**

Problems Associated with Pesticide Use

According to the national authorities there are some problems with trade of non-authorised products across the Hungarian border.

Annex 11

Pesticide Usage in Slovenia

Annex 11: Pesticide Usage in Slovenia

Arable land and permanent crops in Slovenia occupy 285,000 ha; permanent pastures 502,000 ha and forests 1.1 million ha. Main crops are maize 44,401 ha, wheat 31,615 ha, potatoes 9,840 ha, fruits 37,514 ha, vegetables 3,941 ha and hops 1,803 ha.

According to the International Society for Horticultural Science, there are 5,000 ha of intensive orchards (mainly apples, pears, peaches, olives and strawberries). By cadastre there are also 31,000 ha of extensive old orchards. The acreage of vineyards is 25,000 ha. Annually 3,000,000 wine grafts and 700,000 maiden fruit trees are produced. Vegetables are grown on 11,500 ha of which 1,000 ha under cover.

The yearly production of ornamentals is about 30,000,000 trees, bushes, and cut and pot plants.

Pesticide use data from available for Slovenia from the FAO are not up to date and rather raw, since they based upon sales data by formulated products and they do not present specific use data by crop or active ingredients. The FAO database provides trends of sales by chemical class only for the last two years (1997, 1998), which does not allow to evaluate a trend. The overall use, however, declined by 30% in 1995-1998 years.

The agrochemical journal Agrow states in January 2003 that: *"In contrast to the declining western European market, there has been steady growth over the past two years in the crop protection markets of the ten EU accession countries. This is attributed to EU aid and high disease pressure in 2001*"[13]. Numbers for Slovenia were, however, not published.

Using the 1998 usage data and the 285.000 hectares for arable land and permanent crop an average use of 3,8kg/ha applies. Since this number presents the use of formulated products it cannot be compared with other countries. In addition, such numbers have to be interpreted with caution. There are approximately 92.000 small farmers in Slovenia, most of them may not use pesticides at all[14].

Table 42 shows sales data of formulated products containing priority pesticides. These data were provided by national experts.

The sum of some 200,000 kg represents ca. 20% of the national sales (based upon 1998 total). These numbers are possibly underestimated considering the large areas with specialty crops such as grapes, orchards and hops.

Information on treated areas are not available.

Table 42: Amounts Priority Pesticides Sold in Slovenia in 2001

Pesticide	Amount sold in 2001 (kg formulated product)
Copper hydroxide	83,150
Isoproturon	67,000
2,4-D	20,700
Copper sulphate	12,600
Copper oxychloride	12,200
Trifluralin	2,460
Simazine	2,400
Endosulfan	2,030

[13] PJB Publications Ltd (2003): Agrow No 416, January 17th 2003, page 9

[14] Neumeister, L. (2003): Pesticides Registered in Eastern European Countries, Usage, Registration, Identification and Evaluation, Part 4: Slovenia , Pestizid Aktions-Netzwerk e.V. (PAN Germany), Hamburg

Chlorpyrifos	1,670
Alachlor	0

Total	**204,210**

Problems Associated with Pesticide Use

The production of maize as animal fodder occupies 40% of the arable land, which leads to narrow crop rotation with increasing environmental and agricultural problems – including the use of the herbicides Atrazine and Simazine in doses which are higher than recommended.

Excessive concentrations of the herbicide atrazine, its metabolites plus a number of other herbicides simazine, metolachlor and prometryne were detected in aquifers in central Slovenia. In this area aquifers represent water sources for 45-50% of the population. Extensive use of the maize herbicide atrazine also caused a resistance of lambs quarter (Chenopodium album) against this herbicide and possibly to other similar herbicides.

In November 2002 atrazine was banned in Slovenia.

Spreading too closely to water sources is (or it use to be) a common practice. The 'Water Act' which has been accepted in 2002 interdicts spreading fertilisers or pesticides in the 5 metre strip near smaller streams/ditches and in 15 metre strip near main watercourses.

Table 43: Pesticide Registration Data of Pesticide Products Containing Priority Pesticides and Amounts Sold in Slovenia

Pesticide	Name of Formulated Product containing AI	Percentage AI	Amounts Sold
2,4-D	DEHERBAN A DEHERBAN COMBI-MD DICOFLUID MP COMBI DIKOCID HERBOCID	2,4-D 464 g/l mecoprop (MCPP) 400 g/l + 2,4-D 150 g/l mecoprop 430 g/l + 2,4-D 130 g/l 2,4-D 464 g/l 2,4-D 460 g/l	20,700 kg
Alachlor	ALAPIN	Alachlor 480 g/l	
Copper hydroxide	CHAMPION 50 WP CUPRABLAU-Z CUPRABLAU-Z ULTRA	Copper 50% (in form of Copper hydroxide) Copper in form of Copper hydroxide and Calcium chloride complex 35% + zinc in form of zinc sulphide 2% Copper (in form of Copper hydroxide and Calcium chloride complex: 3Cu(OH)2 x CaCl2) 35 % + zinc (in form of Zinc sulphide: ZnS) 2 %	83,150 kg
Copper oxychloride $_3$	BAKRENI DITHANE GALBEN C KUPROPIN RAMIN 50 RIDOMIL PLUS 48 WP	mancozeb 25% + Copper in form of Copper oxychloride 30% Copper oxychloride 33 %, benalaxyl 4 % Copper in form of Copper oxychloride 50% Copper 50% metalaxil 8% + Copper oxychloride 40%	12.200 kg
Copper sulphate (basic)	BORDOJSKA BROZGA BORDOJSKA BROZGA CAFFARO BORDOJSKA BROZGA-SCARMAGNAN MODRA GALICA MODRA GALICA-PINUS	Copper in form of Copper sulphate 20% Copper in form of Copper sulphate 20% Copper in form of Copper sulphate 20% Copper in form of Copper sulphate 25% Copper in form of Copper sulphate 25%	12,600 kg

	MODRA GALICA-SCARMAGNAN VEDRJUL	Copper 25% Copper in form of Copper sulphate 20%	
Chlorpyrifos	CHROMOREL D CHROMOREL P-2 PYRINEX 48 EC	Chlorpyrifos 500 g/l + cipermethrin 50 g/l Chlorpyrifos 1,8% + cipermethrin 0,2% Chlorpyrifos 480 g/l	1,670 kg
Endosulfan	THIODANE E-35	Endosulfan 350 g/l	2,030 kg
Malathion			
Isoproturon	GRODYL PLUS MENTOR TOLKAN	amidosulfuron 15 g/l + isoproturon 600 g/l pendimetalin 250 g/l + isoproturon 125 g/l isoproturon 500 g/l	67,000 kg
Simazine	PIN 140-S SIMAPIN KS 50	glifosat 140 g/l + simazine 140 g/l + dissolvent polioxyethylen-alkylamin 200 g/l simazine 50%	2,400 kg
Trifluralin	TREFLAN EC TRIKEPIN	trifluralin 480 g/l trifluralin 240 g/l	2,460 kg

Table 44: Products containing Priority Pesticides Their Application Rate and Number of Application

Name of Product containing Active Ingredients	**Main Crops Applied to**	**Typical Application Rate (kg or litre per ha)**	**Typical Number of Applications per Year**
2,4-D containing products			
DEHERBAN A	Grasslands and pastures	2.5 – 3 l/ha	1
	Corn	1.5 – 2.5 l/ha	1
	Cereals (except barley)	1.5 – 2.5 l/ha	1
DEHERBAN	Grasslands and pastures	4 – 5 l/ha	1
COMBI-MD	Cereals (except barley)	4 l/ha	1
DICOFLUID MP	Grasslands and pastures	4 – 5 l/ha	1
COMBI	Cereals (except barley)	4 l/ha	1
	Grasslands and pastures	2.5 – 3 l/ha	1
DIKOCID	Corn	1.0 – 1.5 l/ha	1
	Cereals (except barley)	1.5 – 2.5 l/ha	1
	Grasslands and pastures	2.5 – 3 l/ha	1
HERBOCID	Corn	1.5 – 2.5 l/ha	1
	Cereals (except barley)	1.5 – 2.5 l/ha	1
Alachlor containing products			
ALAPIN	Silage corn	4 – 6 l/ha	1
	Sunflower and Soya	4 – 6 l/ha	1
	Oil rape	3 – 5 l/ha	1
Copper containing products			
CHAMPION 50 WP	Vineyards Fruit trees	0.20 – 0.25 %	1-4
	Ventuira inaequalis, Venturia pyrina	0.70%	1
	Stigmina carpophila	0.5 – 1%	1
	Taphrina deformans		1
	Monilinia laxa	0.5%	1
	Hops	1%	1
	Vegetables	2.5 kg/ha	2
	Peronospora destructor	3.5 kg /ha	2
	Xanthomonas phaseoli	0.5%	2
	Pseudoperonospora cubensis	0.3 – 0.5%	3
	Potatoes and tomatoes	2.5 kg/ha	3
CUPRABLAU-Z	Vineyards	0.3%	3
	Hop fields	0.25% – 0.3%	3
	Fruit orchards	0.8%	1

Name of Product containing Active Ingredients	Main Crops Applied to	Typical Application Rate (kg or litre per ha)	Typical Number of Applications per Year
	Crops and vegetables	3 – 4 kg/ha	2
CUPRABLAU-Z ULTRA	Vineyards Hop fields Crops and vegetables: Potatoes and Tomatoes Onions, tomatoes Fruit orchards	0.25% 0.2 – 0.25% 2 – 2.5 kg/ha 2 – 2.5 kg/ha 0.70%	3 3 3 3 1
BAKRENI DITHANE	Vineyards Fruit orchards Potatoes	0.3 – 0.4 % 0.7 – 0.8% (0.3 – 0.4%) 3 – 4 kg/ha	1 3
GALBEN C	*Plasmopora viticola* *Phytophora infestans* *Peronospora destructor*	0.4 – 0.5% 5 – 6 kg/ha 4 – 5 kg/ha	4 3 3
KUPROPIN	Fruit orchards Vineyards Hop field Potatoes and tomatoes	0.5 – 0.75% 0.5 – 0.75% 0.5 – 0.75% 5 – 7 kg/ha	1 3 3 3
RAMIN 50	Fruit orchards Vineyards Hop field Potatoes and tomatoes Onions Cucumbers Beans	0.5 – 0.75% 0.5 – 0.75% 0.5 – 0.75% 5 – 7 kg/ha 0.3 – 0.5% 0.3 – 0.5% 0.5%	1 3 2-3 3 3 3 3
BORDOJSKA BROZGA	Fruit orchards Vineyards Hop field Crops and vegetables	1 – 1.5% 1 – 1.5% 1 – 2% 1 – 1.5%	1 2 2 2
BORDOJSKA BROZGA CAFFARO	Fruit orchards Vineyards Crops and vegetables	0.95 – 1.15% 0.6 – 0.8% 1 – 1.5%	1 3 2
BORDOJSKA BROZGA-SCARMAGNAN	Fruit orchards Vineyards Crops and vegetables	0.95 – 1.15% 0.6 – 0.8% 1 – 1.5%	1 3 2
MODRA GALICA	Fruit orchards Vineyards Hop field Crops and vegetables	1 – 1.5% 1 – 1.5% 1 – 2% 1 – 1.5%	1 3 3 2
MODRA GALICA-PINUS	Fruit orchards Vineyards Hop field Crops and vegetables	1 – 1.5% 1 – 1.5% 1 – 2% 1 – 1.5%	1 3 3 2
VEDRJUL	Fruit orchards Vineyards Hop field Crops and vegetables	1 – 1.5% (1.5 – 2%) 1.5% 1 – 2% 1 – 1.5%	1 3 3 2
Chlorpyrifos containing products			
CHROMOREL D	Aphididae; *Cydia pomonella,*	0.075 – 0.1%	2

Name of Product containing Active Ingredients	Main Crops Applied to	Typical Application Rate (kg or litre per ha)	Typical Number of Applications per Year
	Cacopsylla pyri	0.1 – 0.15%	2
	Crops:		
	Leptinotarsa decemlineata	0.5 – 0.9 l/ha	2
	Beet (*Mamestra* spp.)	1 – 1.5 l/ha	2
	Oil rape (*Meligethes aeneus*)	0.75 – 1 l/ha	2
	Leptinotarsa decemlineata	15 – 20kg/ha	2
	Fruit orchards:		
	Aphididae; *Hyphatnria cunea, Lymatria dispar*	1 – 1.5%	2
		1.5%	2
	Crops:	0.1 – 0.15%	2
	Aphididae;		
CHROMOREL P-2		0.15%	2
	Eurygater spp., *Mamestra* spp.		
PYRINEX 48 EC	Potatoes, vegetables	6 – 8 l/ha	2
Endosulfan containing products			
THIODANE E-35	Fruit trees		
	Aphididae; *Eriosoma lanigerum, Hoplocampa* spp.	0.15 – 0.20 %	2
			2
	Anthonomus pomorum, Hyphantira cunea		
	Phyllobius oblongus	0.15%	1
	Eriophyes piri		
	Vineyards	0.1%	1
	Colomerus vitis	0.15%	1
	Industrial plants	0.15%	2
	Aphididae		
	Meligethes aenus, Ceutorhynchus assimilis		
	Forests	0.15 – 20%	2
		1.2 – 1.8 l/ha	1
		0.30 – 0.60%	1
Isoproturon containing products			
GRODYL PLUS	Cereals	1.75 – 2 kg/ha	1
MENTOR	Winter wheat, barley, triticala	3 – 4 l/ha	1
TOLKAN	Winter wheat, barley, rye	4 – 5 l/ha (autumn)	1
		2.5 – 3.5 l/ha (spring)	
Simazine containing products			
PIN 140-S	Vineyards and orchards (apples and pears)	9.0 – 12.5 l/ha	1
	Corn	2 – 3 kg /ha	1
SIMAPIN KS 50	Vineyards and orchards (apples and pears)	3kg/ha	1
Trifluralin containing products			
TREFLAN EC	Sunflower, soya, cotton, carrots, beans and oil rape	1.0 – 2.5 l/ha:	1
		1 – 1.5 l/ha light soil	
	Red pepper, eggplants , cabbage and cauliflower	2 l/ha medium heavy soil	
	Onion	2.5 l/ha heavy soil	
	Sunflower, soya, cotton, carrots, beans and oil rape	2.5 – 4.8 l/ha:	1
		2.5 l/ha light soil	
		3.6 l/ha medium heavy	
	red pepper, eggplants , cabbage and cauliflower	soil	
TRIKEPIN		4.8 l/ha heavy soil	1

Annex 12

Pesticide Usage in the Ukraine

Annex 12: Pesticide Usage in the Ukraine

In the Ukraine there are not statistics on pesticide usage.

In order to obtain the required information the national experts used the marketing database of the biggest international chemical companies operating in Ukraine and of the State Office for plant protection.

The absence of an effective pesticide control mechanism in the Ukraine is leading to the country gaining a reputation as a so-called "dumping market" whereby low quality products are entering Ukraine and being sold cheaply on the local market. According to experts, more than 50% of the products are illegal i.e. not certified or fake.

The following data are therefore just a small part of the picture.

Table 45: Top 25 Pesticides Sold in the Ukraine in 2001 (kg)

Pesticide	kg or litre reported to be sold
Acetochlor	248,515
MCPA	104,021
Haloxyfop	91,251
Dimethoate	55,451
Molinate	40,869
EPTC	40,167
Dimethenamid	31,530
2,4-D	**26,804**
Lambda-cyhalothrin	16,848
Mancozeb	15,039
Malathion	**14,824**
DNOC	12,639
Dimethomorph	10,290
Mefenoxam	9,809
Fluazifop-P	9,446
Carbofuran	9,051
Carbendazim	8,632
Metolachlor	7,944
Difenoconazole	7,751
Cypermethrin	6,942
Propamocarb	6,722
Diazinon	5,530
Diquat	5,371
Pendimethalin	4,602
Chloridazon	4,551
Thiophanate-methyl	4,384
Total	**798,984**

The top 25 pesticides represent 91% of the total reported sales, which account for 880.064 kg. Only two priority pesticides belong two the top 25 pesticides.

There is not a single copper compound or sulphur compound among the top 25. This is most likely an error caused by the source of information. Copper compounds and sulphur unusually belong to most heavily applied pesticides in Europe. Copper oxychloride and copper hydroxide are not authorised in the Ukraine, they are the most common fungicides in Central and Eastern European countries. The question is, whether or not Ukraine requires authorisation for inorganic compounds such as sulphur, copper oxychloride and copper hydroxide. Possibly they are on the market without authorisation.

Table 46 shows the areas treated with pesticides in the Ukraine. The data suggest that all vineyards are treated with fungicides almost 3 times a year, and that half of the vineyards are sprayed with insecticides.

Altogether, the percentage of areas treated is on average about 50%.

Table 46: Percentage of Crops Treated with Pesticides in Ukraine

	Percentage of Crops treated in 2001			
Crop	**Crop area in 1000 ha**	**Fungicides**	**Herbicides**	**Insecticides**
Cereals	15,070		19	
Fruit trees	239	49	2	64
Maize			45	
Potatoes	1,596	133	1	21
Sugar beet	932	15	67	29
Sunflower	2,769		11	3
Vegetables	480	20		20
Vineyards	103	270		50

Problems Associated with Pesticide Use

There are huge storages of banned pesticides in Ukraine and this is considered as one of the biggest ecological threats. There are around 147 centralized storages of banned pesticides all around Ukraine and around 5 000 storages on the farms and agricultural enterprises. Almost all of them are considered to be inadequate and unsafe and there are many known cases when tragedy happened.

Table 47: Pesticide Registration Data of Pesticide Products Containing Priority Pesticides and Amounts Sold in the Ukraine

Product Name	**Percent AI**	**Amount Sold in 2001**
2,4-D containing products		
2,4-D 500 WS	50	48,292
Dezormon 720 WS	72	
Luvaran 600 SL	60	
2,4-D 400 SL	40	
2,4-D 685 SL	68,5	
2.4-D 500	50	
Dicopur F 600 SL	60	4,430
2,4-D 500 WS	50	
2,4-D 685 SL	68,5	
Luvaran 600 SL	60	
2.4-D 500	50	
Dicopur F 600 SL	60	
Dezormon 720 WS	72	

Alachlor containing products		
Lasso 480 EC	48	
Chlorpyrifos containing products		
Dursban 408 EC	48	3,517
Copper sulphate containing products		
Cuproxat 34.5 TR	34,5	8,731
Blue Vitriol 98 TEC	98	
Cuproxat 34.5 TR	34,5	
Malathion containing products		
Fufanon 570 EC	57	26,007
Carbofos 500 EC	50	
Trifluralin containing products		
Treflan 240 EC	24	11,200
Herbotref 240 EC	24	

Annex 13

Example of Good Plant Protection Practice for Wheat

Annex 13

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General Principles

Wheat crops are sown in spring or in autumn. Spring crops are exposed to pests for a shorter period. Crop rotation with other cereals or field crops reduces the build-up of pest populations in the soil or in crop debris. In general, careful soil cultivation is recommended as an effective cultural control method. Minimal cultural practices such as direct drilling, though they may reduce labour costs, also favour the survival and build-up of pest populations in the soil. As wheat is mainly grown for grain, the aim of protection against pests is to ensure a good quantity and quality of grain yield. The physical and chemical characteristics of grain are particularly important when processing is involved.

Use of resistant cultivars, optimum time of sowing, good crop rotation, use of healthy seeds, well prepared seedbed, cultural operations (destroying or burying stubble) are important elements in GPP on wheat. Cultivars with good resistance to lodging should be used in areas where lodging is a major problem. Treatments with plant protection products may be necessary at any stage of development of the crop. The use of seed treatment is GPP when it is used against pests that cannot be controlled by foliar fungicides. It may also be GPP to use seed treatment against other pests, if the seed treatment results in fewer sprays and thus in a reduced amount of plant protection product early in the season. Wheat is more tolerant of attack by soil pests than, for example, maize or sugarbeet, because seedling losses can be compensated by growth of adjoining plants. The products used for seed treatment should as far as possible cover the full range of fungal or insect pests concerned. It is important that seeds should be uniformly treated with product.

Simultaneous application of two or more active substances as sprays or seed treatments is GPP only if the all pests to be controlled cross the economic threshold value or it is expected. The farmer or adviser must be familiar with the main pests, monitor fields regularly and make full use of existing early warning systems and economic threshold values. As soon as practical thresholds for weed infestation become available, these must be used. Dosages should relate to the pest spectrum observed, taking account of the individual effects and possible interactions. For fungal diseases in particular, it is GPP to select products and to time applications in an optimal way.

Except for spot application of perennial weeds and ULV-insecticide applications early in the season, boom-sprayers, mounted on or towed by tractors, are the only equipment advised for sprays. It is GPP to reduce drift and unwanted dispersal of plant protection products as much as possible by using drift-preventing covers on the nozzles or equipment that produces a good and uniform droplet spectrum across all nozzles on the spray boom.

The risk of developing resistance to fungicides, insecticides and herbicides is a real threat. It is GPP to avoid spraying a fungicide or insecticide later in the season if an active substance with the same mode of action has already been applied as a seed treatment. An active substance with a different mode of action should preferably be used. For the control of the important powdery mildew and rust diseases, active substances should be alternated or coformulations containing products with different mode of action should be used as much as practicable.

The principal wheat problems considered are the following.

Major Diseases, Pests and Weeds in Wheat and Basic Strategies

Fungus

Puccinia striiformis (yellow rust), P. recondita (brown rust), P. graminis (black rust)

General

Rust fungi are highly specialized to their hosts, and wheat is attacked by the formae speciales tritici of the three main rust fungi, Puccinia striiformis, P. recondita and P. graminis. In addition, pathotypes specialized to host resistance genotypes are common. Some of the cereal rusts have alternate hosts (Thalictrum spp. for P. recondita; Berberis vulgaris for P. graminis), but P. striiformis is a short-cycle autoecious rust. Cereals are infected in the spring by air-borne aecidiospores coming from the alternate host or by air-borne urediniospores coming from other areas. Infections with P. striiformis and P. recondita can also occur in the autumn from late tillers or volunteers. This initial air-borne inoculum is practically ubiquitous and uncontrollable. Rust epidemics on cereals develop by repeated secondary urediniospore infection, and this is the stage which is subject to control. At the end of the season, teliospores are formed which give rise to the infection of the alternate host. The different rusts of wheat differ in the pattern and colour of the uredosori formed on wheat leaves. These are yellow to orange in P. striiformis, characteristically in rows on older leaves (in very susceptible wheat cultivars the leaves turn yellow and die). The darker uredosori of P. recondita are irregularly spread over the entire leaf surface. The uredosori of P. graminis form dark brown stripes on leaves and leaf sheaths. In general, yellow rust and brown rust are the diseases of practical importance in Europe. The importance of black rust was much reduced by a campaign to eradicate its alternate host (Berberis vulgaris) early in the 20th century, and black rust is only now occasionally serious in areas with warm summers in central and eastern Europe and on hard wheat in southern Europe.

Basic strategy

There is a range of cultural practices that may reduce rust infection of wheat. First, resistant cultivars should be grown or, at least, very susceptible cultivars should be avoided. Volunteer wheat should be destroyed and winter wheat should not be sown too early. Excessive nitrogen application should be avoided, to prevent too heavy and too dense a stand. It may still be useful in some areas to destroy alternate hosts such as Berberis vulgaris. If the risk of infection by rusts becomes serious in spring, application of a fungicide spray may be necessary. Normally, one or two applications are sufficient, but more may be needed on very susceptible cultivars. In practice, thresholds may be used (e.g. first appearance of P. striiformis, appearance of P. recondita on leaf 3). Alternatively, the advice of warning services (based on various forecasting models) must be followed. If rusts are present with other diseases at growth stage 39-65, it is common practice to apply fungicides against the whole disease complex.

Erysiphe graminis (powdery mildew)

General

Erysiphe graminis forms patches of superficial white, then greyish mycelium (powdery mildew) on leaves, leaf sheaths and ears of wheat. Leaves remain green and active for some time after infection, then the infected areas gradually die. The conidia, formed in great quantities as a white powder on the mycelium, are wind-dispersed over considerable distances to infect healthy leaves. This air-borne inoculum is practically ubiquitous and uncontrollable. Infection by conidia requires high humidity (but not free water on the leaf surface), while sporulation and spore dispersal are favoured by rather dry conditions. Powdery mildew is thus favoured by an alternation of wet and dry conditions, as often occurs in north-west Europe. Infected areas on leaves become chlorotic and cease to photosynthesize. Early mildew attack reduces tillering and later infection reduces "green leaf area", and thus grain yield. Moderate levels of mildew can be tolerated. Cleistothecia may appear on old colonies (as black points) at growth stage 39-65, but these contribute relatively little to inoculum in the spring, which mainly comes from lesions on winter cereal crops.

Basic strategy

Wheat is infected only by forma specialis tritici of E. graminis, so powdery mildew from barley or rye cannot infect wheat and vice versa. Winter wheat should, however, not be grown next to spring wheat. In general, wheat is not as heavily affected as barley (see EPPO Standard PP 2/11(1) Guideline on GPP for barley), but losses can be severe if the disease is not controlled. A range of cultural practices exist that may somewhat reduce infection by E. graminis. The growing of resistant cultivars is recommended. An open stand of wheat reduces the incidence of powdery mildew as compared to a dense stand, heavily fertilized with nitrogen. If powdery mildew infection becomes too serious, one or more chemical applications may be necessary; this should not be after full ear emergence (growth stage 59). Treatment may commence at first appearance of symptoms after growth stage 31. If powdery mildew is present with other diseases, it is common practice to apply fungicides against the whole disease complex.

Problems with resistance

E. graminis has been reported to show reduced sensitivity to fungicides of the sterol-biosynthesis inhibitor group, which has been characterized by gradual loss of performance, particularly in the triazole group of fungicides. Though fungicides of the benzimidazole group are effective against E. graminis, it is not GPP to use them on wheat because of resistance problems with Pseudocercosporella herpotrichoides (see below).

Leptosphaeria nodorum (glume blotch)

General

The disease caused by Leptosphaeria nodorum (synonym Phaeosphaeria nodorum; anamorph Septoria nodorum) can be seed-borne, but soil-borne debris is the main source of infection. Seed-borne infection can cause seedling losses. Wind-borne ascospores may bring the disease into a first-year wheat crop. Small brown blotches, sometimes increasing considerably, appear on leaves and leaf sheaths. Plant-to-plant spread is by rain splash of pycnidiospores. A few weeks before ripening, the glumes are also infected, their tips turning brownish with minute reddish/light brown points (pycnidia). Grain in infected ears does not fill properly. The disease is associated with heavy rain during summer. Glume blotch is the major disease of wheat in north-western Europe, but is less important further south.

Basic strategy

Commercial cultivars are available with a moderate degree of resistance. The use of disease-free seed is recommended, but seed treatments will give acceptable control of seed-borne infection if seed with a low incidence of the pathogen is used. If infection is heavy, fungicide sprays may be needed. One spray should be applied after flag-leaf emergence and a further application may be needed at ear emergence if conditions are very conducive. The aim of control is to prevent infection of the ear and flag leaf. The advice of warning services should be followed, if available. If glume blotch is present with other diseases, it is common practice to apply fungicides against the whole disease complex.

Mycosphaerella graminicola (leaf spot)

General

Mycosphaerella graminicola (anamorph Septoria tritici) causes speckled leaf blotch or leaf spot of wheat. The disease is not seed-borne, the primary inoculum usually being wind-blown ascospores from pseudothecia formed on last year's stubble. Spring-sown crops tend to escape this inoculum. However, if crops are sown into infected stubble or trash, the primary inoculum may also be pycnidiospores from this source. Yellow, later brown-yellow, spots appear on the leaves, with dark-brown specks (pycnidia) and apical yellowing of the leaf (tip-burn). Plant-to-plant spread is by rain-splashed pycnidiospores. Infected leaves die entirely or partly. The glumes are rarely infected (see Leptosphaeria nodorum). The disease is favoured by rainfall, especially in thin crops, and occurs on wheat crops throughout Europe, though especially in the west.

Basic strategy

Commercial cultivars with moderate levels of resistance are available. Early drilled crops are more severely affected. It is important to prevent infection of the upper leaves. One or two fungicide sprays may be needed, applied when infection is seen after growth stage 39, and earlier in the case of rainfall favouring infection of the upper leaves. The advice of warning services should be followed, if available. If leaf spot is present with other diseases, it is common practice to apply fungicides against the whole disease complex.

Tilletia tritici, Ustilago tritici (bunt and smut)

General

Tilletia tritici (syn. T. caries) causes covered smut or bunt of wheat. Seedlings are systemically infected by spores carried on the outside of the seeds. The disease can also be soil-borne. Shortly after flowering, infected tillers give rise to ears which become blue-green and during ripening the glumes open slightly. Diseased plants can be stunted, and the grains are filled with a mass of black spores, retained within the seed coat (covered smut).

Ustilago tritici (syn. U. nuda) causes loose smut of wheat. Infection is seed-borne within the seed, the fungus penetrating the endosperm while the grain is being formed. Infected seeds give rise to systemically infected plants. Diseased ears are visible directly after heading. The black spores are released between glumes and broken-down grains, giving a loose black powder (loose smut). They are wind-borne to healthy ears, which they infect.

In both cases, losses arise from direct loss of infected ears. In U. nuda, ears may also be secondarily infected at harvest.

Basic strategy

Seeds of wheat are externally contaminated by T. tritici during harvesting, when bunted grains are broken open and release their content of spores. Infection then occurs at the time of seed germination and can be prevented by a contact fungicide. In the case of U. tritici, the seeds are already internally infected at the time of harvest. Use of a systemic fungicide is needed to prevent further development of the fungus in the plant after seed germination. In any case, it is important to use disease-free and fungicide-treated seed. Treatment is very effective in controlling these diseases, and certification is of use against U. tritici. Therefore, these diseases are now practically unknown in intensive cereal cultivation in Europe. However, bunt is commonly found on seed samples and, if untreated farmer-saved seed is sown, these diseases reappear. This practice is therefore not GPP. It is also possible to have seed lots tested to decide whether they require treatment.

Tilletia controversa (dwarf bunt)

General

Tilletia controversa causes dwarf bunt, a disease which can only develop in regions where snow cover persists for several weeks. Therefore, this disease is mainly observed in regions above 600 m. Although T. controversa can be seed-borne, the main source of inoculum is soil infested with

teliospores. The spores can persist for at least 10 years. For germination of the spores, light is essential and the temperature optimum lays between 1 and 8°C. Only spores on the soil surface germinate and infect the seedlings shortly after emergence. A persistent snow cover favours this rather long process of infection. Heavy infection at the stage of tillering results in severe damage. The symptoms are similar to those caused by T. tritici, but the plants are usually drastically shortened. The disease causes losses of grain that can be as high as 50%. The bunt balls are crushed during threshing, the teliospores are transported with the wind and contaminate the soil of neighbouring fields.

Basic strategy

It is recommended to avoid growing winter wheat in areas where T. controversa occurs. Spring wheat should be cultivated instead, as it can escape from the disease. Certified and fungicide-treated seed should be used to prevent infection. Every effort should be made to avoid contaminating healthy soils.

Pseudocercosporella herpotrichoides (eyespot)

General

Tapesia yallundae (anamorph Pseudocercosporella herpotrichoides) overwinters on stubble residues. Conidia formed in the spring (and, as recently discovered, also ascospores) constitute the primary inoculum. Plants are infected through the leaf sheath, and the lesion gradually penetrates through to the stem, forming a lens-shaped spot with a darker border. Another fungus, Ceratobasidium cereale (anamorph Rhizoctonia cerealis), forms lesions with a darker, more sharply defined border (sharp eyespot). If eyespot lesions reach the stem before growth stage 31/32, there is a high risk of later foot rot and crop lodging. Secondary infection of other plants does not normally occur, so the aim of control is to prevent primary infection. Fast- and slow-growing strains of P. herpotrichoides occur in different areas; this situation is monitored by warning services, which should be consulted if necessary.

Basic strategy

A number of factors predispose wheat crops to eyespot: high soil pH, cereal as preceding crop, early sowing date, cultivar, dense sowing, dense tillering. Good cultural conditions reduce the incidence. Winter wheat should be sown late and rather shallow (the disease is of no importance on spring wheat). The proportion of cereals in the crop rotation should not be too high; in a 50% rotation of cereals with non-cereals, a 2-year change may be advisable rather than a crop change every year. Cultivars with a certain degree of resistance are available. Since fast- and slow-growing strains of the fungus may show different susceptibility to fungicides, the advice of warning services should be sought as to the strains locally present. If at the start of stem elongation (growth stage 31) more than a threshold percentage of tillers shows eyespots, a fungicide spray should be applied. This threshold varies according to the strain and the climatic conditions from 15 to 35%. The advice of warning services should be followed, if available. Use of plant growth regulators to shorten the length of the stem and reduce lodging may reduce the effects of eyespot infection.

Problems with resistance

P. herpotrichoides was slow to develop resistance to the benzimidazole group of fungicides, but this resistance is now common. Resistance to triazoles (which, in any cases, are less effective against the slow-growing strains) and prochloraz has also been found in certain areas.

Gaeumannomyces graminis (take-all)

General

Gaeumannomyces graminis is a soil fungus which infects the roots of wheat, on which it forms a characteristic black superficial mycelium. The infection may spread to the collar and lower leaf sheaths. The root system is partly or entirely destroyed, and infected plants produce bleached inflorescence (whiteheads) with no grain (take-all), especially under hot dry conditions. The fungus persists as saprophytic mycelium in crop debris, which infects new roots directly. There is no air-borne phase (see eyespot). Infection tends to occur as patches in the crop. Take-all is one of the most

serious causes of yield loss in intensive cereal crops, and is the principal reason why it is not GPP to grow wheat continuously.

Basic strategy

As a root-infecting soil fungus, G. graminis is practically inaccessible to treatment with fungicides. Because the fungus does not persist very long in debris, control is readily achieved by crop rotation.

Fusarium culmorum, Monographella nivalis (foot rot, snow mould)

General

Fusarium culmorum and Monographella nivalis are soil fungi which infect the foot of wheat plants. Both can infect seedlings and M. nivalis, in particular, can cause serious seedling losses. Both may also be seed-borne but the two fungi can also infect the roots of young plants directly from the soil. Under suitable conditions, root infection can spread to the stem base, which can be seriously damaged. In the case of F. culmorum, this spread is favoured by rather dry warm weather and the disease is mostly known from central and southern Europe. The base of the tillers turns brown or develops large brown spots; the tillers bend, and the crop lodges. In the case of M. nivalis, this spread occurs at low temperatures, characteristically under melting snow cover during the winter. The spots are lighter in colour. F. culmorum is an unspecialized parasite, able to infect the roots of many plants and to persist saprophytically. M. nivalis similarly attacks many other Gramineae and persists in the soil. Seedlings and young plants can be protected from primary root infection by treating the seeds with fungicide. Another member of the foot-rot complex, Ceratobasidium cereale (anamorph Rhizoctonia cerealis), has symptoms resembling eyespot, but is less important. Other fungi with Fusarium anamorphs (e.g. Gibberella avenacea) also belong to this complex.

Basic strategy

Because of the build-up of inoculum on a preceding cereal crop, rotation may reduce foot rot incidence to a certain extent. However, both pathogens remain as part of the natural soil microflora, and rotation is not as effective as against Gaeumannomyces graminis. Soil conditions should be optimal, and the seeds used should be certified and disease-free. Use of a fungicidal seed treatment against these fungi is effective routine GPP for wheat. Seed treatment with contact fungicides can be used for low levels of infection (<10%) but systemic fungicides are recommended for higher levels.

Gibberella zeae, Fusarium culmorum (ear rot)

General

Infection of ears by Gibberella zeae (anamorph Fusarium graminearum) or Fusarium culmorum is favoured by wet weather conditions (relative humidity over 75%) after ear emergence. Infection by F. culmorum is by rain-splashed conidia coming from infected debris in the soil, and the ear-rot phase can be considered as an extension of the foot-rot phase of this fungus (q.v.). Lightly infected ears give rise to infected seeds. G. zeae forms perithecia on infected debris and on wheat ears after infection, and the inoculum consists mainly of air-borne ascospores. Infection of the leaves can lead to large, oily blotches. The fungus is not important as a foot-rot pathogen of wheat (though it is important on maize). Ear rot reduces yield, decreases the thousand-grain weight and leads to bad quality indices. Under improper storage conditions, the fungi in infected wheat may produce toxins which are health-hazardous for human or animal consumption.

Basic strategy

Tolerant cultivars should be used. In areas at risk, heavy nitrogen fertilization and late sowing should be avoided. The foot-rot phase of F. culmorum should be controlled by treating the seeds with a fungicide (see Foot rot). If climatic conditions favourable to ear rot appear, preventive fungicide sprays should be applied especially in central Europe where this disease is most important. In other areas, fungicide sprays applied against other diseases generally control ear rot.

Pyrenophora tritici-repentis (leaf blotch)

General

Pyrenophora tritici-repentis is a fungus which gained importance in the 1980s. It infects a wide range of cultivated and wild monocotyledonous plants. The pathogen overwinters on stubble residues and initial infection in spring is caused by ascospores from this source. Symptoms are observed in late March-early April in the form of light-brown ascospore lesions with yellow margins on the lower leaves of winter-wheat plants. Following secondary conidial infection, small dark-brown spots, then oval or fusiform light-brown spots develop. Finally, leaves dry from the tip. P. tritici-repentis and Leptosphaeria nodorum may appear together. Conidial infection requires warmth (20-22°C) and precipitation.

Basic strategy

Stubble residues should preferably be ploughed in. Less susceptible cultivars should be used in areas at risk. Infection may occur from the two-node stage to flowering. A single fungicide spray may be applied at the time of appearance of symptoms.

F u n g u s S t r a t e g i e s s p e c i f i c t o D e n m a r k

Autumn control of leaf diseases or snow mould is never recommended.

From GS 29 it is recommended to carry out monitoring in the field to follow the development of eyespot, mildew and rust diseases. This information should create background for assessing the need for control as well as recommending and effective fungicide and dose. Various handbooks or the decision support system PC-Plant Protection can be used as support. Control of septoria (*Septoria tritici, Stagonospora nodorum*) diseases are based on information on precipitation or visible assessments.

The following thresholds are examples from some of the growth stages :

Eyespot : Control of more than 35% of the plants have attack at GS 30-32. On attacked plants symptoms should be visible on the white leaf sheath beneath the outer leaf.

Mildew : susceptible varieties – more than 10 % plants attacked at GS 29-31, resistant varieties – more than 25% of plants attacked at GS 29-31.

Yellow rust: susceptible varieties – more than 1 % plants attacked at GS 29-31, after 1st application treatments are repeated with 3 weeks interval. resistant varieties – more than 1 % of plants attacked at GS 29-31. Should not be followed by routine treatments.

Septoria : susceptible varieties – Count days with precipitation from GS 33. Apply an effective fungicide after 4 days with precipitation (more than 1 mm per day) or if more than 10 % of plants are attacked at 3rd leaf at GS 45-59. less susceptible varieties – Count days with precipitation from GS 37. Apply an effective fungicide after 5 days with precipitation (more than 1 mm per day). Do not apply before GS 39.

Choice of fungicide: It is recommended to use mixtures with different mode of action to avoid fungicide resistance. A maximum of two applications with strobilurins per season is recommended.

Although reduced dosages are recommended this are only on low disease levels in order to avoid a big selection pressure.

Aphids and Insects

General

Aphids, especially Sitobion avenae, Metopolophium dirhodum and Rhopalosiphum padi, may become numerous on tillers and ears of wheat, and may inflict direct feeding damage or indirect damage because of the formation of sooty moulds or transmission of virus diseases (especially Barley yellow dwarf luteovirus).

Quality of grain is also affected by aphid infestations. Diuraphis noxia is important in the eastern part of the EPPO region.

Basic strategy

The wheat crop should be regularly inspected in spring, and an insecticide spray application should be made if numbers reach a certain level. Various threshold levels are recommended, for example: 30% of tillers carry aphids before flowering; 70% of tillers are infested during and shortly after flowering up to caryopsis watery ripe. A single spray is usually sufficient. Use of certain selective insecticides will favour natural enemies.

Virus diseases are not normally a problem in wheat and chemical control of aphids for that purpose is generally not necessary. In areas with mild winter climate, there may however be a problem with Barley yellow dwarf luteovirus; damage can be prevented by late sowing (winter wheat) or early sowing (spring wheat), or by spraying an insecticide in the autumn. Seed treatment of winter wheat is also possible.

Insects

Thrips

General

Many species of thrips (Limothrips cerealium, L. denticornis, Stenothrips graminum, Haplothrips aculeatus, Thrips angusticeps, Haplothrips tritici, Aptinothrips elegans, Anaphothrips obscurus) feed on wheat leaves, causing silvery spots; infested leaves may turn brown. Feeding on the ear during emergence causes whitish, empty grains. Thrips are only a problem in the northern part of the EPPO region.

Basic strategy

Thrips can be controlled by spray application of insecticides, but this is normally not necessary. A single treatment may be applied after emergence of the ears (growth stage 50), if numbers exceed two larvae per ear. Thorough inspection is necessary, for the insects are minute and difficult to see. Sprays should not be applied after the milky-ripe stage. Certain treatments applied against aphids will give incidental control of thrips.

Tipula spp. (leatherjackets)

General

Leatherjackets are the larvae of craneflies (Tipula spp.). They live in the soil and largest populations occur in grassland.

Basic strategy

Wheat crops may be damaged when following grassland or uncultivated land. In general, this rotation should be avoided if possible. The presence of larvae can be checked before ploughing the grassland by either taking soil cores and extracting larvae in the laboratory or by pouring a salt solution onto the ground, which forces the larvae to the surface. Spring wheat is likely to be at risk when 50 larvae per m2 or more are present in early spring. Winter wheat is less at risk from leatherjackets because the crop usually establishes before the main feeding period of the larvae; no specific threshold has been expressed. Attacks may be prevented by ploughing out grassland before mid-August. It is GPP to

apply a soil insecticide treatment, by overall spray at high water volume, soon after ploughing grassland or uncultivated land if damaging populations of leatherjackets are present. An overall spray at high water volume can also be applied to a growing crop if damage is seen.

Wireworms and white grubs

General

The larvae of certain Elateridae (Agriotes spp., wireworms) and Melolonthidae (Melolontha spp., white grubs) damage the stem bases and the roots of wheat plants. These become yellow and the main shoot turns brown. Development of wireworms takes several years, and adults and larvae of different ages coexist each year. Development of white grubs takes 3-4 years and is generally synchronized. Damage normally only occurs from the 3rd larval stage onwards, starting in the year after adult flight.

Basic strategy

Grassland or uncultivated land as a preceding crop should be avoided. However, if a wheat crop is grown in such a high-risk rotation, an overall soil spray treatment as well as the seed treatment may be justified. The level of population of wireworms and white grubs in the soil is needed to make an informed decision on treatment and should be determined by soil sampling.

Delia coarctata (wheat bulb fly)

General

Eggs of Delia coarctata are laid during the summer months in bare soil or in soil under a root crop. The eggs hatch in the following spring and the larvae bore into the wheat plant. Both winter and early-sown spring wheat may be damaged. The central shoot of the attacked plant dies, turning yellow although the outer leaves remain green. The larvae move from tiller to tiller on the same plant and sometimes through the soil to another plant. Damage is common and can be serious. Opomyza florum is another cereal fly which mines wheat stems like D. coarctata.

Basic strategy

Damage can be reduced effectively by cultural methods. The crop rotation can be chosen so that wheat does not follow a fallow or crop which provides suitable egg-laying conditions (bare soil during July and August). If the crop follows grass, ploughing out can be delayed to reduce egg-laying. Land lying bare after harvest should not be tilled in early August as this will encourage egg-laying. In high-risk situations, early drilling with an increase in seed rate is recommended.

Control with insecticides is normal GPP against D. coarctata. The type of treatment is decided on the basis of previous cropping, crop-sowing date and the perceived level of risk based on sampling for eggs. Insecticides are preferably applied as seed treatments, but may also be applied as seedbed sprays at or soon after sowing, as sprays at the start of egg hatch or at peak egg hatch, and as sprays at the onset of plant damage. If a soil or seed treatment has been applied against wireworms, this may also have action against D. coarctata, according to the insecticide used.

Agromyza spp. (leaf miners)

General

Agromyza spp. are small flies (3-5 mm long) which emerge in spring. The females feed by puncturing leaves along the veins. The eggs are deposited between the two epidermes of the leaves, and the larvae mine the mesophyll. The mines often become confluent, giving a typical appearance (mesophyll tissues in the upper third of leaf are completely destroyed). Agromyza spp. are locally important in northern Europe.

Basic strategy

Moderate levels of attack do not cause losses. Insecticide sprays may be applied from growth stage 31 in the case of heavy attacks, or if a threshold of more than 20% mining on lower leaves accompanied with puncturing of upper leaves is reached at growth stage 55. Aphid control has an incidental effect on Agromyza spp.

Oscinella frit (frit fly)

General

The larvae of Oscinella frit are 3-4 mm long, white, legless and lack a distinct head (though having black mouthparts). There are normally three generations a year, but only the autumn generation attacks wheat when it is sown after infested grass. The larvae migrate from the ploughed-in grass to invade the wheat plant, the centre leaf of which turns yellow and dies.

Basic strategy

If winter wheat is sown after grass, the land should be ploughed early and at least 4 weeks before sowing. Similarly, grass-infested stubble should be ploughed soon after harvest. The risk of damage to wheat is only slight in most years and does not justify routine insecticide spray treatment unless regular damage has occurred previously. Crops at risk should be examined from emergence and sprayed if more than 10% of shoots are damaged. Seed treatments are also effective.

Zabrus tenebrioides (corn ground beetle)

General

The larvae of Zabrus tenebrioides live in the soil in a self-made tube. Leaves of young wheat plants are pulled down into the tube. The larvae eat only the leaf blade. Damage can be detected from the remains of the leaves in the tubes. The pest tends to occur and damage plants in patches. The larvae are active in spring, and on mild winter days, and their development ends at the beginning of heading. Z. tenebrioides is mainly important in central and eastern Europe. It has one generation every 2 years in the northern part of its range and one generation per year in the southern part. It can survive on volunteer cereals.

Basic strategy

Cultural control can be used to reduce the risk of attack: early harvesting of straw and destruction of volunteer cereals. In areas of heavy infestation, an overall insecticide treatment of soil is recommended before sowing. Seed treatments may be used but are less effective. If infestations are nevertheless observed, a corrective spray treatment may be applied. It is advisable to treat in the morning or in the evening, as the larvae do not feed during daytime. Z. tenebrioides can also occur sporadically in other areas of Europe. In this case, a spray treatment when damage is seen is sufficient.

Eurygaster and Aelia spp. (shield bugs)

General

Pentatomid bugs (e.g. Aelia acuminata, A. rostrata, Eurygaster austriaca, E. integriceps, E. maura, E. testudinaria) are mainly important in south-east Europe and Mediterranean countries. Adults overwinter in uplands and migrate to cereal crops in spring. Nymphs develop on the wheat crop and cause damage by feeding on the young grain (injection of saliva which affects bread-making quality).

Basic strategy

Most commonly, sprays are applied at full heading to protect the young grain, on the basis of a threshold density of nymphs. An alternative strategy is to spray at the end of winter, when the adults migrate, on the basis of forecasts of adult development.

Cnephasia pumicana

General

Adults are small moths with 1.5-cm wingspan. They lay eggs in summer under the bark of trees. In spring, the larvae are carried to wheat crops by wind. They can be found mainly on field edges. They perforate the leaf surface and mine the leaves, causing leaves to curl upwards. At heading, they move to the ears on which they can cause serious damage.

Basic strategy

Insecticide sprays should be applied if a threshold of one larva per 20 tillers is observed.

Psammotettix striatus

General

This leafhopper transmits a phytoplasma causing a yellow dwarfing disease of wheat. The symptoms can be confused with Barley yellow dwarf luteovirus.

Basic strategy

Generally controlled by treatments against aphids. Sprays against Psammotettix striatus may be needed if aphids are not treated.

Contarinia tritici, Sitodiplosis mosellana (wheat blossom midges)

General

The larvae of Contarinia tritici feed on the floral parts of wheat, preventing pollination and development of the grain. The larvae of Sitodiplosis mosellana feed on the developing grain, resulting in reduced grain size and milling/baking qualities. In most seasons and regions, damage is slight. However, S. mosellana in particular can cause serious losses in northern Europe.

Basic strategy

Regular rotation will reduce numbers of midges. Intensive wheat growing and successive cropping will increase the risk of damage. When control measures are required, sprays should be applied between ear emergence and start of flowering.

Mayetiola destructor (Hessian fly)

General

The larvae damage the stems of wheat causing them to lodge. Damage occurs sporadically, mainly in northern Europe.

Basic strategy

An insecticide spray should be applied at the time of egg-laying, according to warning systems if available. A suggested threshold is 15 eggs per stem.

Haplodiplosis marginata (saddle gall midge)

General

In May and June, female midges deposit their eggs on the surface of wheat leaves. The whitish, later orange-red larvae attack the stems under the leaf sheaths. Larval feeding results in the formation of saddle-shaped galls. Spring-sown crops are more susceptible to damage than those sown in the autumn. Infestations are common but at low levels.

Basic strategy

The pest is associated with frequent cereal growing on heavy land. It can be avoided by practising a wide crop rotation and controlling grass weeds wherever possible. In high-risk areas, insecticide sprays are necessary and should be directed against newly hatched larvae. If 10% or more of tillers have eggs present, an insecticide should be applied at egg hatch. Only one application is necessary.

Oulema melanopus, O. gallaeciana (cereal leaf beetles)

General

Oulema melanopus and O. gallaeciana (syn. O. lichenis) are shiny-blue beetles which feed on wheat leaves, causing elongated holes. The yellow larvae are covered by a blackish, sticky substance and may be mistaken for small slugs. The larvae skeletonize the leaves, causing long white stripes.

Basic strategy

Damage is commonly seen, especially on spring-sown crops, but is often not very important. Chemical treatment is justified after reaching a threshold such as 15 adults per m2 just before oviposition, or 0.5-1 larvae per stem. Treatments may be combined with those against aphids, in which case suitable active substances should be used.

Aphid control strategies specific to Denmark

It is not GPP to add an insecticide to a fungicide treatment if the threshold is not exceeded.

The fields should be monitored for Ahpids from earing and on to GS 75.

The following thresholds are used:

GS 41-50: More than 40% tillers attacked

GS 51-60: More than 50% tillers attacked

GS 61-75: More than 60% tillers attacked

0,5-1,0 larvae of Oulema melanopus per ear bearing tiller

Nematodes

General

Two nematodes feed on the roots of wheat: Meloidogyne naasi (cereal root-knot nematode) which induces the formation of many extra roots and elongated root knots, and Heterodera avenae (cereal cyst nematode) which causes strong root branching and deformation, with cysts visible later in the season. Attacks are visible in the field as spots where crop growth is retarded. Spring-sown wheat is especially susceptible to M. naasi.

Basic strategy

Crop rotation is useful, reducing the proportion of cereals and grass seed crops. Maize is not a host plant and can safely be grown. No treatment is recommended specifically against these nematodes.

S l u g s

General

Slugs (e.g. Agriolimax arvensis, Deroceras reticulatum) damage wheat seedlings and hollow out wheat seeds, and the problem is increasing with direct drilling and when land is left uncultivated (e.g. "set aside" according to the Common Agricultural Policy of the European Union). Early slug damage can be very important. Later leaf feeding is not important. Slugs are largely a problem on medium to heavy textured soils in wet seasons.

Basic strategy

A firmly consolidated seedbed will restrict slug movement and encourage rapid seedling growth. The surface should be clod-free. To assess the risk of slug damage and the need for and time of molluscicide treatments, test baiting when the soil surface is moist is advised. The normal method of treatment is to scatter molluscicide formulated as a bait, and it is most effectively applied after seedbed preparation but a few days prior to drilling. Bait pellets can also be mixed with the seed. As slugs are often at the borders of the field, spot treatment is sometimes possible.

W e e d s

Basic strategy

Although chemical weed control is the most widely used method of weed control in wheat, there are opportunities to use cultural methods before sowing the crop and during crop growth, e.g. competitive crops and mechanical weed control. It is GPP to destroy emerged grass and broad-leaved weeds by mechanical cultivation or use of herbicides in the stubble of the preceding crop. This is particularly useful where it is intended to prepare the seedbed without ploughing. Normally, it is GPP to cultivate, e.g. to plough and harrow, before sowing the wheat crop, with a light harrowing and/or rolling after drilling to consolidate the seedbed, if necessary. Seedbed preparation methods depend on soil type, soil conditions and time of the year. The objective is to remove remnants of the previous crop, destroy weed populations and prepare a seedbed in optimal conditions to encourage rapid germination of a full, competitive stand of wheat and to provide a level clod-free surface for maximum activity of a residual herbicide.

Herbicides can be applied pre-sowing, pre-emergence, post-emergence and pre-harvest. Weed-control decisions should be based on economic damage thresholds if available (including the risk of seed return of aggressive weed species), or on past knowledge of the field, if a treatment before weed emergence is planned. Annual grass and dicotyledonous weeds may be controlled in the autumn provided that it is likely that weed thresholds may be exceeded. A suitable combination of residual and foliar-acting herbicides should be used. Late-sown crops or crops with low weed populations may not need herbicide treatment before the spring. Spring applications of suitable foliar-acting herbicides should be made only where annual grass or dicotyledonous weed thresholds are likely to be exceeded, or where weeds have escaped the autumn treatment, or where spring-germinating weeds predominate. With spring wheat, seedbed cultivation should destroy a large proportion of the autumn or spring-germinated weeds. A post-emergence foliar herbicide may be necessary, with rates adjusted for weed size.

It is GPP to ensure that conditions favourable for active growth of crop and weeds exist in the spring before application of a foliar herbicide. Crop and weed growth stages should be followed carefully to avoid inefficient use of herbicides on large weeds and crop damage. The risk of a carry-over effect to a succeeding crop should also be considered.

In order to delay or minimize the development of herbicide resistance, guidelines are available and should be followed.

Perennial weeds such as Phragmites australis, Juncus spp., Elymus repens, Cirsium spp. and volunteer potatoes can be controlled shortly before harvest with non-selective foliar herbicides, e.g. glyphosate. The crop should be almost dead at this time and the grain nearly ripe, and the weeds should be alive

and well exposed. Spot treatment with ropewick applicators is also possible at this time for some weeds.

Weed Control Strategies Specific to Denmark

Delaying sowing can reduce the population of weed in the field. Although the level can be reduced it is often not cost effective to do so, as weed control still may be needed and yields will be reduced significantly from late sowing. Weed harrowing has in some situations been used successfully, but generally the methods are too uncertain in autumn sown crops.

It is recommended to make a weed map of the fields in order to know which weed problems are likely to appear. Before application monitoring of the weed species and numbers/m2 in the field should create background for assessing the need for control as well as recommending and effective herbicide and dose. Various handbooks or decision support systems can be used as support. It is generally recommended to aim at weed control in the autumn as this give good possibilities of using reduced dosages of herbicides. Only if specific weed problems develop in spring is it recommended to repeat the herbicide application. It is obligatory to control wild oat if this appear either by herbicide or hand weeding.

If perennial grasses (*Elymus repens)* are found at significant levels treatments can be recommended as pre-harvest treatment. This is not an option in wheat grown for bread quality.

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