

Performance of the FOCUS 2010 Software Packages for Performing Tier 1 Ground Water Assessments in the EU

R L Jones, J J T I Boesten, M Klein, and E van den Berg

5 January 2011

Introduction

The Ground Water Work Group of FOCUS prepared a revised version of the Tier 1 procedures used to assess potential for movement to ground water. These changes have been extensively described in the report of the work group (FOCUS, 2009). Since the issuing of the report, several minor changes have been made in the software packages. This report documents the changes that have been made and the impact of these changes on the predicted concentrations.

Changes in the Software Packages

The changes in the software packages were minor. For PELMO and PRZM the only change in the models was the change in the concentration below which the K_{oc} was represented by a linear isotherm. In PEARL this concentration is 10^{-24} $\mu\text{g/L}$ so “sub-molecular level” whereas this concentration was originally 0.01 $\mu\text{g/L}$ in PELMO and PRZM. In a number of cases when the values of the Freundlich exponent ($1/n$), were significantly below 0.9, this difference led to differences in calculated leaching concentrations predicted by PEARL and PELMO. Therefore, this minimum concentration for a Freundlich isotherm was dropped to 10^{-20} $\mu\text{g/L}$ in PELMO and PRZM (while different from PEARL, this difference is insignificant). To the best of our knowledge no evidence is available showing a dependency of the Freundlich exponent to this concentration level, also not when adsorption isotherms were measured for concentrations in the liquid phase differing several orders of magnitude (eg., Boesten and van der Pas, 1988).

In PEARL, the water balances changed slightly (on the order of a few mm) because a revised version of SWAP is now used in PEARL. In addition the spring points for winter cereals and winter oil seed rape have been added (as prescribed in FOCUS, 2009) and the application date for the second crop in the Sevilla cabbage scenario has been corrected. The addition of the spring points and the correction of the application date decreased the PEC_{gw} for these scenarios.

In PELMO and PRZM, the default value for the Q10 value has been set at 2.58 and in PEARL the Arrhenius activation energy E_A has been set to 65.4 kJ/mol. The simulations in FOCUS (2009) were performed with a Q10 of 2.2 and an E_A 54 kJ/mol. This change in Q10 and E_A resulted in increases in the 80th percentile concentration of up to a factor of three, with the largest increases occurring for northern location/crop combinations (Table A1-1). Some southern location/crop combinations showed relatively minor decreases in the PECgw values as a result of the increases in Q10 and E_A .

Comparison of Results with Previous Results

Simulations were conducted with the three software packages for pesticide D with all 125 location/crop combinations assuming a Q10 of 2.58 and an E_A of 65.4 kJ/mol. A single application at 1 kg ai/ha was assumed to occur the day before plant emergence. For those location/crop combinations with two cropping periods, single applications of 1 kg ai/ha were made during each of the cropping periods. For apples, citrus, grass, and vines, the applications were assumed to occur on May 1. The results of these simulations are presented in Tables A1-1 to A1-7 along with the results presented in FOCUS (2009) for the FOCUS 2000 versions of the software packages.

The comparisons between the predictions of the three models (Figures 1-3) remained roughly the same as shown in FOCUS (2009). One exception to this statement is that the changes in the concentration below which the K_{oc} was represented by a linear isotherm and in the Q10 and E_A increased the difference between PEARL and both PELMO and PRZM for some of the crop/location combinations where the values of PECgw were below 0.01 µg/L (this occurred only in Thiva and Sevilla). However, in this specific example this difference in these low PECgw values does not change the outcome of the regulatory assessment. Table 1 shows the effect of these changes on predicted PECgw values of pesticide D for potatoes and tomatoes in Sevilla and Thiva. For these four cases, the effect of the change in the concentration below which the K_{oc} was represented by a linear isotherm reduced the concentrations in PELMO and PRZM more than the effect of increasing Q10 (which could either increase slightly or decrease slightly the predicted PECgw value), while the effect of the E_A increase in PEARL increased the predicted PECgw. However, investigating the increase in these differences between PEARL and both PELMO and PRZM for these low values of PECgw is beyond the scope of this release procedure.

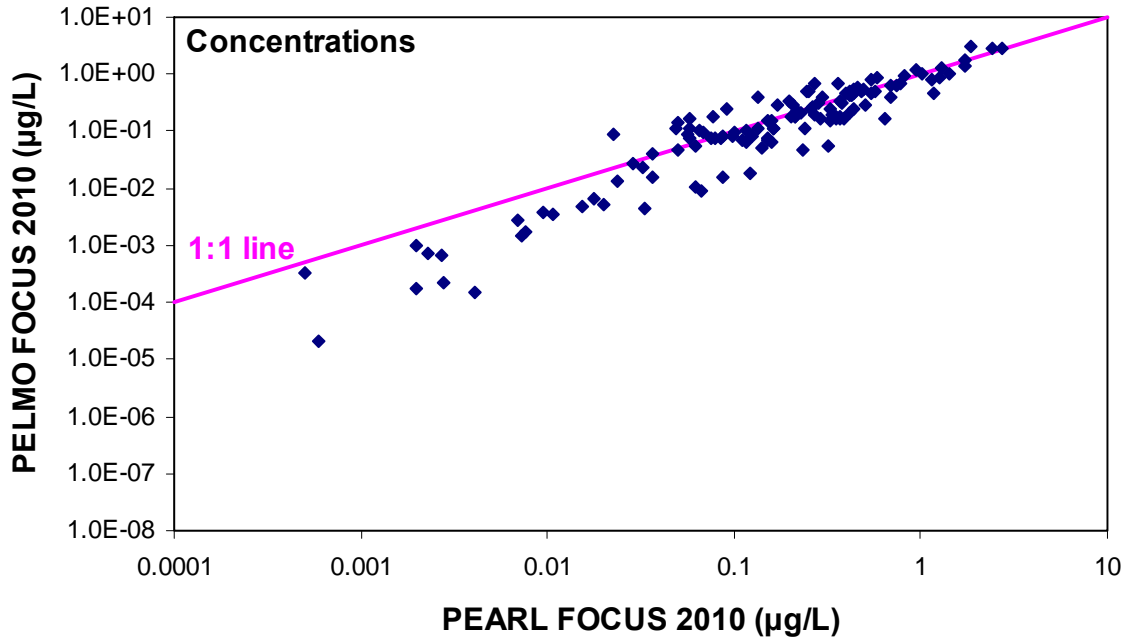


Figure 1. Comparison of PEC_{gw} predicted by PEARL and PELMO for all 125 FOCUS 2010 scenarios.

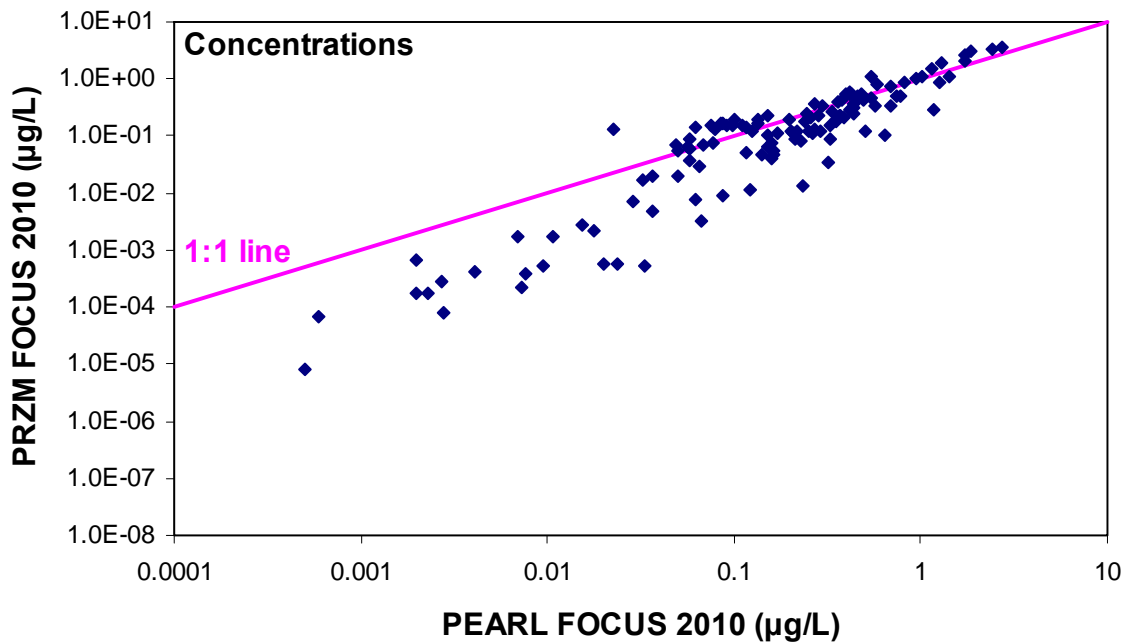


Figure 2. Comparison of PEC_{gw} predicted by PRZM and PELMO for all 125 FOCUS 2010 scenarios.

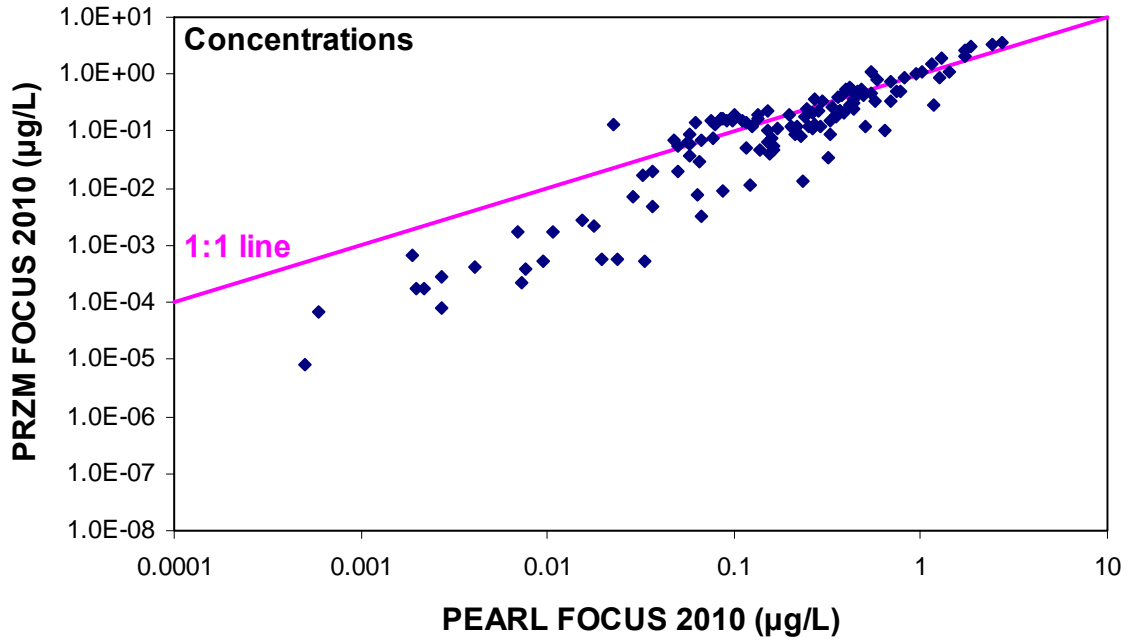


Figure 3. Comparison of PEC_{gw} predicted by PRZM and PEARL for all 125 FOCUS 2010 scenarios.

Table 1. Effect of Q₁₀/EA and the lower cutoff on the Freundlich isotherm on the predicted PEC_{gw}

	<u>Potatoes</u>		<u>Tomatoes</u>	
	<u>Sevilla</u>	<u>Thiva</u>	<u>Sevilla</u>	<u>Thiva</u>
PEARL				
E _A of 54 kJ/mol	0.0015	0.0065	0.0026	0.0067
E _A of 65.4 kJ/mol	0.0020	0.0095	0.0027	0.0076
PELMO				
Q ₁₀ of 2.2, Freundlich lower limit of 0.01 µg/L	0.0015	0.0036	0.0013	0.0033
Q ₁₀ of 2.58, Freundlich lower limit of 0.01 µg/L	0.0016	0.0044	0.0013	0.0032
Q ₁₀ of 2.58, Freundlich lower limit of 1x10 ⁻²⁰ µg/L	0.0010	0.0038	0.0007	0.0018
PRZM				
Q ₁₀ of 2.2, Freundlich lower limit of 0.01 µg/L	0.0010	0.0008	0.0013	0.0007
Q ₁₀ of 2.2, Freundlich lower limit of 1x10 ⁻²⁰ µg/L	0.0007	0.0006	0.0004	0.0005
Q ₁₀ of 2.58, Freundlich lower limit of 1x10 ⁻²⁰ µg/L	0.0007	0.0005	0.0003	0.0004

References

- Boesten JJTI, van der Pas LJT. 1988. Modeling Adsorption/Desorption Kinetics of Pesticides in a Soil Suspension. *Soil Sci.* 146: 221-31.
- FOCUS. 2009. Assessing Potential for Movement of Active Substances and their Metabolites to Ground Water in the EU. Report of the FOCUS Ground Water Work Group, EC Document Reference Sanco/13144/2010 version 1, 604 pp.
- FOCUS. 2000. FOCUS groundwater scenarios in the EU review of active substances. Report of the FOCUS Groundwater Scenarios Workgroup, EC Document Reference Sanco/321/2000 rev.2, 202pp.

**APPENDIX 1. RESULTS OF SIMULATIONS COMPARING THE CURRENT (FOCUS 2000)
AND THE PROPOSED SCENARIOS (FOCUS 2010)**

Table A1-1. PECgw for Pesticide D at 1 m.

Location	Crop	PECgw ($\mu\text{g/L}$) for Pesticide D at 1 m							
		FOCUS 2010 ¹				FOCUS 2000 ²			
		PEARL	PELMO	PRZM	MACRO	PEARL	PELMO	PRZM	MACRO
Châteaudun	apples	0.5699	0.5038	0.3272	-	0.5763	0.3870	0.3199	-
Châteaudun	cabbage	0.2923	0.1687	0.1217	-	0.2855	0.0084	0.0039	-
Châteaudun	carrots	0.3305	0.1578	0.0858	-	0.2664	0.0060	0.0024	-
Châteaudun	cereals (spring)	0.0155	0.0049	0.0027	-	0.0092	0.0002	0.0000	-
Châteaudun	cereals (winter)	0.1515	0.0680	0.0640	-	0.1618	0.0132	0.0156	-
Châteaudun	grass	0.1613	0.1127	0.0465	-	0.0962	0.0067	0.0019	-
Châteaudun	maize	0.1391	0.0509	0.0460	-	0.1911	0.0012	0.0007	-
Châteaudun	onions	0.0327	0.0230	0.0173	-	0.1888	0.0078	0.0030	-
Châteaudun	peas	0.0070	0.0028	0.0017	-	0.0033	0.0000	0.0000	-
Châteaudun	potatoes	0.1166	0.0665	0.0495	-	0.2258	0.0014	0.0007	-
Châteaudun	rape (winter)	0.1503	0.0732	0.1063	-	0.1102	0.0270	0.0318	-
Châteaudun	sugar beets	0.6350	0.1634	0.1004	-	0.3393	0.0393	0.0131	-
Châteaudun	tomatoes	0.1569	0.0628	0.0399	-	0.3141	0.0101	0.0052	-
Châteaudun	vines	0.3712	0.3499	0.2349	-	0.6473	0.4510	0.4294	-
Hamburg	apples	0.6923	0.4095	0.3393	-	1.9109	0.1210	0.1383	-
Hamburg	beans (field)	0.3676	0.1725	0.2307	-	0.2358	0.0462	0.0493	-
Hamburg	cabbage	1.4191	0.9901	1.1250	-	0.7704	0.2430	0.2053	-
Hamburg	carrot	1.2506	0.8629	0.8396	-	0.6890	0.2310	0.2248	-
Hamburg	cereals (spring)	0.4198	0.2149	0.2821	-	0.2632	0.0467	0.0528	-
Hamburg	cereals (winter)	2.4139	2.9090	3.3620	-	1.2972	1.0600	1.2260	-
Hamburg	grass	0.3835	0.1618	0.2051	-	0.2010	0.0261	0.0871	-
Hamburg	maize	0.4327	0.2503	0.3071	-	0.2939	0.0731	0.0690	-
Hamburg	onions	0.3482	0.1667	0.1922	-	0.1941	0.0505	0.0425	-
Hamburg	peas	0.3654	0.1795	0.2202	-	0.2258	0.0446	0.0385	-
Hamburg	potato	0.3342	0.1912	0.2725	-	0.1980	0.0518	0.0351	-
Hamburg	rape (winter)	1.7374	1.4311	2.0420	-	0.8392	0.5220	0.6456	-
Hamburg	strawberries	1.1791	0.4478	0.2949	-	0.6833	0.0813	0.1140	-
Hamburg	sugar beets	0.3537	0.1815	0.1798	-	0.2405	0.0630	0.0635	-
Hamburg	vines	0.4899	0.5278	0.4361	-	0.2927	0.1470	0.1670	-
Jokioinen	apples	0.1506	0.1535	0.2366	-	0.0492	0.1410	0.0042	-
Jokioinen	bush berries	0.2407	0.1079	0.1758	-	0.0693	0.0060	0.0017	-
Jokioinen	cabbage	0.0787	0.0778	0.1274	-	0.0233	0.0008	0.0001	-
Jokioinen	carrots	0.0757	0.0785	0.1507	-	0.0274	0.0007	0.0001	-
Jokioinen	cereals (spring)	0.0979	0.0791	0.1595	-	0.0258	0.0010	0.0001	-
Jokioinen	cereals (winter)	0.5442	0.8163	1.1330	-	0.2091	0.0758	0.0053	-
Jokioinen	grass	0.1327	0.1153	0.1612	-	0.0414	0.1600	0.0023	-
Jokioinen	onions	0.0619	0.0543	0.1436	-	0.0176	0.0003	0.0001	-
Jokioinen	peas	0.1014	0.0939	0.1894	-	0.0288	0.0007	0.0001	-
Jokioinen	potatoes	0.0846	0.0761	0.1690	-	0.0283	0.0003	0.0000	-
Jokioinen	rape (summer)	0.0860	0.0832	0.1662	-	0.0262	0.0011	0.0001	-

Table A1-1 (continued). PECgw for Pesticide D at 1 m.

Location	Crop	PECgw (µg/L) for Pesticide D at 1 m							
		FOCUS 2010 ¹				FOCUS 2000 ²			
		PEARL	PELMO	PRZM	MACRO	PEARL	PELMO	PRZM	MACRO
Jokioinen	strawberries	0.1100	0.0690	0.1551	-	0.0338	0.0014	0.0005	-
Jokioinen	sugar beets	0.1170	0.1037	0.1475	-	0.0342	0.0017	0.0001	-
Kremsmünster	apples	0.4343	0.4772	0.2471	-	0.3578	0.1420	0.1024	-
Kremsmünster	beans (field)	0.2684	0.1948	0.1291	-	0.2000	0.0078	0.0016	-
Kremsmünster	cabbage	0.7385	0.6542	0.5050	-	0.3791	0.0365	0.0096	-
Kremsmünster	carrots	0.7746	0.7129	0.5014	-	0.4663	0.0334	0.0084	-
Kremsmünster	cereals (spring)	0.3272	0.2390	0.1538	-	0.1919	0.0147	0.0040	-
Kremsmünster	cereals (winter)	0.8075	0.9057	0.8577	-	0.5478	0.1470	0.0661	-
Kremsmünster	grass	0.2268	0.2075	0.0834	-	0.1208	0.0576	0.0144	-
Kremsmünster	maize	0.2594	0.2457	0.2057	-	0.1908	0.0052	0.0017	-
Kremsmünster	onions	0.2123	0.1753	0.1124	-	0.1440	0.0086	0.0019	-
Kremsmünster	potatoes	0.2024	0.1830	0.1194	-	0.1281	0.0026	0.0004	-
Kremsmünster	rape (winter)	1.0174	0.9846	1.0990	-	0.5014	0.2720	0.2376	-
Kremsmünster	strawberries	0.5019	0.2801	0.1184	-	0.2978	0.0173	0.0074	-
Kremsmünster	sugar beets	0.2106	0.1730	0.0878	-	0.1743	0.0283	0.0058	-
Kremsmünster	vines	0.3580	0.6651	0.3901	-	0.2512	0.2370	0.2022	-
Okehampton	apples	0.5831	0.9025	0.8069	-	0.4485	0.9870	0.3248	-
Okehampton	beans (field)	0.4218	0.4322	0.5483	-	0.3174	0.0310	0.0337	-
Okehampton	cereals (spring)	0.5373	0.4505	0.4688	-	0.3328	0.0346	0.0377	-
Okehampton	cereals (winter)	2.7091	2.8434	3.7180	-	1.9732	1.0900	1.7070	-
Okehampton	grass	0.4576	0.5836	0.4935	-	0.2515	1.1100	0.0984	-
Okehampton	linseed	0.4161	0.4951	0.5691	-	0.2531	0.0537	0.0597	-
Okehampton	maize	0.6980	0.6281	0.7679	-	0.4623	0.0189	0.0196	-
Okehampton	peas	0.3783	0.3105	0.4199	-	0.2332	0.0134	0.0153	-
Okehampton	potatoes	0.4128	0.4126	0.5390	-	0.2997	0.0094	0.0096	-
Okehampton	rape (summer)	0.4758	0.5093	0.5411	-	0.2745	0.0597	0.0375	-
Okehampton	rape (winter)	1.2955	1.2852	1.9370	-	0.8349	0.4090	0.6886	-
Okehampton	sugar beets	0.3996	0.4464	0.5507	-	0.2667	0.0496	0.0609	-
Piacenza	apples	0.2688	0.7042	0.3756	-	1.3552	2.2600	0.3663	-
Piacenza	cereals (winter)	0.9348	1.2118	1.0230	-	1.6928	2.0800	1.4320	-
Piacenza	citrus	0.3004	0.3905	0.3286	-	1.6609	4.2400	0.6345	-
Piacenza	grass	0.2503	0.5108	0.1189	-	0.7350	1.4800	0.1024	-
Piacenza	maize	0.2197	0.2368	0.1203	-	0.7182	0.3910	0.1347	-
Piacenza	potatoes	0.1574	0.1551	0.0753	-	0.7016	0.2330	0.0531	-
Piacenza	rape (winter)	1.7254	1.8059	2.7160	-	5.5158	4.2100	5.1590	-
Piacenza	soybeans	0.1646	0.1122	0.0546	-	0.4719	0.1590	0.0522	-
Piacenza	sugar beets	0.2655	0.2612	0.1116	-	1.0647	0.3440	0.0863	-
Piacenza	sunflowers	0.1949	0.3465	0.1919	-	0.9875	0.4190	0.1262	-
Piacenza	tobacco	0.1696	0.2845	0.1162	-	0.7428	0.3740	0.1318	-
Piacenza	tomatoes	0.2059	0.2976	0.1148	-	1.1246	0.4650	0.1145	-
Piacenza	vines	0.2471	0.5200	0.2467	-	1.3510	2.8800	0.4505	-
Porto	apples	0.0769	0.1839	0.0748	-	0.0000	0.0085	0.0000	-
Porto	beans (veg)	0.0562	0.0898	0.0639	-	0.0000	0.0000	0.0000	-

Table A1-1 (continued). PECgw for Pesticide D at 1 m.

Location	Crop	PECgw (µg/L) for Pesticide D at 1 m							
		FOCUS 2010 ¹				FOCUS 2000 ²			
		PEARL	PELMO	PRZM	MACRO	PEARL	PELMO	PRZM	MACRO
Porto	cabbage	0.4367	0.5579	0.3567	-	0.0010	0.0000	0.0000	-
Porto	carrots	0.2816	0.3056	0.2301	-	0.3507	0.0000	0.0000	-
Porto	cereals (spring)	0.0579	0.1713	0.0897	-	0.0000	0.0000	0.0000	-
Porto	cereals (winter)	1.8643	3.1892	3.0610	-	0.0087	0.0013	0.0006	-
Porto	citrus	0.0676	0.0936	0.0682	-	0.0000	0.0104	0.0000	-
Porto	grass	0.0656	0.1040	0.0284	-	0.0000	0.0038	0.0000	-
Porto	maize	0.0367	0.0411	0.0198	-	0.0000	0.0000	0.0000	-
Porto	onions	0.0582	0.1115	0.0383	-	0.0000	0.0000	0.0000	-
Porto	potatoes	0.0497	0.1374	0.0556	-	0.0000	0.0000	0.0000	-
Porto	rape (summer)	0.0914	0.2442	0.1572	-	0.0000	0.0000	0.0000	-
Porto	rape (winter)	1.1376	0.7736	1.5410	-	0.0040	0.0007	0.0002	-
Porto	sugar beets	0.1334	0.4016	0.1891	-	0.0000	0.0000	0.0000	-
Porto	tomatoes	0.0582	0.0752	0.0594	-	0.0000	0.0000	0.0000	-
Porto	vines	0.0483	0.1109	0.0692	-	0.0000	0.0086	0.0000	-
Sevilla	apples	0.3187	0.0548	0.0350	-	0.3059	0.0036	0.0011	-
Sevilla	cabbage	0.0041	0.0001	0.0004	-	0.3507	0.0000	0.0000	-
Sevilla	cereals (winter)	0.0000	0.0109	0.0390	-	0.1107	0.0001	0.0000	-
Sevilla	citrus	0.0864	0.0159	0.0089	-	0.4434	0.1500	0.0181	-
Sevilla	cotton	0.0106	0.0036	0.0017	-	0.0611	0.0000	0.0000	-
Sevilla	grass	0.0073	0.0015	0.0002	-	0.0190	0.0010	0.0000	-
Sevilla	maize	0.0006	0.0000	0.0001	-	0.0067	0.0000	0.0000	-
Sevilla	potatoes	0.0020	0.0010	0.0007	-	0.0155	0.0000	0.0000	-
Sevilla	strawberries	0.0227	0.0918	0.1283	-	0.1278	0.0000	0.0000	-
Sevilla	sugar beets	0.1244	0.0797	0.1260	-	0.3054	0.0014	0.0007	-
Sevilla	sunflowers	0.0020	0.0002	0.0002	-	0.0421	0.0000	0.0000	-
Sevilla	tomatoes	0.0027	0.0007	0.0003	-	0.0885	0.0000	0.0000	-
Sevilla	vines	0.1227	0.0179	0.0117	-	0.2943	0.0134	0.0026	-
Thiva	apples	0.2358	0.0487	0.0130	-	0.2368	0.0487	0.0020	-
Thiva	beans (veg)	0.0668	0.0091	0.0032	-	0.1266	0.0000	0.0000	-
Thiva	cabbage	0.0628	0.0105	0.0076	-	0.0488	0.0008	0.0001	-
Thiva	carrots	0.0330	0.0044	0.0005	-	0.1161	0.0000	0.0000	-
Thiva	cereals (winter)	0.0502	0.0459	0.0190	-	0.1592	0.0174	0.0040	-
Thiva	citrus	0.0287	0.0271	0.0073	-	0.4053	0.4830	0.0432	-
Thiva	cotton	0.0023	0.0007	0.0002	-	0.1128	0.0000	0.0000	-
Thiva	grass	0.0239	0.0129	0.0006	-	0.0184	0.0393	0.0000	-
Thiva	maize	0.0179	0.0067	0.0021	-	0.1142	0.0000	0.0000	-
Thiva	onions	0.0005	0.0003	0.0000	-	0.0673	0.0000	0.0000	-
Thiva	potatoes	0.0095	0.0038	0.0005	-	0.0348	0.0000	0.0000	-
Thiva	sugar beets	0.0198	0.0054	0.0006	-	0.1252	0.0001	0.0000	-
Thiva	tobacco	0.0028	0.0002	0.0001	-	0.0225	0.0000	0.0000	-
Thiva	tomatoes	0.0076	0.0018	0.0004	-	0.0385	0.0000	0.0000	-
Thiva	vines	0.0363	0.0163	0.0047	-	0.2601	0.2240	0.0260	-

¹For FOCUS 2010, Q10=2.58, E_A=65.4 kJ/mol;

²For FOCUS 2000, Q10=2.2, E_A=54 kJ/mol

Table A1-2. Annual averages of rainfall and irrigation.

Location	Crop	Rainfall (mm)	Irrigation (mm)			
		FOCUS 2000 and 2010	FOCUS 2010			FOCUS 2000
		All Models	PEARL	PELMO and PRZM	MACRO	All Models
Châteaudun	apples	648	349	369	-	323
Châteaudun	cabbage	648	186	198	-	284
Châteaudun	carrots	648	176	171	-	284
Châteaudun	cereals (spring)	648	0	0	-	0
Châteaudun	cereals (winter)	648	0	0	-	0
Châteaudun	grass	648	338	331	-	303
Châteaudun	maize	648	265	255	-	323
Châteaudun	onions	648	116	139	-	284
Châteaudun	peas	648	0	0	-	0
Châteaudun	potatoes	648	198	211	-	311
Châteaudun	rape (winter)	648	0	0	-	0
Châteaudun	sugar beets	648	394	328	-	349
Châteaudun	tomatoes	648	175	177	-	284
Châteaudun	vines	648	242	237	-	323
Hamburg	all crops	786	0	0	-	0
Jokioinen	all crops	650	0	0	-	0
Kremsmünster	all crops	899	0	0	-	0
Okehampton	all crops	1038	0	0	-	0
Piacenza	apples	857	154	448	-	361
Piacenza	cereals (winter)	857	0	0	-	0
Piacenza	citrus	857	62	241	-	361
Piacenza	grass	857	215	457	-	369
Piacenza	maize	857	187	399	-	365
Piacenza	potatoes	857	220	335	-	381
Piacenza	rape (winter)	857	0	0	-	0
Piacenza	soybeans	857	218	341	-	365
Piacenza	sugar beets	857	167	294	-	392
Piacenza	sunflowers	857	175	403	-	365
Piacenza	tobacco	857	158	358	-	365
Piacenza	tomatoes	857	105	234	-	328
Piacenza	vines	857	96	290	-	361
Porto	apples	1150	398	509	-	0

Table A1-2 (continued). Annual averages of rainfall and irrigation.

Location	Crop	Rainfall (mm)	Irrigation (mm)			
		FOCUS 2000 and 2010	FOCUS 2010			FOCUS 2000
		All Models	PEARL	PELMO and PRZM	MACRO	All Models
Porto	beans (veg)	1150	314	415	-	0
Porto	cabbage	1150	287	399	-	0
Porto	carrots	1150	211	299	-	0
Porto	cereals (spring)	1150	0	0	-	0
Porto	cereals (winter)	1150	0	0	-	0
Porto	citrus	1150	194	309	-	0
Porto	grass	1150	376	541	-	0
Porto	maize	1150	309	393	-	0
Porto	onions	1150	8	93	-	0
Porto	potatoes	1150	78	138	-	0
Porto	rape (summer)	1150	175	312	-	0
Porto	rape (winter)	1150	0	0	-	0
Porto	sugar beets	1150	71	177	-	0
Porto	tomatoes	1150	266	361	-	0
Porto	vines	1150	255	310	-	0
Sevilla	apples	493	1086	916	-	829
Sevilla	cabbage	493	536	623	-	504
Sevilla	cereals (winter)	493	0	0	-	0
Sevilla	citrus	493	813	729	-	829
Sevilla	cotton	493	241	275	-	605
Sevilla	grass	493	1025	1171	-	871
Sevilla	maize	493	379	430	-	605
Sevilla	potatoes	493	177	205	-	265
Sevilla	strawberries	493	545	913	-	504
Sevilla	sugar beets	493	300	298	-	461
Sevilla	sunflowers	493	315	361	-	605
Sevilla	tomatoes	493	161	181	-	504
Sevilla	vines	493	854	757	-	829
Thiva	apples	500	747	744	-	660
Thiva	beans (veg)	500	474	515	-	525
Thiva	cabbage	500	184	214	-	525
Thiva	carrots	500	435	491	-	525

Table A1-2 (continued). Annual averages of rainfall and irrigation.

Location	Crop	Rainfall (mm)	Irrigation (mm)			
		FOCUS 2000 and 2010	FOCUS 2010			FOCUS 2000
		All Models	PEARL	PELMO and PRZM	MACRO	All Models
Thiva	cereals (winter)	500	0	0	-	0
Thiva	citrus	500	433	533	-	660
Thiva	cotton	500	261	312	-	604
Thiva	grass	500	727	856	-	613
Thiva	maize	500	505	599	-	604
Thiva	onions	500	58	217	-	525
Thiva	potatoes	500	356	393	-	567
Thiva	sugar beets	500	463	516	-	667
Thiva	tobacco	500	553	615	-	604
Thiva	tomatoes	500	526	578	-	525
Thiva	vines	500	514	483	-	660

Table A1-3. Annual averages of runoff.

Location	Crop	Runoff (mm)							
		FOCUS 2010				FOCUS 2000			
		PEARL	PELMO	PRZM	MACRO	PEARL	PELMO	PRZM	MACRO
Châteaudun	apples	0	0	0	-	0	12	11	-
Châteaudun	cabbage	0	0	0	-	0	84	75	-
Châteaudun	carrots	0	0	0	-	0	106	97	-
Châteaudun	cereals (spring)	0	0	0	-	0	44	46	-
Châteaudun	cereals (winter)	0	0	0	-	0	31	30	-
Châteaudun	grass	0	0	0	-	0	6	5	-
Châteaudun	maize	0	0	0	-	0	149	137	-
Châteaudun	onions	0	0	0	-	0	77	69	-
Châteaudun	peas	0	0	0	-	0	50	50	-
Châteaudun	potatoes	0	0	0	-	0	144	131	-
Châteaudun	rape (winter)	0	0	0	-	0	21	20	-
Châteaudun	sugar beets	0	0	0	-	0	77	71	-
Châteaudun	tomatoes	0	0	0	-	0	82	74	-
Châteaudun	vines	0	0	0	-	0	12	11	-
Hamburg	apples	0	0	0	-	0	3	3	-
Hamburg	beans (field)	0	0	0	-	0	53	55	-
Hamburg	cabbage	0	0	0	-	0	41	45	-
Hamburg	carrot	0	0	0	-	0	43	46	-
Hamburg	cereals (spring)	0	0	0	-	0	47	50	-
Hamburg	cereals (winter)	0	0	0	-	0	25	24	-
Hamburg	grass	0	0	0	-	0	2	3	-
Hamburg	maize	0	0	0	-	0	58	61	-
Hamburg	onions	0	0	0	-	0	47	50	-
Hamburg	peas	0	0	0	-	0	51	54	-
Hamburg	potato	0	0	0	-	0	58	59	-
Hamburg	rape (winter)	0	0	0	-	0	16	15	-
Hamburg	strawberries	0	0	0	-	0	10	12	-
Hamburg	sugar beets	0	0	0	-	0	41	44	-
Hamburg	vines	0	0	0	-	0	4	5	-
Jokioinen	apples	0	0	0	-	0	23	20	-
Jokioinen	bush berries	0	0	0	-	0	20	19	-
Jokioinen	cabbage	0	0	0	-	0	88	92	-
Jokioinen	carrots	0	0	0	-	0	89	90	-
Jokioinen	cereals (spring)	0	0	0	-	0	96	100	-
Jokioinen	cereals (winter)	0	0	0	-	0	52	54	-
Jokioinen	grass	0	0	0	-	0	18	18	-
Jokioinen	onions	0	0	0	-	0	98	102	-
Jokioinen	peas	0	0	0	-	0	103	108	-
Jokioinen	potatoes	0	0	0	-	0	114	114	-
Jokioinen	rape (summer)	0	0	0	-	0	94	98	-
Jokioinen	strawberries	0	0	0	-	0	39	40	-
Jokioinen	sugar beets	0	0	0	-	0	84	87	-
Kremsmünster	apples	4	0	0	-	6	30	28	-

Table A1-3 (continued). Annual averages of runoff.

Location	Crop	Runoff (mm)							
		FOCUS 2010				FOCUS 2000			
		PEARL	PELMO	PRZM	MACRO	PEARL	PELMO	PRZM	MACRO
Kremsmünster	beans (field)	4	0	0	-	5	145	141	-
Kremsmünster	cabbage	4	0	0	-	3	112	112	-
Kremsmünster	carrots	4	0	0	-	3	124	122	-
Kremsmünster	cereals (spring)	4	0	0	-	3	121	120	-
Kremsmünster	cereals (winter)	4	0	0	-	5	100	94	-
Kremsmünster	grass	3	0	0	-	1	20	19	-
Kremsmünster	maize	5	0	0	-	4	174	171	-
Kremsmünster	onions	4	0	0	-	5	123	121	-
Kremsmünster	potatoes	4	0	0	-	3	170	165	-
Kremsmünster	rape (winter)	4	0	0	-	6	87	81	-
Kremsmünster	strawberries	4	0	0	-	1	63	60	-
Kremsmünster	sugar beets	4	0	0	-	3	108	109	-
Kremsmünster	vines	8	0	0	-	13	31	30	-
Okehampton	apples	0	0	0	-	0	23	24	-
Okehampton	beans (field)	0	0	0	-	0	153	152	-
Okehampton	cereals (spring)	0	0	0	-	0	151	149	-
Okehampton	cereals (winter)	0	0	0	-	0	89	86	-
Okehampton	grass	0	0	0	-	0	17	17	-
Okehampton	linseed	0	0	0	-	0	136	135	-
Okehampton	maize	1	0	0	-	0	193	188	-
Okehampton	peas	0	0	0	-	0	165	164	-
Okehampton	potatoes	0	0	0	-	0	190	187	-
Okehampton	rape (summer)	0	0	0	-	0	151	148	-
Okehampton	rape (winter)	0	0	0	-	0	68	66	-
Okehampton	sugar beets	0	0	0	-	0	132	130	-
Piacenza	apples	0	0	0	-	0	2	2	-
Piacenza	cereals (winter)	0	0	0	-	0	52	52	-
Piacenza	citrus	0	0	0	-	0	2	2	-
Piacenza	grass	0	0	0	-	0	1	0	-
Piacenza	maize	0	0	0	-	0	71	61	-
Piacenza	potatoes	0	0	0	-	0	80	69	-
Piacenza	rape (winter)	0	0	0	-	0	36	35	-
Piacenza	soybeans	0	0	0	-	0	90	75	-
Piacenza	sugar beets	0	0	0	-	0	67	60	-
Piacenza	sunflowers	0	0	0	-	0	85	75	-
Piacenza	tobacco	0	0	0	-	0	95	81	-
Piacenza	tomatoes	0	0	0	-	0	89	79	-
Piacenza	vines	0	0	0	-	0	7	6	-
Porto	apples	30	0	0	-	31	48	49	-
Porto	beans (veg)	24	0	0	-	44	281	286	-
Porto	cabbage	30	0	0	-	44	215	216	-
Porto	carrots	30	0	0	-	48	249	250	-
Porto	cereals (spring)	20	0	0	-	46	271	276	-

Table A1-3 (continued). Annual averages of runoff.

Location	Crop	Runoff (mm)							
		FOCUS 2010				FOCUS 2000			
		PEARL	PELMO	PRZM	MACRO	PEARL	PELMO	PRZM	MACRO
Porto	cereals (winter)	25	0	0	-	55	173	177	-
Porto	citrus	48	0	0	-	43	50	51	-
Porto	grass	32	0	0	-	37	39	41	-
Porto	maize	25	0	0	-	39	306	308	-
Porto	onions	29	0	0	-	57	275	277	-
Porto	potatoes	30	0	0	-	54	303	307	-
Porto	rape (summer)	20	0	0	-	38	273	278	-
Porto	rape (winter)	23	0	0	-	54	109	111	-
Porto	sugar beets	19	0	0	-	39	275	280	-
Porto	tomatoes	20	0	0	-	42	272	276	-
Porto	vines	33	0	0	-	36	49	50	-
Sevilla	apples	0	0	0	-	0	173	132	-
Sevilla	cabbage	0	0	0	-	0	262	218	-
Sevilla	cereals (winter)	0	0	0	-	0	101	96	-
Sevilla	citrus	0	0	0	-	0	193	166	-
Sevilla	cotton	0	0	0	-	0	354	283	-
Sevilla	grass	0	0	0	-	0	106	59	-
Sevilla	maize	0	0	0	-	0	391	320	-
Sevilla	potatoes	0	0	0	-	0	236	209	-
Sevilla	strawberries	0	0	0	-	0	164	123	-
Sevilla	sugar beets	0	0	0	-	0	196	157	-
Sevilla	sunflowers	0	0	0	-	0	420	349	-
Sevilla	tomatoes	0	0	0	-	0	300	252	-
Sevilla	vines	0	0	0	-	0	178	145	-
Thiva	apples	2	0	0	-	0	69	49	-
Thiva	beans (veg)	1	0	0	-	0	275	281	-
Thiva	cabbage	2	0	0	-	0	287	269	-
Thiva	carrots	1	0	0	-	0	228	195	-
Thiva	cereals (winter)	0	0	0	-	0	66	69	-
Thiva	citrus	2	0	0	-	0	78	66	-
Thiva	cotton	0	0	0	-	0	279	241	-
Thiva	grass	2	0	0	-	0	40	23	-
Thiva	maize	1	0	0	-	0	342	307	-
Thiva	onions	1	0	0	-	0	281	249	-
Thiva	potatoes	1	0	0	-	0	311	278	-
Thiva	sugar beets	1	0	0	-	0	251	210	-
Thiva	tobacco	1	0	0	-	0	253	221	-
Thiva	tomatoes	1	0	0	-	0	215	176	-
Thiva	vines	2	0	0	-	0	75	64	-

Table A1-4. Annual Averages of potential evapotranspiration (not reported by PRZM).

Location	Crop	Potential Evapotranspiration (mm)					
		FOCUS 2010			FOCUS 2000		
		PEARL	PELMO	MACRO	PEARL	PELMO	MACRO
Châteaudun	apples	817	817	-	730	733	-
Châteaudun	cabbage	765	765	-	692	719	-
Châteaudun	carrots	766	765	-	687	711	-
Châteaudun	cereals (spring)	770	768	-	680	682	-
Châteaudun	cereals (winter)	768	767	-	675	622	-
Châteaudun	grass	774	774	-	741	741	-
Châteaudun	maize	788	787	-	694	696	-
Châteaudun	onions	740	739	-	652	674	-
Châteaudun	peas	808	808	-	699	711	-
Châteaudun	potatoes	790	790	-	675	696	-
Châteaudun	rape (winter)	766	766	-	655	578	-
Châteaudun	sugar beets	798	796	-	684	689	-
Châteaudun	tomatoes	777	776	-	702	719	-
Châteaudun	vines	650	646	-	647	659	-
Hamburg	apples	646	647	-	602	604	-
Hamburg	beans (field)	617	615	-	527	543	-
Hamburg	cabbage	605	605	-	567	592	-
Hamburg	carrot	602	601	-	564	586	-
Hamburg	cereals (spring)	620	619	-	537	561	-
Hamburg	cereals (winter)	613	612	-	535	512	-
Hamburg	grass	609	610	-	610	610	-
Hamburg	maize	622	621	-	570	573	-
Hamburg	onions	582	580	-	533	555	-
Hamburg	peas	637	637	-	577	586	-
Hamburg	potato	625	624	-	561	573	-
Hamburg	rape (winter)	602	602	-	529	476	-
Hamburg	strawberries	610	610	-	610	610	-
Hamburg	sugar beets	627	627	-	572	567	-
Hamburg	vines	512	509	-	535	543	-
Jokioinen	apples	596	596	-	551	553	-
Jokioinen	bush berries	446	445	-	559	559	-
Jokioinen	cabbage	557	557	-	536	542	-
Jokioinen	carrots	567	563	-	532	536	-
Jokioinen	cereals (spring)	565	564	-	506	514	-
Jokioinen	cereals (winter)	562	561	-	493	469	-
Jokioinen	grass	559	559	-	559	559	-
Jokioinen	onions	532	531	-	499	508	-
Jokioinen	peas	582	582	-	531	536	-
Jokioinen	potatoes	572	572	-	530	525	-
Jokioinen	rape (summer)	554	553	-	520	520	-
Jokioinen	strawberries	559	559	-	559	559	-
Jokioinen	sugar beets	574	573	-	528	520	-
Kremsmünster	apples	710	710	-	661	664	-

Table A1-4 (continued). Annual Averages of potential evapotranspiration (not reported by PRZM).

Location	Crop	Potential Evapotranspiration (mm)					
		FOCUS 2010			FOCUS 2000		
		PEARL	PELMO	MACRO	PEARL	PELMO	MACRO
Kremsmünster	beans (field)	678	665	-	582	597	-
Kremsmünster	cabbage	665	661	-	625	650	-
Kremsmünster	carrots	663	680	-	621	644	-
Kremsmünster	cereals (spring)	681	671	-	594	617	-
Kremsmünster	cereals (winter)	673	670	-	589	563	-
Kremsmünster	grass	670	681	-	670	670	-
Kremsmünster	maize	682	639	-	628	630	-
Kremsmünster	onions	640	685	-	589	610	-
Kremsmünster	potatoes	686	667	-	619	630	-
Kremsmünster	rape (winter)	663	670	-	585	523	-
Kremsmünster	strawberries	670	683	-	671	670	-
Kremsmünster	sugar beets	683	560	-	630	623	-
Kremsmünster	vines	563	752	-	589	597	-
Okehampton	apples	743	734	-	701	702	-
Okehampton	beans (field)	734	721	-	585	631	-
Okehampton	cereals (spring)	722	713	-	630	653	-
Okehampton	cereals (winter)	714	710	-	628	596	-
Okehampton	grass	709	693	-	710	710	-
Okehampton	linseed	695	712	-	575	596	-
Okehampton	maize	712	741	-	663	667	-
Okehampton	peas	742	720	-	670	681	-
Okehampton	potatoes	720	702	-	659	667	-
Okehampton	rape (summer)	702	702	-	648	660	-
Okehampton	rape (winter)	702	726	-	628	553	-
Okehampton	sugar beets	727	856	-	669	660	-
Piacenza	apples	857	788	-	757	762	-
Piacenza	cereals (winter)	790	485	-	696	646	-
Piacenza	citrus	485	809	-	561	562	-
Piacenza	grass	809	839	-	769	769	-
Piacenza	maize	839	837	-	713	723	-
Piacenza	potatoes	838	800	-	683	723	-
Piacenza	rape (winter)	800	812	-	699	600	-
Piacenza	soybeans	814	811	-	694	708	-
Piacenza	sugar beets	812	832	-	703	716	-
Piacenza	sunflowers	833	807	-	621	662	-
Piacenza	tobacco	808	812	-	745	754	-
Piacenza	tomatoes	813	674	-	725	746	-
Piacenza	vines	678	1001	-	667	685	-
Porto	apples	1002	980	-	865	868	-
Porto	beans (veg)	984	952	-	724	780	-
Porto	cabbage	954	959	-	810	851	-
Porto	carrots	962	953	-	823	842	-
Porto	cereals (spring)	955	665	-	809	807	-

Table A1-4 (continued). Annual Averages of potential evapotranspiration (not reported by PRZM).

Location	Crop	Potential Evapotranspiration (mm)					
		FOCUS 2010			FOCUS 2000		
		PEARL	PELMO	MACRO	PEARL	PELMO	MACRO
Porto	cereals (winter)	944	942	-	779	737	-
Porto	citrus	574	575	-	640	640	-
Porto	grass	958	958	-	876	877	-
Porto	maize	973	970	-	822	824	-
Porto	onions	942	940	-	837	798	-
Porto	potatoes	972	969	-	844	824	-
Porto	rape (summer)	950	948	-	801	815	-
Porto	rape (winter)	949	948	-	754	684	-
Porto	sugar beets	946	945	-	818	815	-
Porto	tomatoes	976	975	-	816	851	-
Porto	vines	820	815	-	771	780	-
Sevilla	apples	1559	1559	-	1289	1295	-
Sevilla	cabbage	1483	1482	-	1226	1269	-
Sevilla	cereals (winter)	1479	1478	-	1202	1099	-
Sevilla	citrus	896	896	-	955	955	-
Sevilla	cotton	1492	1491	-	1230	1243	-
Sevilla	grass	1494	1494	-	1308	1308	-
Sevilla	maize	1489	1488	-	1231	1230	-
Sevilla	potatoes	1499	1499	-	1251	1230	-
Sevilla	strawberries	1493	1494	-	1308	1308	-
Sevilla	sugar beets	1479	1478	-	1234	1217	-
Sevilla	sunflowers	1475	1474	-	1179	1125	-
Sevilla	tomatoes	1477	1476	-	1272	1269	-
Sevilla	vines	1206	1202	-	1106	1164	-
Thiva	apples	1244	1245	-	1010	1013	-
Thiva	beans (veg)	1187	1184	-	880	911	-
Thiva	cabbage	1196	1196	-	1001	993	-
Thiva	carrots	1202	1200	-	944	982	-
Thiva	cereals (winter)	1182	1180	-	906	860	-
Thiva	citrus	718	718	-	747	747	-
Thiva	cotton	1199	1196	-	973	972	-
Thiva	grass	1197	1197	-	1024	1023	-
Thiva	maize	1223	1222	-	942	962	-
Thiva	onions	1173	1170	-	969	931	-
Thiva	potatoes	1219	1218	-	935	962	-
Thiva	sugar beets	1204	1202	-	949	952	-
Thiva	tobacco	1195	1196	-	997	1003	-
Thiva	tomatoes	1228	1226	-	950	993	-
Thiva	vines	979	975	-	876	911	-

Table A1-5. Annual averages of actual evapotranspiration.

Location	Crop	Actual evapotranspiration (mm)							
		FOCUS 2010				FOCUS 2000			
		PEARL	PELMO	PRZM	MACRO	PEARL	PELMO	PRZM	MACRO
Châteaudun	apples	764	796	789	-	696	724	722	-
Châteaudun	cabbage	591	608	616	-	579	628	626	-
Châteaudun	carrots	579	616	615	-	587	647	644	-
Châteaudun	cereals (spring)	475	468	466	-	445	430	426	-
Châteaudun	cereals (winter)	498	509	506	-	454	441	439	-
Châteaudun	grass	723	713	736	-	695	703	702	-
Châteaudun	maize	649	676	686	-	595	624	627	-
Châteaudun	onions	556	578	579	-	535	595	593	-
Châteaudun	peas	503	479	477	-	469	439	439	-
Châteaudun	potatoes	637	645	636	-	580	614	618	-
Châteaudun	rape (winter)	519	523	522	-	452	436	435	-
Châteaudun	sugar beets	711	738	745	-	615	647	648	-
Châteaudun	tomatoes	608	629	628	-	576	621	618	-
Châteaudun	vines	605	634	635	-	615	655	655	-
Hamburg	apples	585	535	529	-	539	552	547	-
Hamburg	beans (field)	537	505	506	-	447	473	474	-
Hamburg	cabbage	507	492	490	-	468	484	481	-
Hamburg	carrot	488	494	491	-	453	484	482	-
Hamburg	cereals (spring)	555	515	526	-	474	493	492	-
Hamburg	cereals (winter)	516	523	521	-	436	473	471	-
Hamburg	grass	567	479	490	-	570	403	490	-
Hamburg	maize	525	504	505	-	475	492	493	-
Hamburg	onions	484	480	480	-	436	466	466	-
Hamburg	peas	555	518	518	-	496	496	496	-
Hamburg	potato	509	487	488	-	447	464	465	-
Hamburg	rape (winter)	513	515	513	-	439	440	438	-
Hamburg	strawberries	544	504	502	-	545	503	501	-
Hamburg	sugar beets	542	501	505	-	487	487	490	-
Hamburg	vines	414	462	462	-	384	517	516	-
Jokioinen	apples	473	441	445	-	459	439	443	-
Jokioinen	bush berries	370	354	358	-	433	400	403	-
Jokioinen	cabbage	406	387	395	-	393	379	388	-
Jokioinen	carrots	392	362	372	-	371	352	362	-
Jokioinen	cereals (spring)	426	404	407	-	396	387	391	-
Jokioinen	cereals (winter)	440	433	436	-	394	395	396	-
Jokioinen	grass	469	432	435	-	469	428	432	-
Jokioinen	onions	386	352	354	-	371	340	344	-
Jokioinen	peas	431	413	392	-	403	391	395	-
Jokioinen	potatoes	397	366	374	-	372	345	357	-
Jokioinen	rape (summer)	419	403	406	-	399	388	392	-
Jokioinen	strawberries	402	369	366	-	403	367	365	-
Jokioinen	sugar beets	419	400	407	-	394	379	387	-
Kremsmünster	apples	623	647	636	-	537	629	623	-

Table A1-5 (continued). Annual averages of actual evapotranspiration.

Location	Crop	Actual evapotranspiration (mm)							
		FOCUS 2010				FOCUS 2000			
		PEARL	PELMO	PRZM	MACRO	PEARL	PELMO	PRZM	MACRO
Kremsmünster	beans (field)	575	591	586	-	486	541	538	-
Kremsmünster	cabbage	553	575	573	-	516	561	560	-
Kremsmünster	carrots	542	573	569	-	503	554	553	-
Kremsmünster	cereals (spring)	598	606	605	-	517	565	565	-
Kremsmünster	cereals (winter)	568	605	603	-	486	528	528	-
Kremsmünster	grass	601	584	588	-	601	587	587	-
Kremsmünster	maize	562	590	592	-	503	562	564	-
Kremsmünster	onions	526	550	551	-	480	532	534	-
Kremsmünster	potatoes	562	574	575	-	500	536	539	-
Kremsmünster	rape (winter)	559	598	591	-	483	490	490	-
Kremsmünster	strawberries	583	600	598	-	583	594	593	-
Kremsmünster	sugar beets	582	589	594	-	528	563	567	-
Kremsmünster	vines	455	521	521	-	397	567	567	-
Okehampton	apples	646	660	649	-	613	608	659	-
Okehampton	beans (field)	642	575	575	-	534	528	528	-
Okehampton	cereals (spring)	629	595	592	-	560	560	558	-
Okehampton	cereals (winter)	604	608	605	-	528	532	530	-
Okehampton	grass	630	580	579	-	631	579	579	-
Okehampton	linseed	606	576	578	-	503	527	527	-
Okehampton	maize	595	587	588	-	564	559	561	-
Okehampton	peas	617	573	571	-	570	545	544	-
Okehampton	potatoes	598	578	577	-	551	546	546	-
Okehampton	rape (summer)	605	592	588	-	559	588	563	-
Okehampton	rape (winter)	584	596	593	-	516	498	496	-
Okehampton	sugar beets	599	587	591	-	549	556	561	-
Piacenza	apples	799	843	835	-	707	758	758	-
Piacenza	cereals (winter)	523	557	539	-	448	480	475	-
Piacenza	citrus	478	485	485	-	533	562	562	-
Piacenza	grass	737	801	809	-	730	769	769	-
Piacenza	maize	698	767	757	-	611	684	686	-
Piacenza	potatoes	730	767	755	-	611	709	707	-
Piacenza	rape (winter)	489	517	501	-	407	427	423	-
Piacenza	soybeans	682	727	724	-	603	666	667	-
Piacenza	sugar beets	713	762	752	-	639	704	705	-
Piacenza	sunflowers	723	794	784	-	543	649	650	-
Piacenza	tobacco	648	732	722	-	634	708	709	-
Piacenza	tomatoes	644	711	692	-	592	697	695	-
Piacenza	vines	602	661	657	-	514	683	683	-
Porto	apples	887	988	986	-	648	596	590	-
Porto	beans (veg)	837	891	887	-	501	448	446	-
Porto	cabbage	758	788	802	-	507	459	459	-
Porto	carrots	681	731	747	-	473	448	449	-
Porto	cereals (spring)	607	565	563	-	500	463	461	-

Table A1-5 (continued). Annual averages of actual evapotranspiration.

Location	Crop	Actual evapotranspiration (mm)							
		FOCUS 2010				FOCUS 2000			
		PEARL	PELMO	PRZM	MACRO	PEARL	PELMO	PRZM	MACRO
Porto	cereals (winter)	612	611	603	-	471	477	470	-
Porto	citrus	535	575	575	-	547	519	519	-
Porto	grass	860	945	956	-	594	531	531	-
Porto	maize	794	891	902	-	523	492	494	-
Porto	onions	491	565	566	-	403	416	414	-
Porto	potatoes	548	624	620	-	435	449	445	-
Porto	rape (summer)	733	832	826	-	556	532	529	-
Porto	rape (winter)	641	620	613	-	466	469	463	-
Porto	sugar beets	693	725	720	-	565	537	532	-
Porto	tomatoes	821	855	854	-	525	462	462	-
Porto	vines	691	792	792	-	578	577	576	-
Sevilla	apples	1378	1323	1314	-	1155	1118	1153	-
Sevilla	cabbage	933	961	1000	-	760	710	751	-
Sevilla	cereals (winter)	512	374	372	-	435	311	312	-
Sevilla	citrus	895	896	896	-	950	955	955	-
Sevilla	cotton	698	663	669	-	787	727	792	-
Sevilla	grass	1304	1424	1471	-	1159	1135	1175	-
Sevilla	maize	806	772	791	-	802	670	735	-
Sevilla	potatoes	564	544	544	-	505	478	493	-
Sevilla	strawberries	987	1160	1153	-	881	729	761	-
Sevilla	sugar beets	724	654	658	-	676	683	694	-
Sevilla	sunflowers	709	724	742	-	657	655	717	-
Sevilla	tomatoes	580	578	580	-	639	681	719	-
Sevilla	vines	1035	1097	1094	-	979	1090	1113	-
Thiva	apples	1073	1129	1121	-	823	947	960	-
Thiva	beans (veg)	821	836	847	-	651	653	635	-
Thiva	cabbage	474	486	498	-	593	613	632	-
Thiva	carrots	820	829	831	-	692	705	733	-
Thiva	cereals (winter)	448	403	402	-	385	317	316	-
Thiva	citrus	689	718	718	-	541	746	746	-
Thiva	cotton	674	701	704	-	718	748	776	-
Thiva	grass	1044	1119	1138	-	897	857	870	-
Thiva	maize	903	966	970	-	663	691	722	-
Thiva	onions	440	537	540	-	566	630	654	-
Thiva	potatoes	753	748	751	-	701	663	691	-
Thiva	sugar beets	884	909	912	-	716	801	824	-
Thiva	tobacco	878	915	932	-	768	757	788	-
Thiva	tomatoes	918	932	940	-	716	721	754	-
Thiva	vines	822	863	861	-	630	895	897	-

Table A1-6. Annual averages of percolation past 1 m.

Location	Crop	Percolation past 1 m (mm)							
		FOCUS 2010				FOCUS 2000			
		PEARL	PELMO	PRZM	MACRO	PEARL	PELMO	PRZM	MACRO
Châteaudun	apples	234	226	232	-	473	416	398	-
Châteaudun	cabbage	244	239	241	-	354	221	232	-
Châteaudun	carrots	245	204	204	-	346	180	192	-
Châteaudun	cereals (spring)	174	180	182	-	203	174	176	-
Châteaudun	cereals (winter)	150	140	142	-	194	177	179	-
Châteaudun	grass	264	267	244	-	255	242	245	-
Châteaudun	maize	265	227	228	-	376	199	207	-
Châteaudun	onions	208	209	209	-	398	261	270	-
Châteaudun	peas	146	170	171	-	179	159	160	-
Châteaudun	potatoes	210	214	225	-	380	202	211	-
Châteaudun	rape (winter)	129	128	129	-	197	191	195	-
Châteaudun	sugar beets	331	240	242	-	382	273	281	-
Châteaudun	tomatoes	216	197	198	-	357	230	240	-
Châteaudun	vines	285	256	254	-	534	481	498	-
Hamburg	apples	201	254	259	-	369	274	275	-
Hamburg	beans (field)	250	281	280	-	339	260	257	-
Hamburg	cabbage	280	294	297	-	318	261	260	-
Hamburg	carrot	298	293	295	-	334	259	259	-
Hamburg	cereals (spring)	231	271	261	-	312	246	245	-
Hamburg	cereals (winter)	271	265	267	-	362	289	295	-
Hamburg	grass	219	307	297	-	217	381	294	-
Hamburg	maize	261	283	282	-	329	239	239	-
Hamburg	onions	303	307	307	-	351	273	271	-
Hamburg	peas	231	268	268	-	290	240	237	-
Hamburg	potato	278	299	299	-	340	264	262	-
Hamburg	rape (winter)	274	273	275	-	361	332	337	-
Hamburg	strawberries	242	282	284	-	241	273	274	-
Hamburg	sugar beets	245	286	282	-	309	260	256	-
Hamburg	vines	372	326	326	-	457	334	340	-
Jokioinen	apples	177	211	207	-	238	197	202	-
Jokioinen	bush berries	280	296	292	-	218	230	228	-
Jokioinen	cabbage	244	263	255	-	257	183	171	-
Jokioinen	carrots	258	288	278	-	279	209	198	-
Jokioinen	cereals (spring)	224	247	243	-	254	167	158	-
Jokioinen	cereals (winter)	210	217	214	-	256	204	200	-
Jokioinen	grass	181	218	216	-	181	204	200	-
Jokioinen	onions	265	298	296	-	279	212	204	-
Jokioinen	peas	219	238	258	-	247	156	147	-
Jokioinen	potatoes	254	284	276	-	278	191	179	-
Jokioinen	rape (summer)	231	247	244	-	251	169	160	-
Jokioinen	strawberries	248	281	284	-	247	244	245	-
Jokioinen	sugar beets	231	250	244	-	256	188	176	-
Kremsmünster	apples	234	255	265	-	447	301	297	-

Table A1-6 (continued). Annual averages of percolation past 1 m.

Location	Crop	Percolation past 1 m (mm)							
		FOCUS 2010				FOCUS 2000			
		PEARL	PELMO	PRZM	MACRO	PEARL	PELMO	PRZM	MACRO
Kremsmünster	beans (field)	273	308	313	-	409	214	220	-
Kremsmünster	cabbage	320	325	327	-	381	226	227	-
Kremsmünster	carrots	342	327	330	-	393	222	224	-
Kremsmünster	cereals (spring)	354	294	294	-	379	213	214	-
Kremsmünster	cereals (winter)	298	296	297	-	419	272	282	-
Kremsmünster	grass	327	316	312	-	298	293	293	-
Kremsmünster	maize	295	310	308	-	406	168	172	-
Kremsmünster	onions	333	350	348	-	415	244	243	-
Kremsmünster	potatoes	368	325	324	-	396	193	194	-
Kremsmünster	rape (winter)	333	303	309	-	423	324	333	-
Kremsmünster	strawberries	336	299	301	-	316	243	246	-
Kremsmünster	sugar beets	313	311	306	-	378	230	228	-
Kremsmünster	vines	313	381	379	-	518	398	407	-
Okehampton	apples	436	380	390	-	516	407	397	-
Okehampton	beans (field)	392	463	463	-	504	357	358	-
Okehampton	cereals (spring)	396	443	446	-	478	327	331	-
Okehampton	cereals (winter)	409	430	433	-	510	417	422	-
Okehampton	grass	433	458	459	-	407	442	442	-
Okehampton	linseed	408	462	460	-	535	376	376	-
Okehampton	maize	432	451	450	-	475	287	289	-
Okehampton	peas	442	465	467	-	468	328	330	-
Okehampton	potatoes	421	460	461	-	487	301	305	-
Okehampton	rape (summer)	440	446	449	-	478	298	327	-
Okehampton	rape (winter)	433	442	445	-	521	472	476	-
Okehampton	sugar beets	454	451	446	-	489	350	346	-
Piacenza	apples	439	464	472	-	672	498	499	-
Piacenza	cereals (winter)	212	301	319	-	410	325	331	-
Piacenza	citrus	335	614	651	-	809	690	698	-
Piacenza	grass	441	514	506	-	496	456	457	-
Piacenza	maize	335	490	501	-	611	468	476	-
Piacenza	potatoes	346	425	441	-	627	450	462	-
Piacenza	rape (winter)	347	341	357	-	450	394	399	-
Piacenza	soybeans	368	471	482	-	620	465	481	-
Piacenza	sugar beets	392	389	401	-	610	478	484	-
Piacenza	sunflowers	311	467	482	-	679	488	498	-
Piacenza	tobacco	309	484	497	-	589	420	433	-
Piacenza	tomatoes	367	381	402	-	593	400	412	-
Piacenza	vines	319	488	491	-	801	591	600	-
Porto	apples	351	674	674	-	541	525	543	-
Porto	beans (veg)	631	674	681	-	604	421	417	-
Porto	cabbage	603	761	760	-	598	476	475	-
Porto	carrots	648	719	718	-	628	453	451	-
Porto	cereals (spring)	650	585	587	-	604	417	413	-

Table A1-6 (continued). Annual averages of percolation past 1 m.

Location	Crop	Percolation past 1 m (mm)							
		FOCUS 2010				FOCUS 2000			
		PEARL	PELMO	PRZM	MACRO	PEARL	PELMO	PRZM	MACRO
Porto	cereals (winter)	513	540	548	-	624	500	504	-
Porto	citrus	760	887	886	-	704	596	610	-
Porto	grass	635	746	735	-	519	579	578	-
Porto	maize	639	652	654	-	588	352	349	-
Porto	onions	638	678	680	-	690	459	458	-
Porto	potatoes	650	664	671	-	661	398	398	-
Porto	rape (summer)	572	630	638	-	557	346	343	-
Porto	rape (winter)	486	532	539	-	629	572	577	-
Porto	sugar beets	508	604	610	-	547	338	340	-
Porto	tomatoes	575	656	662	-	583	416	411	-
Porto	vines	681	671	670	-	670	541	557	-
Sevilla	apples	201	92	100	-	462	67	86	-
Sevilla	cabbage	95	155	155	-	237	24	27	-
Sevilla	cereals (winter)	-19	119	121	-	58	81	85	-
Sevilla	citrus	411	330	329	-	648	260	312	-
Sevilla	cotton	35	105	106	-	311	17	23	-
Sevilla	grass	214	240	193	-	205	122	129	-
Sevilla	maize	66	151	149	-	296	37	43	-
Sevilla	potatoes	106	154	157	-	253	45	56	-
Sevilla	strawberries	50	245	253	-	116	104	112	-
Sevilla	sugar beets	69	137	141	-	277	75	102	-
Sevilla	sunflowers	99	129	130	-	441	24	32	-
Sevilla	tomatoes	75	95	98	-	357	15	26	-
Sevilla	vines	311	158	159	-	566	99	129	-
Thiva	apples	172	120	126	-	517	186	192	-
Thiva	beans (veg)	152	179	178	-	374	97	109	-
Thiva	cabbage	209	228	224	-	432	125	124	-
Thiva	carrots	114	162	162	-	333	93	97	-
Thiva	cereals (winter)	52	97	98	-	115	117	116	-
Thiva	citrus	242	318	317	-	725	394	419	-
Thiva	cotton	87	110	111	-	387	78	87	-
Thiva	grass	181	237	218	-	217	216	220	-
Thiva	maize	101	133	136	-	441	71	76	-
Thiva	onions	117	180	181	-	459	114	122	-
Thiva	potatoes	102	145	146	-	365	93	98	-
Thiva	sugar beets	78	107	109	-	451	115	134	-
Thiva	tobacco	174	201	199	-	336	93	96	-
Thiva	tomatoes	108	147	147	-	309	90	95	-
Thiva	vines	190	123	124	-	654	295	325	-

Table A1-7. Annual averages of percolation past the bottom of the soil column.

Location	Crop	Percolation past the Bottom of the Soil Column (mm)							
		FOCUS 2010				FOCUS 2000			
		PEARL	PELMO	PRZM	MACRO	PEARL	PELMO	PRZM	MACRO
Châteaudun	apples	234	222	229	-	275	235	238	-
Châteaudun	cabbage	244	239	241	-	354	221	232	-
Châteaudun	carrots	245	204	204	-	346	180	192	-
Châteaudun	cereals (spring)	174	180	182	-	203	174	176	-
Châteaudun	cereals (winter)	150	140	142	-	194	177	179	-
Châteaudun	grass	264	249	244	-	255	242	245	-
Châteaudun	maize	265	227	228	-	376	199	207	-
Châteaudun	onions	208	209	209	-	398	261	270	-
Châteaudun	peas	146	170	171	-	179	159	160	-
Châteaudun	potatoes	210	214	225	-	380	202	211	-
Châteaudun	rape (winter)	129	126	127	-	197	191	193	-
Châteaudun	sugar beets	331	238	240	-	382	273	279	-
Châteaudun	tomatoes	216	197	198	-	357	230	240	-
Châteaudun	vines	285	250	251	-	356	304	305	-
Hamburg	apples	201	259	258	-	247	232	237	-
Hamburg	beans (field)	250	281	280	-	339	260	257	-
Hamburg	cabbage	280	294	297	-	318	261	260	-
Hamburg	carrot	298	293	295	-	334	259	259	-
Hamburg	cereals (spring)	231	271	261	-	312	246	245	-
Hamburg	cereals (winter)	271	264	266	-	351	289	291	-
Hamburg	grass	219	323	297	-	217	381	294	-
Hamburg	maize	261	283	281	-	312	236	233	-
Hamburg	onions	303	307	307	-	351	273	271	-
Hamburg	peas	231	268	268	-	290	240	237	-
Hamburg	potato	278	299	299	-	340	264	262	-
Hamburg	rape (winter)	274	271	274	-	347	331	333	-
Hamburg	strawberries	242	282	284	-	241	273	274	-
Hamburg	sugar beets	245	285	282	-	299	259	253	-
Hamburg	vines	372	342	324	-	402	265	266	-
Jokioinen	apples	177	210	206	-	191	188	187	-
Jokioinen	bush berries	280	296	292	-	218	230	228	-
Jokioinen	cabbage	244	263	255	-	257	183	171	-
Jokioinen	carrots	258	288	278	-	279	209	198	-
Jokioinen	cereals (spring)	224	247	243	-	254	167	158	-
Jokioinen	cereals (winter)	210	217	214	-	256	204	200	-
Jokioinen	grass	181	233	216	-	181	204	200	-
Jokioinen	onions	265	298	296	-	279	212	204	-
Jokioinen	peas	219	238	258	-	247	156	147	-
Jokioinen	potatoes	254	284	276	-	278	191	179	-
Jokioinen	rape (summer)	231	247	244	-	251	169	160	-
Jokioinen	strawberries	248	288	284	-	247	244	245	-
Jokioinen	sugar beets	231	250	244	-	256	188	176	-
Kremsmünster	apples	273	222	263	-	356	241	248	-

Table A1-7 (continued). Annual averages of percolation past the bottom of the soil column.

Location	Crop	Percolation past the Bottom of the Soil Column (mm)							
		FOCUS 2010				FOCUS 2000			
		PEARL	PELMO	PRZM	MACRO	PEARL	PELMO	PRZM	MACRO
Kremsmünster	beans (field)	320	266	313	-	409	214	220	-
Kremsmünster	cabbage	342	308	327	-	381	226	227	-
Kremsmünster	carrots	354	325	330	-	393	222	224	-
Kremsmünster	cereals (spring)	298	327	294	-	379	213	214	-
Kremsmünster	cereals (winter)	327	294	296	-	409	271	277	-
Kremsmünster	grass	295	294	312	-	298	293	293	-
Kremsmünster	maize	333	344	307	-	393	164	164	-
Kremsmünster	onions	368	309	348	-	415	244	243	-
Kremsmünster	potatoes	333	350	324	-	396	193	194	-
Kremsmünster	rape (winter)	336	325	308	-	410	323	328	-
Kremsmünster	strawberries	313	302	301	-	316	243	246	-
Kremsmünster	sugar beets	313	300	306	-	368	228	223	-
Kremsmünster	vines	436	310	378	-	489	302	303	-
Okehampton	apples	392	393	388	-	425	407	356	-
Okehampton	beans (field)	396	381	463	-	504	357	358	-
Okehampton	cereals (spring)	409	463	446	-	478	327	331	-
Okehampton	cereals (winter)	433	443	433	-	510	417	422	-
Okehampton	grass	408	430	459	-	407	442	442	-
Okehampton	linseed	432	486	460	-	535	376	376	-
Okehampton	maize	442	462	450	-	475	287	289	-
Okehampton	peas	421	451	467	-	468	328	330	-
Okehampton	potatoes	440	465	461	-	487	301	305	-
Okehampton	rape (summer)	433	460	449	-	478	298	327	-
Okehampton	rape (winter)	454	446	445	-	521	472	476	-
Okehampton	sugar beets	439	442	446	-	489	350	346	-
Piacenza	apples	212	451	470	-	512	458	459	-
Piacenza	cereals (winter)	335	461	318	-	410	325	330	-
Piacenza	citrus	441	301	613	-	685	655	655	-
Piacenza	grass	335	613	506	-	496	456	457	-
Piacenza	maize	346	496	501	-	611	468	475	-
Piacenza	potatoes	347	489	441	-	627	450	462	-
Piacenza	rape (winter)	368	425	357	-	450	394	399	-
Piacenza	soybeans	392	341	482	-	620	465	481	-
Piacenza	sugar beets	311	471	401	-	610	478	484	-
Piacenza	sunflowers	309	389	481	-	679	488	498	-
Piacenza	tobacco	367	466	496	-	589	420	432	-
Piacenza	tomatoes	319	483	402	-	593	400	411	-
Piacenza	vines	351	380	490	-	704	529	530	-
Porto	apples	631	480	672	-	472	505	513	-
Porto	beans (veg)	603	661	681	-	604	421	417	-
Porto	cabbage	648	674	760	-	598	476	475	-
Porto	carrots	650	761	718	-	628	453	451	-
Porto	cereals (spring)	524	719	587	-	604	417	413	-

Table A1-7 (continued). Annual averages of percolation past the bottom of the soil column.

Location	Crop	Percolation past the Bottom of the Soil Column (mm)							
		FOCUS 2010				FOCUS 2000			
		PEARL	PELMO	PRZM	MACRO	PEARL	PELMO	PRZM	MACRO
Porto	cereals (winter)	512	539	547	-	624	500	502	-
Porto	citrus	760	884	885	-	559	581	582	-
Porto	grass	635	735	735	-	519	579	578	-
Porto	maize	639	652	654	-	588	352	349	-
Porto	onions	638	678	680	-	690	459	458	-
Porto	potatoes	650	664	671	-	661	398	398	-
Porto	rape (summer)	572	630	638	-	557	346	343	-
Porto	rape (winter)	485	530	537	-	629	572	576	-
Porto	sugar beets	508	602	608	-	547	338	338	-
Porto	tomatoes	575	656	662	-	583	416	411	-
Porto	vines	681	654	668	-	535	524	527	-
Sevilla	apples	201	69	94	-	167	31	37	-
Sevilla	cabbage	95	155	155	-	237	24	27	-
Sevilla	cereals (winter)	-19	119	121	-	58	81	85	-
Sevilla	citrus	411	326	326	-	372	174	201	-
Sevilla	cotton	35	105	106	-	311	17	23	-
Sevilla	grass	214	224	193	-	205	122	129	-
Sevilla	maize	66	151	149	-	296	37	43	-
Sevilla	potatoes	106	154	157	-	253	45	56	-
Sevilla	strawberries	50	245	253	-	116	104	112	-
Sevilla	sugar beets	69	137	141	-	277	75	102	-
Sevilla	sunflowers	99	129	130	-	441	24	32	-
Sevilla	tomatoes	75	95	98	-	357	15	26	-
Sevilla	vines	311	141	155	-	344	53	64	-
Thiva	apples	172	109	124	-	337	145	151	-
Thiva	beans (veg)	152	179	178	-	374	97	109	-
Thiva	cabbage	209	228	224	-	432	125	124	-
Thiva	carrots	114	162	162	-	333	93	97	-
Thiva	cereals (winter)	51	97	98	-	115	117	116	-
Thiva	citrus	242	315	315	-	618	336	348	-
Thiva	cotton	87	110	111	-	387	78	87	-
Thiva	grass	181	225	218	-	217	216	220	-
Thiva	maize	101	133	136	-	441	71	76	-
Thiva	onions	116	180	181	-	459	114	122	-
Thiva	potatoes	102	145	146	-	365	93	98	-
Thiva	sugar beets	78	107	109	-	451	115	134	-
Thiva	tobacco	174	201	199	-	336	93	96	-
Thiva	tomatoes	107	147	147	-	309	90	95	-
Thiva	vines	190	114	122	-	529	190	200	-