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Impact of food consumption habits on the pesticide dietary intake: Comparison between a French vegetarian population and the general one.

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Introduction

Pesticide residues are regularly found in foodstuffs, as revealed by the European Commission which recently acknowledged that they were detected in 45.7% of the 62,569 samples analysed throughout the European Union in 2005 (European Commission, 2007). Pesticide residues are mainly present in cereals, vegetables and fruit. Thus, vegetables and fruit are found to contribute respectively to 75.8% and 20.5% of the estimated daily intakes of the Korean population (Chun and Kang, 2003). Some pesticides, mostly Persistent Organic Pollutants (POPs), also concentrate all along the food chain and contaminate foodstuffs of animal origin (IPCS, 1996). These commodities are found to be the main sources of organochlorine dietary exposure for the Australian population (Kannan *et al.*, 1997) as well as for the Spanish one (Herrera *et al.*, 1996).

Considering pesticide residues in foodstuffs as a public health issue, it is important to characterise which population is at risk. The pesticide dietary intake is a function of both residue levels in food and consumption habits. Vegetarians typically consume more fruit, vegetables and cereal products compared to individuals of the general population whose diet also includes animal-derived products. The aim of this study is to compare the impact of consumption habits of a French vegetarian population and the general one on their pesticide dietary intake.

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Material and methods

Consumption data

French general population. Consumption data for the general population came from the French individual consumption survey "*enquête Individuelle et Nationale de Consommation Alimentaire*" (INCA) conducted in 1999. The original sample of 1985 healthy adults (aged 15 and over) was representative of the French population through the stratification (region of

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2 residence, agglomeration size) and the use of the quota method (age, gender, household size,
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4 individual occupation and socio-professional status) (Volatier, 2000). Subjects were asked to
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6 complete a seven-day food record diary (consecutive days) as well as other questionnaires on
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8 anthropometrical and socio-economic factors. Participants could estimate portion sizes
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10 through comparison of their actual consumption with photographs compiled in a manual
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12 adapted from the SuViMax picture booklet (Herberg *et al.*, 1994). Adult people identified as
13
14 under-reporters by comparing their reported energy intake to their basal metabolic rate as
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16 estimated from the Schofield equations (Black, 2000) were excluded from the study. Thus, the
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18 final sample contained 1474 individuals.

19
20 *The vegetarian population.* Vegetarian subjects were recruited among adherents of the main
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22 French vegetarian or vegan societies between March and July 1997, through questionnaires
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24 published in the society's journal or directly distributed to the adherents (Leblanc *et al.*,
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26 2000). The total participation rate was 19.5% with 145 respondents. After deletion of
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28 incomplete questionnaires, consumption data of 137 individuals were available for analysis.

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30 For each participant, consumption data were collected in a 5-day food diary. Age, gender,
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32 weight and height were also listed. A classification of the vegetarian subjects was adopted on
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34 the basis of their effective food intakes (Table 1): 26 subjects considering themselves as
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36 vegetarians but having an omnivorous diet were gathered in the pseudo-vegetarian (OMN)
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38 group. The lacto-vegetarian (LV) group was composed of 41 subjects that only stand for dairy
39
40 products in their diet. On the contrary, in the ovo-lacto-vegetarian (OLV) and pesco-lacto-
41
42 vegetarian (PLV) groups – 43 and 16 adults – subjects get their proteins via both dairy
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44 products and respectively eggs or fish consumptions. At last, strict vegetarians, for whom all
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46 commodities of animal origin are excluded from the diet, were gathered in the vegan (VG)
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48 group (11 subjects). Although the number of subjects in each subgroup is rather low, the
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50 homogeneity of eating habits within each subgroup allows to consider it sufficient for further
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2 analysis (Leblanc, 2001). No adjustment was done according to the potential food
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4 consumption underreporting.
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8 *Residue data*
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11 *Maximum Residue Limits (MRLs) and Acceptable Daily Intake (ADI)*. To assess the impact of
12
13 consumption habits on the pesticide dietary intake, a fixed contamination level, set at the
14
15 MRL, was considered whatever the population. Priority was given to MRLs in force within
16
17 the European Union in July 2007, and next to French MRLs. Only substances, with an ADI
18
19 and at least one MRL, were included in the study (N = 421) (Table 2).
20

21 *Sensitivity analysis on fish consumption habits*. For a given pesticide, commodities with no
22
23 existing MRL were not taken into account in the intake assessment. In particular, no MRL are
24
25 actually defined at the European level for fish or fish-based products. However, several
26
27 studies have already shown that they are potentially contaminated by pesticides, especially
28
29 organochlorine compounds (Hites *et al.*, 2004), and could even explain the presence of
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31 pesticides in human samples (Rivas *et al.*, 2007). Moreover, PLV eat large amounts of fish as
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33 a source of proteins. A sensitivity analysis on fish consumption habits was consequently
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35 conducted on the Aldrin case. The total Aldrin intake was first calculated based on the
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37 contribution of all food items for which an MRL is defined. Then, it was compared to a total
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39 intake calculated considering a fictive maximum limit for the fish and fish-based products.
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41 This fictive value is assumed at the MRL defined for an other product of animal origin: meat.

42 As Aldrin is a lipophilic compound, its MRL is defined on the fat. Thus, an average fat

43 content of 10% was considered to define the fictive maximum limit for the fish and fish-based

44 products.
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Deleted: The fish residue level was set at the MRL defined for meat, corrected by an average meat fat content of 10% in order to get a residue level for the whole product.

51 *Recipes*
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In order to match consumption data to MRLs, which are established on Raw Agricultural Commodities (RAC), the 895 food items defined in the INCA Survey and the 545 food items defined in the Vegetarian Consumption Survey were respectively broken down into 153 and 137 RAC. 402 standardized recipes, which have been defined taking account of industrial processes, home cooking habits and edible portions for the INCA Survey (Volatier, 2000), have been used. For the few vegetarian food items without any standardized recipe available, a recipe has been specifically defined according to the same approach than the one used to create the standardized recipes.

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Intake assessment

The Theoretical Maximum Daily Intake (TMDI) (in mg. kg⁻¹ bw. day⁻¹) as defined by WHO (WHO, 1997) was estimated for each pesticide at the individual level, according to equation 1. The average was then derived for each population and expressed as a percentage of the ADI.

$$(1) \quad TMDI_{p,i} = \frac{\sum_{a \in A_p} \sum_{k=1}^{N_i} C_{k,a,i} \times MRL_{p,a}}{N_i \times bw_i}$$

Where:

TMDI_{p,i}: Theoretical Maximum Daily Intake of the individual *i* for the pesticide *p*,

C_{k,a,i}: quantity of foodstuff *a* consumed by individual *i* on day *k*,

A_p: list of foodstuffs for which a MRL is defined for the pesticide *p*,

MRL_{p,a}: Maximum Residue Limit for the pesticide *p* in the foodstuff *a*,

N_i: number of days of consumption for the individual *i*,

bw_i: body weight of individual *i*.

The contribution of ten food groups (fruit, vegetables, cereals, potatoes, other products of plant origin (mainly oils and oilseeds), milk and dairy products, eggs, meat and other products of animal origin (honey), water and wine) was characterized as a ratio between the food group intake and the total one.

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Statistical analysis

The statistical analysis was conducted using the SAS® software (SAS, Cary, NC 27513) running on the UNIX® system in order to characterize the determining factors of the total dietary intake and its differences among the studied populations.

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First, the physiological characteristics (age and body mass index) were analysed in order to ensure the two populations to be comparable. Consumption habits were also compared between the general population and the vegetarian cohort based on individual average intakes. As variables were not shown to have a Gaussian distribution according to the Shapiro-Wilk test, all comparisons between the general population and the vegetarian cohort were based on Kruskal-Wallis.

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Into the vegetarian cohort, the five subgroups were considered to be independent due to the fact one individual can only belong to only one subgroup. As a Gaussian distribution was not assured within the studied subgroups, physiological comparisons were based on Kruskal-Wallis tests. Similar tests were conducted to assess whether mean consumption levels were significantly different between two groups – for example the PLV group vs. the four other vegetarian subgroups.

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Then, a specific analysis was done on few pesticides chosen according to their main contributors to the total dietary intake previously described by Menard *et al.* (2008):

- products of animal origin for Aldrin,
- fruit and vegetables for Diazinon,

- cereals for Chlorpyrifos-methyl.

Carbamates (Aldicarb, Tri-allate, Propineb and Thiram) were also chosen for a rapid analysis (linear regression between subgroup average consumptions and TMDIs) because of total intakes differences between the population subgroups.

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For Aldrin, Diazinon and Chlorpyrifos-methyl, the comparison was completed with multi linear regressions (ANOVA procedure) in order to explain the total dietary intake given by the TMDI/ADI ratio. The determining factors were consumptions levels of the different food groups, age, gender, Body Mass Index and pertinent interactions between those variables (for example BMI*gender).

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Results

Description of the populations

Physiological characteristics of the studied populations. Characteristics of both populations are included in Table 1 according to diet group. The sex ratio (M/F) is similar between the studied populations (0.79 and 0.83 in the vegetarian and the general population respectively).

Age distributions are relatively close in both populations with mean age of 49 ± 15 years for vegetarian population and 43 ± 18 for the general one (not significantly different).

The vegetarian population shows a lower mean BMI compared to the general population's one (21.3 ± 2.7 kg. m² vs. 23.5 ± 3.8 , not significantly different). Indeed, respectively 74.5 and 64% of the vegetarian and the general populations have a BMI between 18.5 and 24.9.

The vegetarian group includes less overweight or obese subjects (BMI higher than 25) than the general one (10.2% vs. 30.6%) and more thin subjects with BMI below 18.5 (15.3% vs. 5.4%).

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Some differences can also be observed among the subgroups. The mean age of the LV subgroup (42.2 ± 11.9 years) is significantly the lowest of the vegetarian subgroups ($p=0.003$) and especially when compared to the OMN subgroup (56.6 ± 19.4 years, $p=0.004$). Women

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2 are dominant in all subgroups except in the LV (M/F ratio=1.21) and OLV (M/F ratio=1.05)
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4 ones. The BMI of the PLV subgroup is shown to be significantly the lowest of the vegetarian
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6 subgroups (p=0.002), below the LV (p=0.004), OMN (p=0.012) and OLV (p=0.005) ones.

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8 *Consumptions habits of the studied populations.* As shown in Table 1, the total consumption,
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10 beverages excepted, is higher, but not significantly different, in the general population than in
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12 the vegetarian subgroups (1241.4 g. day⁻¹ for the general population vs. 782.6 – 1174.2 g.day⁻¹
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14 for the vegetarian subgroups), especially when it is compared to the PLV group in which
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16 subjects eat the least.

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18 The general population consumes some products, which are hardly even eaten by vegetarians
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20 such as eggs (p<10⁻⁴, 29.0 g. day⁻¹ vs. 0.1 – 4.0 g. day⁻¹), dairy products (p<10⁻⁴, 299.6 g. day⁻¹
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22 vs. 2.9 – 119.4 g. day⁻¹) and other products of animal origin (p<10⁻⁴, 161.2 g. day⁻¹ for the
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24 general population vs. 1.5 – 9.0 g. day⁻¹ for the vegetarian subgroups). Vegetarians would also
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26 be more abstemious than subjects of the general population (p<10⁻⁴): their wine consumption
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28 goes from 42.6 to 105.2 g. day⁻¹ while its reaches 160.3 g. day⁻¹ for the non vegetarian
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30 population.

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32 On the contrary, compared to the general population, vegetarians eat more fruit (247.7 - 317.6
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34 g. day⁻¹ for OLV, VG, LV and OMV groups, 124.7 g. day⁻¹ for the PLV group vs. 173.4 g.
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36 day⁻¹ for the general population), vegetables (286.1 – 381.8 g. day⁻¹ vs. 170.1 g. day⁻¹), cereals
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38 (189.9 and 206.3g. day⁻¹ for PLV and LV groups, 128.7 - 157.3g. day⁻¹ for VG, OLV and
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40 OMV groups vs. 173.0 g. day⁻¹ for the general population) and potatoes (53.3-86.9 g. day⁻¹ for
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42 VG, LV, OLV, 41.0 and 22.3 g. day⁻¹ for OMV and PLV groups vs. 52.6 g. day⁻¹ for the
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44 general population) (figures not statistically different). Finally, consumption of other products
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46 of plant origin would be similar between the general population (22.3 g. day⁻¹) and
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48 vegetarians groups (18.8 – 36.3 g. day⁻¹).
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2 The LV diet differs from the other vegetarian ones: fruit, vegetables and cereals are consumed
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4 in the same amount while one or several foodstuffs are predominant in other diets. The OLV
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6 diet and the VG one (to a lower extent) distinguish themselves by a low cereal consumption
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8 (respectively 137.6 and 157.3 g. day⁻¹ vs. 173.0 – 206.3 g. day⁻¹ for the other vegetarian
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10 subgroups): meals are essentially composed of fruit and vegetables (respectively 62% and
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12 64% of the total diet). The PLV diet is characterized by the opposite tendency: individuals of
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14 this subgroup have the highest cereal consumption (206.3 g. day⁻¹ vs. 128.7 – 189.9 g. day⁻¹
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16 for the other vegetarian subgroups) and the lowest fruit consumption among vegetarians
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18 (124.7 g. day⁻¹ vs. 247.7 – 317.6 g. day⁻¹ for the other vegetarian subgroups).
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23 *Comparison of pesticide dietary intakes.* Table 2 presents detailed results for pesticides with
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25 at least one TMDI above the ADI (detailed results for the other pesticides are provided in a
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27 supplemental material table).

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28 Among the 421 pesticides taken into account, only 48 molecules (11.4%) have a TMDI value
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30 above the ADI for at least one of the studied populations, half of them (23 molecules)
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32 representing a potential health risk in all subgroups. However, some differences exist between
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34 the two populations. The number of pesticides with TMDI above ADI is always higher in
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36 vegetarian subgroups (30 molecules for PLV, 41 for LV, 42 for OMN, 43 for VG and 44 for
37
38 OLV) than in the general population (29 molecules). It should however be noticed that in
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40 terms of number of pesticides exceeding the ADI, the PLV group is extremely close to the
41
42 general population (30 vs. 29) and that other vegetarians groups are quite similar.

43 All the pesticides with TMDI higher than ADI for the general population have also at least
44
45 one TMDI above ADI in one of the vegetarian subgroups. According to Table 2, most of the
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47 pesticides with TMDI above ADI are detected in all the vegetarian subgroups (25/48). Few
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49 pesticides have a TMDI higher than the ADI only for one of the vegetarian subgroups (5/48):
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2 Imazalil (VG), Formetanate hydrochlorid (OLV), Deltamethrin (PLV), Diquat (PLV) and
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4 Fenpropimorph (OLV). When pesticides are detected in three vegetarian subgroups (5/48), it
5
6 corresponds mostly to the [OMN, OLV, VG] subgroups (3/48) but also to the [LV, PLV, VG]
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8 and the [OMN, LV, OLV] ones (2/48). Finally, when pesticides are detected in four out of the
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10 five vegetarian subgroups (13/48), it always corresponds to the OMN, LV, OLV and VG
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12 subgroups.

13
14 ADI overruns are different from one pesticide class to another or even in the same class. The
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16 pesticides with TMDI above ADI are mainly organophosphates, organochlorine compounds
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18 and carbamates. All populations confounded, respectively 44%, 36% and 17% of the
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20 organophosphates, organochlorines and carbamates have a TMDI above ADI vs. 5% for the
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22 other pesticides. The organochlorine and organophosphate classes appear with TMDI levels
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24 significantly higher in both the vegetarian ($p=0.048$ and 10^{-4} respectively) and the general
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26 ($p<10^{-4}$ and 0.001 respectively) populations than the other pesticides classes. Carbamates also
27
28 appear with TMDI significantly higher than the other pesticides but only for the vegetarian
29
30 population ($p=0.007$). In another hand, some pesticide classes would not present any long-
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32 term risk through dietary intake in both studied populations. For instance, the triazine and
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34 urea classes have no ADI exceedance. In the class of pyrethroids, only Deltamethrin intakes
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36 are above ADI for the PLV subgroup (TMDI = 101.9% ADI). Finally, only two molecules are
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38 potentially representing a risk in the azole class: Imazalil for the VG subgroup (TMDI =
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40 102.5% ADI) and Prochloraz for all vegetarian subgroups except the PLV one (TMDI = 107.5
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42 to 212.3% ADI).

43 44 45 *Determining factors of total pesticide intake*

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47 *Impact of the physiological characteristics.* The impact of physiological characteristics of the
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49 populations has been analysed through multi-linear regression on few pesticides (Aldrin,
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1
2 Diazinon, Chlorpyrifos-methyl and several carbamates). The structure of the population in
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4 term of age or sex ratio is similar between the populations and did not have any significant
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6 effect on the total intake. Nevertheless, the interaction BMI*diet was found to explain the
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8 Chlorpyrifos-methyl intake variability ($p < 0.07$) as well as the Aldrin intake one ($p < 0.07$).
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10 *A strong impact of fruit, vegetables and cereal consumptions on pesticide dietary intake.*

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12 Results of the specific food contributions analyses reveal a strong correlation between the
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14 total dietary intake of carbamates and the consumption of plant origin foodstuffs for all
15
16 vegetarian subgroups (Figures 1a & 1b). By instance, TDMI is linear linked to the total
17
18 average consumption of vegetables, fruit and wine for Tri-allylate ($R^2=0.99$), Thiram ($R^2=0.97$)
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20 and Propineb ($R^2=0.85$) and to potato, vegetables and fruit consumption levels for Aldicarb
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22 ($R^2=0.90$). But food contributions are not the same between the different vegetarian groups.
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24 For Carbaryl, the intake of the PLV subgroup, whose TDMI is lower, mainly comes from
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26 cereals. On the contrary, individuals of the other groups, whose intake mainly results from the
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28 contribution of vegetables, are more exposed (Figure 1c). The same conclusion rises for
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30 Aldicarb: individuals of the PLV subgroup have lower intakes while their cereal consumption
31
32 is the highest among vegetarian subgroups (TDMI = 97.6% ADI vs. 123.2% to 174.5% ADI).
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34 Organophosphate intakes are also significantly different between the five vegetarian
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36 subgroups (respectively $p=0.003$ and $p=0.004$ for Chlorpyrifos-methyl and Diazinon). For
37
38 Chlorpyrifos-methyl, cereals are major contributors to the dietary exposure (Figure 2) and
39
40 PLV subjects are more exposed than the other groups. The classification order of vegetarian
41
42 subgroups to Chlorpyrifos-methyl exposure is the same than for cereal consumption levels:
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44 PLV > LV > VG > OLV > OMN (Table 1). For Diazinon, for which vegetarians are more
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46 exposed than the general population (except PLV group), fruit are major contributors with
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48 respectively 54.2%, 58.7%, 63.7%, 67.9% and 69.7% of the Diazinon TMDI for the PLV,
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50 LV, OMN, OLV and VG subgroups (Figure 2). Therefore the OLV subgroup for which fruit
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2 consumption level is the highest (Table 1) has the highest intake (TMDI = 130.4% ADI). On
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4 the contrary, subjects of the PLV subgroup for which fruit consumption level is the lowest
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6 (Table 1), are less exposed than subjects of the OMN ($p=0.002$), LV ($p<10^{-4}$) and OLV
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8 ($p=0.001$) subgroups (TMDI = 55.7% ADI vs. TMDI = 103.7%, 115.1% and 130.4% ADI
9
10 respectively).

11
12 *The PLV diet: an apparent protection against organochlorines?* The Aldrin dietary intake is
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14 higher in the general population than in the vegetarian cohort (TMDI = 348.7% ADI vs.
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16 TMDI = 146.2 to 183.9% ADI), mainly explained by the contribution of animal-origin
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18 commodities (respectively 59.5% and 9.3% TMDI for meat and dairy products) (Figure 2).
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20 PLV subjects were previously shown to be the least exposed subjects to Aldrin (Figure 2) but
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22 fish-derived products which represent a significant part of their diet were not taken into
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24 account in the assessment. When a fictive contamination is attributed to these foodstuffs, the
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26 order is reversed: subjects from the OMN, LV, OLV and VG groups become less exposed to
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28 Aldrin than PLV subjects (TMDI > 300% ADI) (Figure 3).
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30 31 32 **Discussion**

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34 48 out of the 421 pesticides included in the study may theoretically represent a long-term risk
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36 for the French general population or any of the 5 vegetarian subgroups due to the dietary
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38 intake. These molecules correspond mainly to the carbamate, organochlorine and
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40 organophosphate classes. On the contrary, most of pesticides belonging to the azole,
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42 pyrethroid, triazine and urea classes have TMDIs below ADI. Vegetarians are critically
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44 exposed to a higher number of pesticides (N = 48) than subjects of the general population (N
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46 = 29). All the pesticides with TMDI above ADI for the general population would be detected
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48 as such in at least one vegetarian subgroup.
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Specific analysis about food contributions shows that fruit and vegetables consumption levels explain vegetarians overexposure to carbamates and Diazinon. The PLV subgroup, identified with a high cereal consumption level, has consequently higher TDMI for pesticides with cereals as main contributors, like Chlorpyrifos-methyl. On the contrary, vegetarians are less exposed to organochlorine compound like Aldrin, due to a lower consumption of animal origin commodities.

In order to eliminate any methodological bias in the comparison analysis, physiological characteristics of the two populations have first been compared. No significantly differences could be shown for sex ratio, age distributions and BMI. Moreover, consumption surveys used for this analysis are quite comparable. First, they have been conducted within the same timeframe, in the late 1990s. A new individual survey conducted among the French general population in 2006 – 2007 tends to show that consumption levels of fruit and vegetables haven't significantly changed since 1999 (Lafay, 2009). Thus the trends observed in this study should still be relevant. Secondly, both surveys are based on self-administered food diaries. Food diary allows to estimate a wide range of foods intake (Willet, 1998), which is adapted to this issue, as many food items may contain pesticides residues. Nevertheless, they can be associated with an alteration of the eating behaviour, conducting to a potential underestimation of real consumption level. They also require a high motivation from the subject which can lead to a poor response rate or a lowering quality of answers according to the days of inquiry (Willet, 1998). The food underreporting has been adjusted for subjects of the general population. It has not been the case for vegetarian ones, because of the low number of vegetarian subjects available for this analysis. This methodological bias may have minimized the differences of exposure between the two groups.

Nevertheless, dietary habits appear to be the main explanation to the observed differences. If amount levels of fruit, vegetables and cereals consumed are about equivalent for both subjects

Deleted: The BMI is found to explain the Aldrin and Chlorpyrifos-methyl intake variability. In fact, the ratio "amount of food consumed / body weight" is part of the TMDI equation. According to Schutz *et al.* (1989), if the basal metabolic rate (BMR) increases with weight, when expressed on a body weight basis, it is less important for obese individuals than for individuals with normal weight (Schutz *et al.*, 1989). This could indirectly lead to an average ratio "amount of food consumed / body weight" less important in the general population than in the vegetarian one, and could contribute to a higher total intake in the vegetarian population

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2 of the LV subgroup and the general population, one or several of these foodstuffs are
3 predominant in the other vegetarian diets, in which foods of animal origin are limited or
4 evicted. This “substitution” of animal commodities by plant origin ones impacts both the
5 consumption and contamination parameters of the TDMI equation.
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10 First, it increases the consumption level of plant origin products (591.4 g. day⁻¹ for the general
11 population vs. between 712.1 and 1037.1 g.day⁻¹ for the vegetarian subgroups), all the more
12 that they are less energy-dense than animal origin foodstuffs so larger amounts are
13 consequently needed to reach the same energy level.
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17 Secondly, it impacts the contamination level as the MRL set for an animal origin product is
18 replaced by a MRL set for a product of plant origin. But MRLs are not systematically defined
19 for animal commodities. In fact, they are set only when feed may contain residues at a
20 sufficiently high level (> 0.1 mg. kg⁻¹) and when metabolism studies show they may be found
21 at levels higher than 0.1 mg. kg⁻¹ in products of animal origin (European Commission, 2002).
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25 Moreover, except for pesticides also used as veterinary drugs or biocides, residues in food of
26 animal origin result from an indirect usage via feed and water. Levels are consequently
27 generally less important than for plant origin food on which the farmer may directly apply the
28 pesticide. Exception can be underlined for lipophilic compounds such as for organochlorine
29 and some organophosphate compounds, which tend to concentrate in animal commodities
30 (IPCS, 1996). This explains why dietary intake is higher for the vegetarian population than for
31 the general one, excepted for few compounds such as organochlorine ones.
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35 The impact of the substitution is also observable between the different classes of plant origin
36 commodities. For some pesticides, such as carbamates and Diazinon (organophosphate),
37 intakes are mainly indicated by fruit and/or vegetable_s contributions. This explains why OLV
38 and VG are more exposed than the other population subgroups. On the contrary, subjects of
39 the PLV subgroup are less exposed to these compounds but more exposed to pesticides for
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2 which cereals are the main contributors (Pirimiphos-methyl, Malathion and Chlorpyrifos-
3 methyl).

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5 This substitution seems to have little impact on the total intake of some pesticides, such as
6 Carbaryl. In fact, Carbaryl MRLs are set at 0.05 mg. kg⁻¹ in meat, eggs, dairy products and
7 most of vegetables and oil seeds, whereas it is 10 to 100 times higher than MRL set for
8 cereals, wine, tomatoes and olives (0.5-1, 3, 5 and 5 mg. kg⁻¹ respectively). Some differences
9

10 among the subgroups exposure are consequently expected. In fact, no clear effect of
11 consumption habits on the residue intake can be shown. This could be explained by the fact
12 that TMDI as expressed in this study depends not only on the residue intake but also on the
13 ADI level. Indeed, it has previously been shown that when the ADI is very low, due to high
14 toxicity of the pesticide, residue and consumption levels have a very limited impact on the
15 TMDI (Menard *et al.*, 2008). According to Table 2, it can be determined that the ADI for
16 pesticides with TMDI > ADI for all population groups is of 0.004 mg. kg bw⁻¹. day⁻¹ on
17 average, 25 times lower than the average ADI (0.09 mg. kg bw⁻¹. day⁻¹) based on pesticides
18 with no ADI overrun.
19

20 Nevertheless, this study shows the importance in terms of risk assessment to take account of
21 specific consumption habits among the population. Vegetarians actually represent 2% of the
22 French population (Leblanc *et al.*, 2000). Considering only the general population would
23 potentially put vegetarians in situation of risk. This is all the more important that pesticide
24 uses are sometimes limited on some specific food crops with high MRLs, such as cereals
25 (Delthamethrin 3 mg. kg⁻¹) or fruit (Imazalil 2 mg. kg⁻¹ for citrus crop). Although the general
26 population is protected from these two pesticides, the everyday high cereal consumers such as
27 in the PLV group are theoretically overexposed to Delthametrin as well as the everyday high
28 fruit consumers such as in the VG group for Imazalil. Considering that some ADI overruns
29 would not be identified with a prediction model based only on the general population, it
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2 would be pertinent to develop new pesticide dietary intake model including vegetarian diets.

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4 In that way, European Food Safety Authority has recently built a model for chronic and acute
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6 risk assessment at the European level, which includes a vegetarian population (from UK)
7
8 (EFSA, 2007).

9
10 These conclusions need to be further investigated. In fact, it should be underlined that some
11
12 foodstuffs, such as fish, are not taken into account in the risk assessment. This study aims to
13
14 characterise this bias on the Aldrin case. The PLV group appears first to be more protected
15
16 from Aldrin exposure than the other vegetarian subgroups. This is not any more the case when
17
18 a theoretical fish contribution is taken into account. Dietary intakes of organochlorine
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20 compound and other lipophilic substances may have been consequently underestimated.

21
22 Secondly, the number of respondents standing between 11 and 43 does not allow robust
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24 comparisons between the vegetarian subgroups. Conclusions would need to be confirmed on
25
26 more individuals.

27
28 Moreover, this analysis is based on the hypothesis that the food contamination level
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30 consumed by the general population and the vegetarian one are on average the same.
31
32 However, some studies show that individuals with vegetarian habits would preferably buy
33
34 organic or non-sprayed products (Leitzmann, 2003, Santucci, 2002, Schryver *et al.*, 2007).
35
36 These foods are supposed to be less contaminated than conventional products, even if no
37
38 study has really proven it yet. Consequently, the higher consumption level of products
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40 potentially representing a risk could be offset by lower contamination levels. Further
41
42 investigations based on the food supply habits of the population and the food contamination
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44 levels according to farming practices could be conducted in order to better characterise the
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46 sensitive population to be considered during pesticides residues risk assessment.

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48 Finally, even if this study tends to show a higher risk of pesticides exposure for vegetarians,
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50 the vegetarian diet is generally associated with some beneficial effects. This diet would imply

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2 lower risk of ischemic diseases through its low rate in saturated fatty acids (Rajaram, 2003). A
3
4 lower mortality rate for the vegetarian population has been also shown when compared to the
5
6 general population (Key *et al.*, 1999). Thus, further benefit-risk analysis of fruit and
7
8 vegetables consumption aimed to balance the risk of pesticides exposure and nutritional
9
10 beneficial effects could be conducted to handle the present issue in term of public health.
11

12 13 14 **Conclusion**

15
16 The goal of the present study was to understand how consumption habits, especially the
17
18 vegetarian ones, can influence pesticide dietary intakes. The analysis of pesticide residue
19
20 exposure was carried out via a maximalist approach, using MRL values as contamination
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22 levels of foodstuffs. Vegetarians were shown to be globally more exposed than the general
23
24 population even if differences exist from one population subgroup to another and depending
25
26 on the pesticide considered. The general population is exposed to higher levels than the
27
28 vegetarian one for pesticides with animal products as main contributors (mainly
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30 organochlorines). On the contrary, pesticide dietary intakes coming from fruit, vegetables and
31
32 cereals are higher in the vegetarian population. Finally, this analysis demonstrates that among
33
34 the vegetarians included in the study, dietary intakes from plant origin foodstuffs (eaten in
35
36 great quantities to comfort the absence of animal commodities such as meat, eggs and dairy
37
38 products) largely offset the limited dietary intake associated to a negligible consumption of
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40 origin-animal commodities. The PLV diet is the only one that seems to be advantageous in
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42 terms of number of pesticides exceeding the ADI but the lack of MRL for fish certainly
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44 distorts the evaluation of pesticide intakes, particularly for residues that are persistent in the
45
46 environment. Such results should however be considered cautiously because the approach
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48 using TMDI values is a very conservative one. Afterwards, it should be interesting to adopt a
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50 similar procedure using real food contamination levels instead of MRLs that represent
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2 theoretical estimations. Even if this study tends to show a higher risk for vegetarians
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4 concerning some pesticides, such a diet (even a lifestyle) could also presents great advantages
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6 for health. Thus it would be important to develop methodology in order to consider
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8 simultaneously benefits and risks associated with this particular diet.
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Table 1. General characteristics and food intakes of the study population.

	Pseudo-vegetarians (OMN)	Lacto-vegetarians (LV)	Ovo-lacto-vegetarians (OLV)	Pesco-vegetarians (PLV)	Vegans (VG)	General population
Number of subjects	26	41	43	16	11	1474
Average age (years)	56.6 (±19.4)	42.2 (±11.9) [* ₃ , p=3.10 ⁻³]	51.1 (±15.9)	47.6 (±14.1)	48.0 (±13.9)	43.0 (±18.0)
Sex ratio M/F	0.44	1.41	1.05	0.33	0.57	0.83
Average BMI (kg/m²)	21.3 (±2.6)	21.6 (±2.5)	21.8 (±3.0)	19.6 (±2.2) [* ₂ , p=2.10 ⁻²]	20.8 (±2.2)	23.5 (±3.8)
Average daily intakes (g/capita/day)	956.6	992.6	1121.2	782.6	1174.2	1241.4
<i>Fruits</i>	247.7 (±128.4)	265.0 (±144.9)	317.6 (±228.3)	124.7 (±73.3) [* ₂ , p=2.10 ⁻⁴]	297.0 (±292.4)	173.4 (±135.0)
<i>Vegetables</i>	311.3 (±134.3)	286.1 (±112.9)	381.8 (±144.8)	339.1 (±169.8)	459.6 (±300.2)	170.1 (±79.9)
<i>Cereals</i>	128.7 (±79.5)	189.9 (±84.8)	137.6 (±121.2)	206.3 (±110.4)	157.3 (±93.5)	173.0 (±124.4)
<i>Potatoes</i>	41.0 (±35.2)	68.9 (±47.3)	53.3 (±43.2)	22.3 (±19.2)	86.9 (±120.4)	52.6 (±38.1)
<i>Other products of plant origin</i>	19.3 (±14.5)	18.8 (±10.7)	23.4 (±15.7)	19.7 (±12.2)	36.3 (±37.5) [* ₂ , p=2.10 ⁻³]	22.3 (±10.2)
<i>Milk and dairy products</i>	119.4 (±101.6)	111.5 (±136.3)	89.3 (±96.1)	23.6 (±46.2)	2.9 (±3.3)	299.6 (±160.0) [** ₂ , p<10 ⁻⁴]
<i>Eggs</i>	3.1 (±1.8)	0.9 (±0.7)	4.0 (±2.7)	1.0 (±1.1)	0.1 (±0.0)	29.0 (±22.1) [** ₂ , p<10 ⁻⁴]
<i>Meat and other products of animal origin</i>	5.8 (±9.4)	9.0 (±13.5)	9.0 (±12.4)	1.5 (±1.8)	7.1 (±12.7)	161.2 (±72.0) [** ₂ , p<10 ⁻⁴]
Beverages (g/day)	634.3	783.4	1014.1	493.7	720.3	922.7
<i>Water</i>	554.0 (±358.0)	740.8 (±602.4)	908.9 (±946.6)	449.3 (±185.0)	623.0 (±265.1)	762.4 (±409.3)
<i>Wine</i>	80.3 (±104.1)	42.6 (±93.8)	105.2 (±188.9)	44.4 (±47.7)	97.3 (±110.4)	160.3 (±249.3) [** ₂ , p<10 ⁻⁴]

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[*₂, p=2.10⁻³] represents a comparison inside the vegetarian population: the value given for this group is significantly different with a probability of 2.10⁻³ from those of the four other groups.
 [**₂, p=2.10⁻³] represents a comparison between the two populations: the value given for the general population is significantly different from the one of the global vegetarian population with a probability of 2.10⁻³.
 All probabilities are derived from non-parametric Kruskal-Wallis tests.

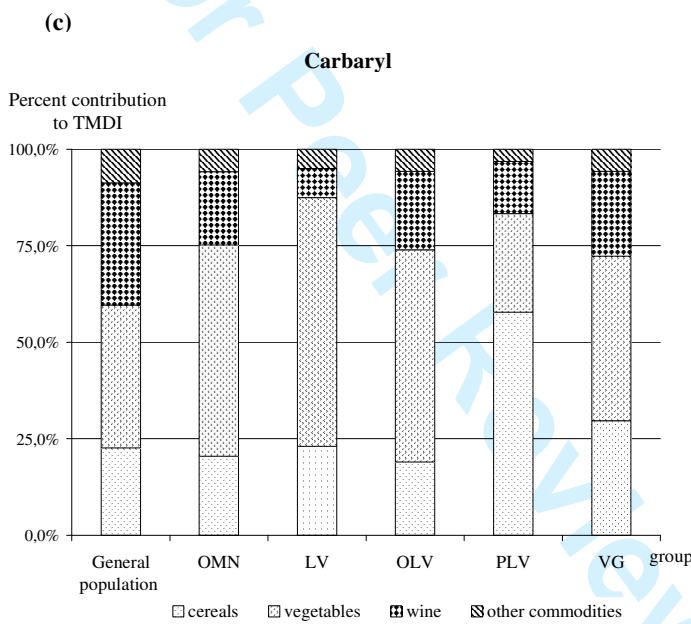
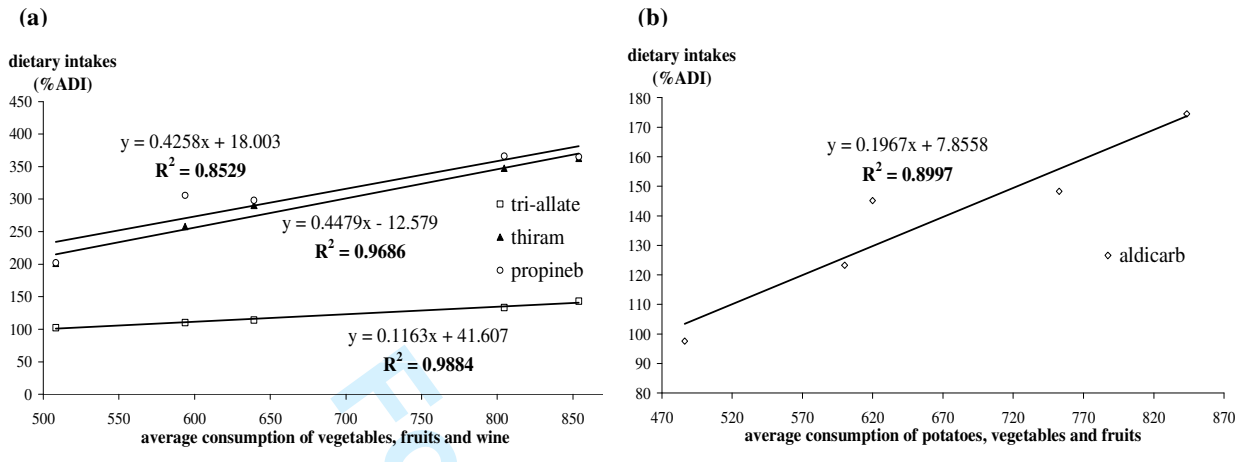
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Table 2. Detailed results concerning the 48 pesticides with at least one TMDI over ADI

Active substance	Class	ADI (source, year)	MRL reference	TMDI (%ADI)					
				GP	OMN	LV	OLV	PLV	VG
Imazalil	AZOL.	0.025 (a, 1997)	EU/N	52,4	71,4	79,8	85,9	39,0	102,5
Prochloraz	AZOL.	0.01 (a, 1988)	EU/N	107,5	139,1	162,3	212,4	95,5	207,4
Aldicarb	CARB.	0.001 (a, 1994)	EU/N	105,9	123,2	145,1	148,3	97,6	174,5
Carbaryl	CARB.	0.0008 (a, 2006)	EU	876,9	858,1	1158,2	984,6	679,4	844,1
Formetanate hydrochlorid	CARB.	0.004 (a, 2005)	N	33,8	61,6	28,5	100,9	38,0	23,6
Propineb	CARB.	0.007 (a, 2003)	EU/N	217,6	298,3	305,9	366,2	202,2	365,1
Thiram	CARB.	0.01 (a, 2003)	EU	177,3	290,5	258,1	347,4	201,1	362,7
Tri-allate	CARB.	0.001 (a, 2003)	EU/N	74,5	114,4	110,2	133,4	102,3	143,2
Aldrin	OC	0.0001 (a, -)	EU/N	348,8	163,5	159,4	175,9	146,4	183,9
Dicofol	OC	0.0025 (a, -)	EU/N	165,1	146,4	172,4	187,0	60,0	139,8
Dieldrin	OC	0.0001 (a, -)	EU/N	348,8	163,5	159,4	175,9	146,4	183,9
Heptachlor	OC	0.0001 (a, -)	EU/N	331,0	152,6	147,1	163,5	135,7	175,7
Azinphos-methyl	OP	0.005 (a, 1991)	EU/N	83,6	122,5	118,8	146,9	90,8	155,3
Chlorfenvinphos	OP	0.0005 (a, -)	EU	95,0	192,0	140,8	176,9	198,8	259,2
Chlorpyrifos-methyl	OP	0.01 (a, 1976)	EU/N	96,0	89,7	116,7	94,4	129,4	105,7
Diazinon	OP	0.002 (a, 1999)	EU/N	75,4	103,7	115,1	130,4	55,7	120,0
Dichlorvos	OP	8E-05 (a, 2005)	EU/N	7355,9	6858,0	8901,7	7151,0	10729,6	8312,1
Dimethoate	OP	0.001 (a, 2006)	EU	92,9	100,5	114,7	120,6	87,2	143,0
Disulfoton	OP	0.0003 (a, -)	EU/N	168,8	151,0	156,3	155,0	134,1	152,6
Ethion	OP	0.002 (a, -)	EU/N	165,2	203,0	220,3	253,0	135,2	237,3
Malathion	OP	0.03 (a, 2005)	EU/N	102,0	111,1	129,5	123,1	141,4	130,6
Methidathion	OP	0.001 (a, -)	EU/N	187,3	200,1	252,2	303,2	89,2	258,8
Mevinphos	OP	0.0008 (a, -)	EU/N	134,0	233,4	211,7	279,2	182,5	303,3
Monocrotophos	OP	0.0006 (a, -)	EU/N	87,5	109,7	100,9	121,2	56,5	131,1
Naled	OP	0.002 (a, 2003)	EU/N	60,0	101,8	92,9	120,3	81,6	127,7
Omethoate	OP	0.0004 (d, -)	EU/N	271,3	479,7	438,2	567,4	364,2	582,4
Oxydemeton-methyl	OP	0.0003 (a, 2006)	EU/N	114,6	114,6	115,9	132,1	112,1	141,4
Phorate	OP	0.0005 (a, 1999)	EU/N	131,2	144,5	146,4	162,5	134,6	175,2
Phosalone	OP	0.01 (a, 1999)	EU/N	66,8	110,1	100,9	127,6	79,2	135,5
Phosmet	OP	0.003 (a, 2006)	EU/N	98,9	189,9	166,6	242,4	89,2	199,6
Phosphamidon	OP	0.0005 (a, -)	EU/N	206,5	327,8	309,7	383,5	283,7	409,9
Pirimiphos-methyl	OP	0.004 (a, 2005)	EU/N	429,6	397,7	499,8	426,3	556,5	454,6
Quinalphos	OP	0.0005 (c, 1992)	EU/N	70,3	112,9	107,9	133,7	93,7	147,8
Sulfotep	OP	0.0005 (c, 1995)	N	231,1	393,5	350,3	466,0	281,9	488,9
Thiometon	OP	0.003 (a, -)	N	97,0	154,0	145,3	189,1	123,2	194,8
Deltamethrin	PYR.	0.01 (a, 2002)	EU	73,4	67,0	85,4	72,0	101,9	83,6
Biphenyl	OTH.	0.05 (c, 1989)	N	138,4	134,7	172,6	234,0	56,6	157,0
Cyhexatin	OTH.	0.0005 (a, 1987)	EU/N	268,8	276,3	263,5	296,7	202,8	299,5
Diquat	OTH.	0.002 (a, 2001)	EU/N	54,1	53,3	62,0	65,7	109,0	75,7
Ethoxyquin	OTH.	0.005 (a, 1998)	N	71,5	119,7	97,3	109,2	71,8	152,2
Fenpropimorph	OTH.	0.003 (a, 1999)	EU/N	70,4	83,1	91,3	108,6	61,6	99,8
Fentin acetate	OTH.	0.0004 (a, -)	EU/N	208,3	200,6	200,8	218,9	181,3	227,1

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4	Fentin									
5	hydroxide	OTH.	0.0004 (a, -)	EU/N	208,3	200,6	200,8	218,9	181,3	227,1
6	Hydrogen									
7	cyanide	OTH.	0.02 (c, 1993)	EU/N	198,2	167,7	232,3	169,4	291,3	201,5
8	Metaldehyde	OTH.	0.025 (a, 2001)	N	65,6	122,3	99,5	116,3	91,2	118,1
9	Ofurace	OTH.	0.0007 (d, -)	N	178,6	133,4	141,2	109,1	39,7	99,3
10	Rotenone	OTH.	0.0001 (a, 2004)	EU/N	240,7	407,8	372,4	482,0	326,9	511,2
11	Vinclozolin	OTH.	0.005 (a, 2004)	EU/N	184,2	266,4	216,9	358,9	171,0	293,1
12										
13										
14										
15	The abbreviations AZOL., CARB., OC, OP, PYR., TRIAZ., UREA and OTH. refer respectively to the following									
16	classes: azoles, carbamates, organochlorines, organophosphates, pyrethroïds, urea and other pesticides.									
17	ADI values are from Agritox database (http://www.dive.afssa.fr/agritox/php/donnees-essentielles.phpor), EFSA									
18	opinions (http://www.efsa.europa.eu/EFSA/efsa_locale-1178620753816_home.htm) or European directives									
19	(http://eur-lex.europa.eu/JOIndex.do?ihmlang=fr) (a), JMPR									
20	(http://www.codexalimentarius.net/mrls/pestdes/pest_ref/plst-f.htm) (b), Iris									
21	(http://cfpub.epa.gov/ncea/iris/index.cfm?fuseaction=iris.showSubstanceList) (c) and Australie									
22	(http://www.tga.gov.au/docs/pdf/adi.pdf) (d). No year is given for the ADI value if the pesticide is now									
23	forbidden. MRL values in force are national values (N) or European ones (EU). Pesticides potentially at risk for									
24	one group are highlighted in grey; TDMI values above ADI are in bold type.									
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Figure 1. Determining factors of the Theoretical Maximum Daily Intakes of carbamates.



Estimations of TMDIs can be obtained from the average consumption of vegetal-origin products. (a) For Tri-allate, Thiram and Propineb, TMDI is a function of the average consumption of vegetables, fruit and wine in each vegetarian subgroup. (b) For Aldicarb, TMDI is a function of the average consumption of potatoes, vegetables and fruit in each vegetarian subgroup. (c) Contributions of vegetal-origin products to the Carbaryl dietary intake.

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Figure 2. Contribution of foodstuffs to Aldrin (organochlorine), Chlorpyrifos-methyl and Diazinon (organophosphates) dietary intakes.

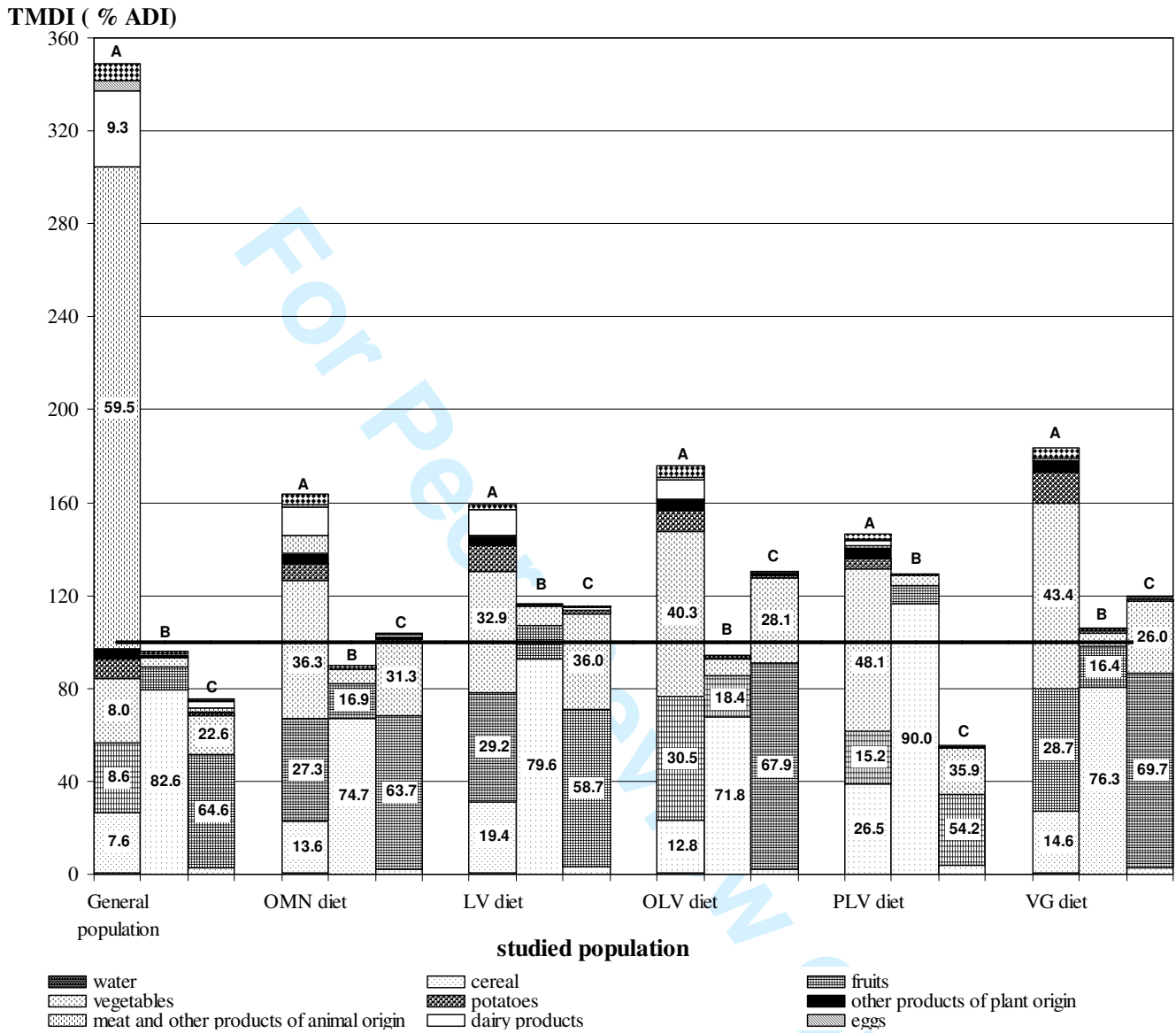
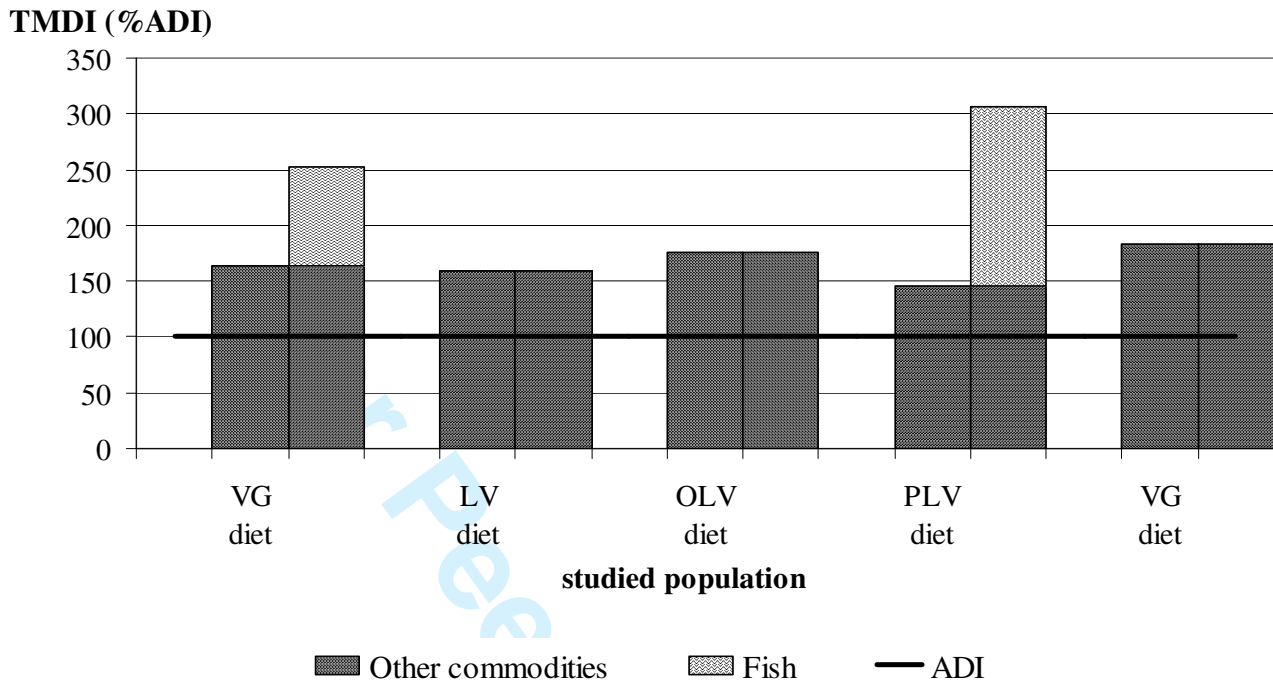


Figure 3. Impact of fish or fish-derived products consumption on the Adrin dietary intake.



Supplemental Table: Detailed results concerning the other pesticides studied

Active substance	Class	ADI (source, year)	MRL reference	TMDI (%ADI)					
				GP	OMN	LV	OLV	PLV	VG
Amitrole									
(Aminotriazole)	AZOL.	0.001 (a, 2001)	EU	10,0	14,1	14,6	16,4	14,2	18,7
Azaconazole	AZOL.	0.025 (d, -)	N	0,0	0,0	0,0	0,0	0,0	0,0
Benomyl	AZOL.	0.1 (a, -)	EU/N	2,3	2,3	2,5	2,6	2,0	2,5
Bitertanol	AZOL.	0.01 (a, 2004)	EU/N	47,0	76,0	86,5	89,0	40,6	88,1
Bromuconazole	AZOL.	0.025 (a, 1999)	N	0,7	0,8	0,9	0,9	0,7	1,0
Carfentrazone-ethyl	AZOL.	0.03 (a, 2003)	EU	0,7	0,8	0,9	0,8	1,0	1,0
Chlorfenapyr	AZOL.	0.02 (d, -)	EU	2,5	3,5	3,6	4,0	3,5	4,5
Cyazofamid	AZOL.	0.17 (a, 2003)	EU	0,4	0,3	0,4	0,4	0,2	0,3
Cyproconazole	AZOL.	0.01 (a, 1989)	N	3,2	3,5	3,3	3,2	2,5	3,6
Difenoconazole	AZOL.	0.01 (a, 1990)	N	9,8	13,1	13,1	13,1	7,3	12,8
Diniconazole	AZOL.	0.005 (a, 1987)	N	6,6	5,3	5,8	5,0	5,0	5,3
Epoxiconazole	AZOL.	0.005 (a, 1992)	N	2,3	1,8	2,1	1,7	1,7	1,6
Fenbuconazole	AZOL.	0.036 (a, 1999)	N	1,8	2,0	2,5	2,1	1,0	1,6
Fipronil	AZOL.	0.0002 (a, 2003)	N	16,5	16,5	21,3	18,2	21,8	20,4
Fluquinconazole	AZOL.	0.003 (a, 1995)	N	10,9	11,8	11,6	10,0	8,7	11,8
Flusilazole	AZOL.	0.002 (a, 2004)	N	27,8	33,1	31,2	33,0	25,5	39,8
Flutriafol	AZOL.	0.01 (a, 1987)	N	2,8	2,5	3,3	2,7	4,5	3,2
Hexaconazole	AZOL.	0.005 (a, 1989)	EU	11,8	14,7	14,7	16,0	11,2	16,1
Metconazole	AZOL.	0.01 (a, 2006)	N	0,6	0,6	0,6	0,7	0,6	0,4
Myclobutanil	AZOL.	0.02 (a, 1989)	EU/N	23,3	29,2	32,2	40,4	12,7	37,4
Paclobutrazol	AZOL.	0.1 (a, 1998)	EU/N	1,3	2,3	2,2	2,8	1,2	3,0
Penconazole	AZOL.	0.03 (a, 1992)	EU/N	3,0	3,8	3,4	3,9	3,0	4,5
Propiconazole	AZOL.	0.04 (a, 2003)	EU	1,5	2,0	2,0	2,3	2,0	2,5
Tebuconazol	AZOL.	0.03 (a, 1989)	N	2,8	3,1	2,7	2,9	2,1	3,0
Tebufenpyrad	AZOL.	0.01 (a, 1998)	N	7,6	11,1	9,0	10,5	6,5	13,7
Tetraconazole	AZOL.	0.008 (a, 2006)	N	7,0	9,4	7,5	8,6	5,5	11,2
Triadimefon	AZOL.	0.03 (a, 1985)	EU/N	12,9	13,1	12,2	13,4	9,1	13,0
Triadimenol	AZOL.	0.05 (a, 1989)	EU/N	7,7	7,9	7,3	8,0	5,5	7,8
Triazamate	AZOL.	0.002 (a, 1993)	N	1,7	2,1	2,4	2,3	1,6	2,9
Triticonazole	AZOL.	0.025 (a, 2005)	N	0,2	0,2	0,3	0,2	0,3	0,2
Asulam	CARB.	0.05 (c, 1995)	N	0,0	0,1	0,0	0,1	0,1	0,0
Benfuracarb	CARB.	0.015 (a, 2002)	EU/N	8,5	5,3	5,2	5,7	4,6	5,8
Carbendazim	CARB.	0.02 (a, 2005)	EU	9,9	11,4	12,7	13,1	10,9	13,2
Carbofuran	CARB.	0.002 (a, 1999)	EU/N	54,5	36,6	38,8	42,1	22,2	32,9
Carbosulfan	CARB.	0.01 (a, 1986)	EU/N	12,9	8,5	8,2	8,9	7,3	9,4
Chlorpropham	CARB.	0.05 (a, 2003)	EU/N	10,9	9,2	13,0	10,7	5,0	15,0
Desmedipham	CARB.	0.03 (a, 2004)	EU	1,7	2,3	2,4	2,7	2,4	3,1
Diethofencarb	CARB.	0.1 (a, 1991)	N	0,9	1,1	1,4	1,7	0,6	1,1
Ethiofencarb	CARB.	0.1 (a, -)	N	3,8	7,4	5,5	7,8	6,2	9,1
Fenoxycarb	CARB.	0.05 (a, 1999)	N	1,5	2,3	2,0	2,2	1,4	2,7
Furathiocarb	CARB.	0.03 (d, -)	EU/N	4,3	2,7	2,7	2,9	2,4	3,0
Iprovalicarb	CARB.	0.015 (a, 2002)	EU	18,1	19,4	19,6	22,7	12,7	21,9
Mancozeb	CARB.	0.05 (a, 1993)	EU/N	30,5	41,8	42,8	51,3	28,3	51,1
Maneb	CARB.	0.05 (a, 2005)	EU/N	30,5	41,8	42,8	51,3	28,3	51,1
Methiocarb	CARB.	0.013 (a, 2006)	N	3,1	5,0	4,5	5,9	4,7	5,7
Methomyl	CARB.	0.0025 (a, 2006)	EU/N	76,8	81,7	81,9	99,9	56,5	93,5
Metiram	CARB.	0.03 (a, 1993)	EU/N	50,8	69,6	71,4	85,5	47,2	85,2

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3	Molinate	CARB.	0.008 (a, 2003)	EU	6,1	8,5	8,7	9,9	8,3	11,2
4	Oxamyl	CARB.	0.001 (a, 2005)	EU	10,7	14,7	15,9	17,4	14,3	18,5
5	Phenmediphame	CARB.	0.03 (a, 2004)	EU	3,0	3,3	3,0	3,4	2,7	3,5
6	Pirimicarbe	CARB.	0.035 (a, 2003)	EU/N	8,9	14,8	13,6	17,5	11,9	18,5
7	Propamocarbe									
8	chlorhydrate	CARB.	0.29 (a, 2006)	N	0,8	1,4	1,3	2,4	1,3	2,4
9	Propham	CARB.	0.02 (c, 1987)	EU/N	4,1	3,9	3,9	4,3	3,4	4,4
10	Propoxur	CARB.	0.02 (a, -)	EU/N	5,2	5,7	5,4	6,2	5,8	6,3
11	Prosulfocarbe	CARB.	0.005 (a, 2005)	N	1,2	1,0	1,3	1,0	0,9	1,2
12	Thiabendazole	CARB.	0.1 (a, 2001)	EU/N	22,5	30,3	33,7	37,2	16,1	49,7
13	Thiodicarb	CARB.	0.01 (a, 2005)	EU	19,2	20,4	20,5	25,0	14,1	23,4
14	Thiophanate-									
15	methyl	CARB.	0.08 (a, 1998)	EU	6,1	6,4	6,6	7,1	4,0	6,2
16	Zineb	CARB.	0.03 (a, -)	EU/N	1,4	69,6	71,4	85,5	47,2	85,2
17										
18	No ADI									
19	available	CARB.								
20										
21	Chlordane	OC	0.0005 (a, -)	EU/N	38,5	33,8	35,7	37,5	36,5	41,9
22	Chlorothalonil	OC	0.015 (a, 2003)	EU/N	52,4	74,0	61,5	77,1	55,2	71,7
23	DDT	OC	0.01 (a, -)	EU/N	17,5	8,0	7,7	8,4	6,8	8,8
24	Endosulfan	OC	0.006 (a, 1998)	EU/N	27,1	28,6	32,8	36,1	17,3	31,7
25	Endrin	OC	0.0002 (a, -)	EU/N	77,7	70,0	70,8	79,5	67,0	87,9
26	Lindane	OC	0.005 (a, -)	EU/N	4,2	3,0	2,9	3,3	2,7	3,5
27	Methoxychlor	OC	0.1 (a, -)	EU/N	0,1	0,1	0,1	0,2	0,1	0,2
28										
29	No ADI									
30	available	OC								
31										
32	Acephate	OP	0.03 (a, -)	EU	1,1	1,1	1,1	1,2	1,0	1,2
33	Azinphos-ethyl	OP	0.002 (d, -)	EU	17,1	18,1	19,6	19,9	19,4	21,9
34	Bromophos	OP	0.04 (a, -)	N	15,0	25,4	23,2	30,1	20,4	31,9
35	Bromophos-									
36	ethyl	OP	0.003 (a, -)	EU/N	11,7	18,8	18,0	22,3	15,6	24,6
37	Chlorpyrifos-									
38	ethyl	OP	0.01 (a, 2005)	EU	25,7	39,7	44,5	57,8	21,1	52,9
39	Dioxathion	OP	0.0015 (a, -)	EU/N	23,4	37,6	36,0	44,6	31,2	49,3
40	Ethephon	OP	0.03 (a, 2005)	EU/N	9,9	11,7	13,4	12,2	7,2	12,0
41	Ethoprophos	OP	0.0004 (a, 1999)	N	9,6	14,2	14,2	17,5	11,5	18,8
42	Etrimfos	OP	0.003 (a, -)	N	4,5	3,9	3,5	3,2	2,5	3,9
43	Fenamiphos	OP	0.0008 (a, 1999)	EU/N	34,7	44,5	47,3	51,7	41,0	54,4
44	Fenitrothion	OP	0.005 (a, 2006)	EU	8,3	6,3	4,3	7,6	4,2	7,6
45	Fenthion	OP	0.007 (a, 1997)	EU/N	35,9	39,7	49,8	58,8	14,1	47,1
46	Fonofos	OP	0.002 (c, 1991)	N	5,9	28,8	16,8	22,4	24,9	31,3
47	Fosthiazate	OP	0.004 (a, 2003)	EU	5,2	7,3	7,6	8,7	7,4	10,0
48	Isofenphos	OP	0.001 (a, -)	N	8,6	13,6	13,7	17,1	9,6	17,7
49	Mecarbam	OP	0.002 (a, -)	EU/N	24,2	33,8	34,7	39,1	33,1	43,7
50	Methacrifos	OP	0.006 (a, -)	EU/N	9,2	11,6	11,9	13,3	11,1	14,6
51	Methamidophos	OP	0.001 (a, 2005)	EU/N	30,4	35,6	29,2	30,3	32,4	28,5
52	Parathion	OP	0.004 (a, -)	EU/N	20,5	19,6	19,6	21,3	17,1	21,9
53	Parathion-									
54	methyl	OP	0.003 (a, -)	EU/N	46,4	70,7	64,6	82,9	54,4	87,2
55	Phoxim	OP	0.004 (a, -)	EU/N	6,6	5,6	7,8	6,1	9,7	6,7
56	Pirimiphos ethyl	OP	0.0002 (d, -)	N	30,6	51,4	47,0	60,8	41,2	64,3
57	Profenofos	OP	0.01 (a, -)	EU/N	6,0	7,0	7,1	8,0	6,7	8,7
58	Pyrazophos	OP	0.004 (a, -)	EU/N	15,9	18,1	18,3	20,4	16,8	21,9
59	Terbufos	OP	0.0002 (a, 1999)	N	9,2	19,1	18,0	22,4	22,9	27,3
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4	Tetrachlor-									
5	vinphos	OP	0.05 (d, -)	N	15,5	24,6	22,7	30,0	14,5	31,3
6	Triazophos	OP	0.001 (a, -)	EU	19,2	18,1	19,0	19,6	17,7	20,6
7	Trichlorfon	OP	0.01 (a, 1978)	EU	31,0	49,6	45,4	59,1	37,0	62,4
8	Vamidithion	OP	0.008 (a, -)	EU/N	8,9	16,7	14,3	17,5	11,8	22,3
9	No ADI									
10	available	OP	Chlormephos, Ditalimfos, Fenclorpos, Formothion, Heptenophos, Pyridiphenthion, TEPP							
11	Acrinathrin	PYR.	0.02 (a, 1990)	N	1,4	1,9	2,3	2,1	0,7	1,6
12	Alphamethrin	PYR.	0.015 (a, 2004)	EU/N	28,2	48,1	43,7	55,4	29,9	55,2
13	Beta-Cyfluthrin	PYR.	0.003 (a, 2002)	EU/N	26,9	30,2	27,6	38,0	24,5	39,0
14	Bifenthrin	PYR.	0.015 (a, 2005)	EU/N	18,0	24,0	22,8	30,4	21,2	33,4
15	Bioresmethrin	PYR.	0.03 (a, -)	N	0,6	0,9	1,0	0,9	0,3	0,6
16	Cyfluthrin	PYR.	0.003 (a, 2002)	EU/N	31,6	40,5	36,3	48,3	31,0	54,3
17	Cypermethrin	PYR.	0.05 (a, 1994)	EU/N	9,9	15,1	13,7	17,4	9,4	17,4
18	Esfenvalerate	PYR.	0.02 (a, 2000)	EU/N	1,6	2,0	2,1	2,3	2,0	2,7
19	Fenpropathrin	PYR.	0.03 (a, -)	N	5,8	8,7	7,1	8,4	4,9	9,5
20	Fenvalerate	PYR.	0.02 (a, -)	N	3,8	0,6	0,5	0,4	0,1	0,0
21	Flucythrinate	PYR.	0.02 (a, -)	EU/N	4,1	3,9	3,9	4,3	3,4	4,4
22	Fluvalinate	PYR.	0.01 (c, 1991)		0,0	0,0	0,0	0,0	0,0	0,0
23	Lambda-									
24	Cyhalothrin	PYR.	0.005 (a, 2000)	EU/N	33,4	33,7	30,2	43,0	26,5	44,1
25	Permethrin	PYR.	0.05 (a, -)	EU/N	2,6	1,6	1,6	1,7	1,4	1,8
26	Resmethrin	PYR.	0.03 (c, 1988)	EU/N	5,1	5,0	4,9	5,5	4,2	5,6
27	Tau-Fluvalinate	PYR.	0.01 (a, 1984)	N	9,7	14,2	11,8	17,5	11,1	20,2
28	Tefluthrin	PYR.	0.013 (a, 2002)	N	0,4	0,3	0,3	0,3	0,3	0,3
29	No ADI									
30	available	PYR.	Tralomethrin							
31	Ametryne	TRIAZ.	0.009 (c, 1989)	N	0,8	1,8	2,4	2,6	1,0	2,6
32	Anilazine	TRIAZ.	0.1 (a, -)	N	2,2	1,8	2,0	1,7	1,7	1,6
33	Atrazine	TRIAZ.	0.035 (c, 1993)	EU	1,0	1,6	1,6	1,9	1,4	2,2
34	Cyromazine	TRIAZ.	0.17 (a, 1984)	EU/N	3,0	6,8	5,7	10,2	5,9	11,7
35	Prometryne	TRIAZ.	0.004 (c, 1992)	N	16,5	30,6	25,0	28,6	23,0	29,7
36	Pymetrozine	TRIAZ.	0.03 (a, 2001)	EU/N	5,3	8,3	8,4	11,5	6,1	11,2
37	Simazine	TRIAZ.	0.005 (a, 2003)	N	5,6	9,8	5,0	8,3	3,2	17,2
38	Terbutylazine									
39		TRIAZ.	0.003 (d, -)	N	6,4	8,1	6,7	6,9	5,1	9,5
40	Terbutryn	TRIAZ.	0.001 (c, 1988)	N	0,5	0,8	0,9	1,2	1,1	0,7
41	No ADI									
42	available	TRIAZ.	Cyanazine, Desmetryne, Terbumeton							
43	Amidosulfuron	UREA	0.2 (a, 1995)	N	0,1	0,1	0,1	0,1	0,1	0,1
44	Azimsulfuron	UREA	0.1 (a, 1999)	EU	0,2	0,3	0,3	0,3	0,3	0,4
45	Bensulfuron-									
46	methyl	UREA	0.2 (a, 1990)	N	0,0	0,0	0,0	0,0	0,1	0,0
47	Chloroxuron	UREA	0.05 (c, 1990)	EU/N	1,0	1,4	1,4	1,6	1,3	1,7
48	Chlortoluron	UREA	0.04 (a, 2005)	N	0,3	0,2	0,3	0,2	0,2	0,2
49	Cinosulfuron	UREA	0.09 (a, 1993)	N	0,0	0,0	0,0	0,0	0,1	0,0
50	Diflubenfuron	UREA	0.02 (a, 1986)	N	5,5	12,3	11,7	13,2	6,9	14,3
51	Diuron	UREA	0.007 (a, 2005)	N	1,7	2,8	2,3	2,3	1,7	3,4
52	Ethoxysulfuron									
53		UREA	0.04 (a, 2003)	EU/N	1,2	1,7	1,7	2,0	1,7	2,2
54	Flazasulfuron	UREA	0.013 (a, 2004)	N	0,1	0,1	0,1	0,1	0,0	0,1
55	Flufenoxuron	UREA	0.01 (a, 1999)	N	9,2	11,9	9,8	10,0	7,0	13,7

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3	Flupyr-sulfuron-									
4	methyl	UREA	0.035 (a, 2001)	EU	0,6	0,8	0,8	0,9	0,8	1,1
5	Foramsulfuron	UREA	0.5 (a, 2003)	EU/N	0,0	0,0	0,0	0,0	0,0	0,0
6	Hexaflumuron	UREA	0.005 (a, 1991)	N	12,2	20,3	16,7	18,6	12,1	25,9
7	Iodosulfuron-									
8	methyl-sodium	UREA	0.03 (a, 2003)	EU	0,6	0,9	0,9	1,0	0,8	1,2
9	Isoproturon	UREA	0.015 (a, 2002)	EU/N	5,5	5,3	5,4	5,8	4,8	6,1
10	Linuron	UREA	0.003 (a, 2003)	EU/N	18,3	29,9	27,8	31,4	28,5	40,2
11	Lufenuron	UREA	0.01 (a, 1993)	N	14,2	15,7	12,3	14,5	8,5	17,7
12	Methabenz-									
13	thiazuron	UREA	0.004 (d, -)	N	5,6	4,5	5,1	4,2	4,3	3,9
14	Metsulfuron-									
15	methyl	UREA	0.22 (a, 2000)	EU	0,2	0,3	0,3	0,4	0,3	0,4
16	Monolinuron	UREA	0.003 (a, -)	EU/N	27,3	26,1	26,2	28,5	22,8	29,2
17	Nicosulfuron	UREA	0.4 (a, 1994)	N	0,0	0,0	0,0	0,0	0,0	0,0
18	Oxasulfuron	UREA	0.013 (a, 2003)	EU/N	4,1	5,2	5,3	6,0	5,1	6,7
19	Pencycuron	UREA	0.025 (a, 1995)	N	1,8	4,8	4,4	7,7	5,1	12,2
20	Prosulfuron	UREA	0.02 (a, 2002)	EU	1,1	1,5	1,6	1,8	1,8	2,1
21	Rimsulfuron	UREA	0.1 (a, 2005)	N	0,0	0,0	0,0	0,0	0,0	0,0
22	Sulfosulfuron	UREA	0.24 (a, 2002)	EU/N	0,3	0,3	0,3	0,4	0,3	0,4
23	Teflubenzuron	UREA	0.035 (a, 1995)	N	1,7	2,9	2,3	2,6	1,7	3,6
24	Thifensulfuron-									
25	methyl	UREA	0.01 (a, 2001)	EU	4,8	6,8	6,9	7,8	6,6	8,7
26	Triasulfuron	UREA	0.01 (a, 2000)	EU	4,8	6,8	6,9	7,8	6,6	8,7
27	Triflumuron	UREA	0.005 (a, 1985)	N	23,8	39,9	32,5	36,4	23,9	50,7
28	Triflusaluron-									
29	methyl	UREA	0.04 (a, 1996)	N	0,0	0,0	0,0	0,0	0,0	0,0
30										
31	No ADI									
32	available	UREA								
33										
34										
35										
36	1,3dichloro-									
37	propene	OTH.	0.0125 (a, 2005)	N	0,5	1,5	0,9	1,4	1,6	2,0
38	2,4,5-T	OTH.	0.03 (a, -)	EU/N	1,2	1,9	1,8	2,2	1,6	2,5
39	2,4-D	OTH.	0.05 (a, 2001)	EU/N	2,6	2,9	3,4	4,0	1,8	3,5
40	2,4-DB	OTH.	0.02 (a, 2003)	EU/N	3,0	3,5	3,6	4,0	3,3	4,4
41	Abamectine	OTH.	0.002 (a, 1997)	EU/N	8,8	11,9	11,0	15,1	10,3	15,1
42	Acetochlor	OTH.	0.02 (a, 1996)	N	0,0	0,0	0,0	0,0	0,0	0,0
43	Acibenzolar-									
44	S-methyl	OTH.	0.1 (a, 2001)	EU/N	0,9	1,0	1,4	1,2	0,6	0,8
45	Acifluorfen,									
46	sodium salt	OTH.	0.013 (c, 1988)	N	0,0	0,1	0,0	0,1	0,1	0,1
47	Aclonifen	OTH.	0.02 (a, 1994)	N	0,2	0,2	0,2	0,2	0,3	0,3
48	Alachlor	OTH.	0.0005 (a, 1984)	N	1,3	1,8	1,7	1,9	4,2	3,4
49	Amitraz	OTH.	0.01 (a, 1998)	EU	4,9	6,8	7,0	7,9	6,7	8,9
50	Azocyclotin	OTH.	0.01 (a, 1989)	N	12,2	12,4	12,3	14,0	9,5	14,6
51	Azoxystrobin	OTH.	0.1 (a, 1998)	EU	8,0	10,5	13,8	14,0	15,4	15,2
52	Benalaxyl	OTH.	0.04 (a, 2004)	EU/N	3,8	2,7	2,8	3,0	2,1	2,9
53	Benoxacor	OTH.	0.004 (a, 1996)	N	0,1	0,0	0,1	0,1	0,1	0,1
54	Bentazone	OTH.	0.1 (a, 2000)	EU/N	1,1	1,4	1,4	1,6	1,3	1,7
55	Bifenox	OTH.	0.3 (a, 2000)	N	0,0	0,0	0,0	0,0	0,0	0,0
56	Binapacryl	OTH.	0.002 (d, -)	EU/N	17,6	28,2	27,0	33,4	23,4	36,9
57	Bromopropylate	OTH.	0.03 (a, -)	EU/N	2,8	2,7	2,7	2,9	2,4	3,0
58	Bromoxynil									
59	phenol	OTH.	0.01 (a, 2004)	N	2,7	1,5	1,9	1,4	2,1	1,5
60	Bupirimate	OTH.	0.05 (a, 1982)	N	1,9	2,6	2,1	2,5	1,4	2,6

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3	Buprofezin	OTH.	0.01 (a, 1990)	N	1,2	1,6	2,9	2,3	0,7	1,6
4	Butralin	OTH.	0.003 (a, 2005)	N	0,8	0,6	0,7	0,5	0,2	0,5
5	Captan	OTH.	0.1 (a, 2006)	EU/N	13,6	15,7	13,0	16,4	8,5	15,2
6	Captofol	OTH.	0.002 (c, 1987)	EU/N	13,7	16,9	18,6	19,1	19,1	21,5
7	Carbetamide	OTH.	0.021 (a, 2005)	N	0,1	0,2	0,1	0,1	0,0	0,0
8	Carbon disulfide	OTH.	0.1 (c, 1990)	EU	0,3	0,2	0,3	0,2	0,4	0,3
9	Carbon									
10	tetrachloride	OTH.	0.0007 (c, 1991)	EU	37,9	32,1	44,4	32,5	55,6	38,5
11	Chinomethionat									
12	(oxythioquinox)	OTH.	0.006 (a, -)	EU	28,3	47,3	42,4	56,8	33,2	59,7
13	Chlorbenside	OTH.	0.01 (b, 1965)	EU/N	4,3	2,4	2,3	2,3	1,5	1,8
14	Chlorfenson	OTH.	0.01 (a, -)	EU/N	1,0	1,3	1,4	1,5	1,3	1,7
15	Chlormequat	OTH.	0.05 (a, 1997)	EU/N	11,7	11,2	11,0	12,0	9,6	9,9
16	Chlorobenzilate									
17		OTH.	0.02 (a, -)	EU/N	1,0	1,4	1,4	1,6	1,3	1,7
18	Chlozolate	OTH.	0.1 (a, -)	EU	0,5	0,7	0,7	0,8	0,7	0,9
19	Cinidon-ethyl	OTH.	0.01 (a, 2002)	EU	6,3	8,1	8,7	9,2	9,0	10,4
20	Clethodim	OTH.	0.01 (a, 1995)	N	1,6	2,5	3,2	3,0	3,6	4,6
21	Clodinafop-									
22	propargyl	OTH.	0.003 (a, 2000)	N	3,8	2,9	3,2	2,6	2,5	2,4
23	Clofentezine	OTH.	0.02 (a, 1986)	EU/N	12,1	14,3	11,6	16,3	6,9	13,4
24	Clomazone	OTH.	0.043 (a, 2001)	N	0,0	0,0	0,0	0,0	0,0	0,0
25	Clopyralid	OTH.	0.15 (a, 2005)	N	1,5	1,3	1,4	1,2	1,2	1,1
26	Cloquintocet-									
27	mexyl	OTH.	0.04 (a, 1993)	N	0,3	0,2	0,2	0,2	0,2	0,2
28	Copper	OTH.	0.5 (a, -)	N	3,9	3,3	2,9	2,4	1,2	2,2
29	Cyclanilide	OTH.	0.0075 (a, 2001)	EU/N	7,3	9,3	9,5	10,6	8,9	11,6
30	Cycloxydim	OTH.	0.07 (a, 2004)	N	2,8	4,2	4,1	3,8	3,1	5,0
31	Cyhalofop-butyl									
32		OTH.	0.003 (a, 2002)	EU	6,7	9,4	9,6	10,9	9,7	12,3
33	Cymoxanil	OTH.	0.016 (a, 1999)	N	1,2	1,2	1,4	1,2	0,5	1,2
34	Cyprodinyl	OTH.	0.03 (a, 2003)	N	15,5	27,2	21,8	37,9	24,8	46,1
35	Daminozide	OTH.	0.45 (a, 2005)	EU/N	0,1	0,1	0,1	0,1	0,1	0,1
36	Dicamba	OTH.	0.02 (a, 1995)	N	0,0	0,0	0,0	0,0	0,0	0,0
37	Dichlobenil	OTH.	0.01 (a, 1997)	N	0,6	0,5	0,5	0,4	0,1	0,3
38	Dichlofluanid	OTH.	0.3 (a, -)	EU/N	11,9	19,3	17,0	23,0	15,0	24,0
39	Dichlorprop	OTH.	0.03 (d, -)	EU/N	1,6	2,3	2,3	2,6	2,2	2,9
40	Dichlorprop-P	OTH.	0.06 (a, 2006)	EU	0,6	0,9	0,9	1,1	0,8	1,2
41	Diclobutrazol	OTH.	0.03 (d, -)	N	2,4	1,8	1,9	1,5	0,7	1,3
42	Diclofop-methyl	OTH.	0.001 (a, 2005)	N	27,8	39,5	35,1	37,5	31,5	37,4
43	Diffufenican	OTH.	0.25 (a, 2000)	N	0,0	0,0	0,0	0,0	0,0	0,0
44	Dimethachlore	OTH.	0.11 (a, 1999)	N	0,0	0,0	0,0	0,0	0,0	0,0
45	Dimethenamid	OTH.	0.02 (a, 2005)	N	0,0	0,0	0,0	0,0	0,0	0,0
46	Dimethenamid-									
47	P	OTH.	0.02 (a, 2003)	EU	0,0	0,0	0,0	0,0	0,0	0,0
48	Dimethipin	OTH.	0.02 (a, 1999)	N	0,4	0,4	0,7	0,5	0,3	0,4
49	Dimethomorph									
50		OTH.	0.05 (a, 2006)	N	4,9	3,6	3,8	2,9	1,0	2,6
51	Dinocap	OTH.	0.004 (a, 2004)	EU/N	9,0	15,5	14,0	18,8	9,0	19,8
52	Dinoseb	OTH.	0.003 (c, 1989)	EU/N	11,7	18,8	18,0	22,3	15,6	24,6
53	Diphenylamine	OTH.	0.08 (a, 1998)	EU	7,0	13,6	10,3	14,0	8,2	18,4
54	Dithianon	OTH.	0.01 (a, 1992)	N	10,4	21,3	17,3	18,8	12,2	25,4
55	Dodine	OTH.	0.1 (a, 2000)	EU/N	2,1	3,8	3,3	4,1	2,7	4,6
56	Ethofumesate	OTH.	0.07 (a, 2002)	EU/N	1,7	1,3	1,3	1,4	1,1	1,3

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3	Ethylene									
4	dibromide	OTH.	0.009 (c, 2004)	EU	1,1	1,5	1,6	1,7	1,5	1,9
5	Etofenprox	OTH.	0.03 (a, 1995)	N	0,7	0,5	1,5	2,5	0,8	2,9
6	Famoxadone	OTH.	0.012 (a, 1995)	EU/N	20,6	15,0	14,0	15,3	8,3	13,1
7	Fenamidone	OTH.	0.03 (a, 2003)	EU/N	3,9	6,3	6,1	9,0	5,3	9,9
8	Fenarimol	OTH.	0.01 (a, 1995)	EU/N	12,6	17,2	17,8	18,6	9,2	16,7
9	Fenazaquin	OTH.	0.005 (a, 1993)	N	11,9	16,0	18,8	16,3	6,3	11,7
10	Fenbutatin oxide	OTH.	0.025 (a, 1973)	EU/N	35,9	45,3	49,6	59,8	21,2	54,7
11	Fenchlorim	OTH.	0.05 (a, 1988)	N	0,1	0,1	0,1	0,1	0,2	0,1
12	Fenhexamid	OTH.	0.2 (a, 2000)	EU/N	6,6	12,9	10,4	19,3	10,2	20,7
13	Fenoxaprop									
14	ethyl	OTH.	0.01 (a, 1988)	N	1,1	0,9	1,0	0,8	0,9	0,8
15	Fenpropidine	OTH.	0.005 (a, 1995)	N	4,5	3,6	4,1	3,3	3,5	3,1
16	Fenpyroximate	OTH.	0.01 (a, 1999)	N	2,3	3,8	3,3	3,0	2,3	4,5
17	Florasulam	OTH.	0.05 (a, 2002)	EU	0,3	0,4	0,4	0,4	0,4	0,5
18	Fluazifop-P-									
19	butyl	OTH.	0.01 (a, 2001)	N	6,3	21,6	22,0	28,4	61,1	47,1
20	Fluazinam	OTH.	0.01 (a, 1997)	N	36,5	27,1	28,2	21,8	7,9	19,2
21	Fludioxonil	OTH.	0.03 (a, 2003)	N	10,3	22,9	20,6	34,9	22,3	52,4
22	Flufenacet	OTH.	0.005 (a, 2003)	EU	10,6	14,4	15,1	16,7	13,8	19,3
23	Flumioxazine	OTH.	0.009 (a, 2002)	EU	5,5	7,7	7,9	8,9	7,8	10,1
24	Fluroxypyr	OTH.	0.8 (a, 2000)	EU	0,1	0,1	0,1	0,1	0,1	0,1
25	Flutolanil	OTH.	0.01 (a, 1992)	N	0,8	0,7	1,1	0,9	0,4	1,4
26	Folpet	OTH.	0.1 (a, 2006)	EU/N	14,0	16,2	13,6	17,0	9,9	15,8
27	Fomesafen	OTH.	0.01 (a, -)	N	0,3	0,4	0,3	0,3	0,4	0,1
28	Fosetyl-Al	OTH.	3 (a, 2005)	N	0,4	0,5	0,4	0,6	0,3	0,5
29	Glufosinate	OTH.	0.02 (a, 2005)	N	12,2	18,9	17,2	20,8	14,3	24,4
30	Glyphosate	OTH.	0.3 (a, 2001)	EU/N	5,6	5,7	6,8	7,0	10,3	7,5
31	Haloxypop-									
32	Ethoxyethyl	OTH.	0.0007 (a, -)	N	3,8	2,9	2,7	3,2	1,8	1,8
33	Haloxypop-R-									
34	methyl	OTH.	0.0007 (a, 1991)	N	4,6	7,6	6,4	7,8	12,5	10,0
35	Hexythiazox	OTH.	0.03 (a, 1988)	N	5,8	8,6	7,5	9,2	6,6	10,1
36	Hydrogen									
37	phosphide	OTH.	0.0003 (c, 1993)	EU	88,5	74,8	103,6	75,8	129,7	89,9
38	Imazamethabenz	OTH.	0.06 (a, 2004)	N	0,2	0,2	0,2	0,2	0,2	0,1
39	Imazamox	OTH.	9 (a, 2002)	EU/N		0,0	0,0	0,0	0,0	0,0
40	Imazaquin	OTH.	0.25 (c, 1990)	N	0,0	0,0	0,0	0,0	0,0	0,0
41	Imidacloprid	OTH.	0.05 (a, 1991)	N	1,3	1,7	1,5	1,6	1,2	1,9
42	Ioxynil	OTH.	0.005 (a, 2004)	N	5,2	2,7	3,5	2,6	4,0	2,7
43	Iprodione	OTH.	0.06 (a, 2003)	EU/N	41,1	59,0	54,8	70,2	42,3	67,8
44	Isoxaben	OTH.	0.05 (a, 1995)	N	0,1	0,2	0,1	0,2	0,1	0,2
45	Isoxaflutole	OTH.	0.02 (a, 2003)	EU	2,5	3,5	3,5	4,0	3,5	4,6
46	Kresoxim-									
47	methyl	OTH.	0.4 (a, 1999)	EU	0,5	0,6	0,5	0,6	0,3	0,5
48	Maleic									
49	hydrazide	OTH.	0.25 (a, -)	EU	17,5	17,1	24,2	20,3	12,0	31,7
50	Mecoprop	OTH.	0.01 (a, 2003)	EU	4,9	6,8	7,0	7,9	6,7	9,0
51	Mecoprop-p	OTH.	0.01 (a, 2003)	EU	4,9	6,8	7,0	7,9	6,7	9,0
52	Mepiquat	OTH.	0.58 (a, 2004)	N	0,6	0,5	0,5	0,5	0,4	0,3
53	Mesotrione	OTH.	0.01 (a, 2003)	EU	4,9	6,8	7,0	7,9	6,7	9,0
54	Metalaxyl	OTH.	0.03 (a, -)	EU/N	8,9	11,8	10,9	12,4	8,0	14,6
55	Metalaxyl-M	OTH.	0.08 (a, 2002)	EU/N	3,6	5,2	4,8	5,9	3,3	6,5

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3	Metamitron	OTH.	0.025 (a, 2003)	N	0,0	0,1	0,1	0,1	0,0	0,0
4	Metazachlor	OTH.	0.036 (a, -)	N	0,0	0,0	0,1	0,1	0,1	0,1
5	Methoprene									
6	(Methprrene)	OTH.	0.4 (d, -)	N	0,0	0,0	0,1	0,1	0,0	0,0
7	Methyl bromide	OTH.	0.1 (a, 1966)	EU/N	0,6	0,8	0,9	0,9	0,9	1,0
8	Metolachlor	OTH.	0.15 (c, 1994)	N	0,1	0,1	0,1	0,1	0,0	0,1
9	Metosulam	OTH.	0.005 (a, 2006)	N	0,9	0,7	0,9	0,7	0,8	0,7
10	Metribuzine	OTH.	0.013 (a, 1999)	N	1,9	2,0	2,6	2,1	1,5	2,4
11	Napropamide	OTH.	0.125 (a, 1999)	N	0,1	0,2	0,2	0,2	0,1	0,2
12	Nitrothal-									
13	isopropyl	OTH.	0.05 (d, -)	N	2,4	4,0	3,2	3,6	2,4	5,1
14	Norflurazon	OTH.	0.04 (c, 1991)	N	0,2	0,4	0,4	0,4	0,5	0,6
15	Ortho-									
16	phenylphenol	OTH.	0.4 (d, -)	N	3,0	2,9	3,7	5,0	1,2	3,4
17	Oryzalin	OTH.	0.05 (c, 1991)	N	0,1	0,1	0,1	0,2	0,1	0,2
18	Oxadiargyl	OTH.	0.008 (a, 2003)	EU/N	1,2	1,7	1,7	2,0	1,7	2,2
19	Oxadiazon	OTH.	0.004 (a, 2004)	EU/N	4,2	6,6	6,2	8,0	4,0	8,5
20	Oxadixyl	OTH.	0.01 (d, -)	N	16,4	16,9	18,2	17,9	6,7	13,1
21	Oxyfluorfen	OTH.	0.004 (a, 1997)	N	0,7	0,6	0,6	0,5	0,2	0,3
22	Paraquat	OTH.	0.004 (a, 2003)	EU	3,6	5,7	5,5	6,8	4,7	7,6
23	Pendimethalin	OTH.	0.125 (a, 2003)	EU/N	0,7	0,8	0,8	0,8	0,7	0,9
24	Picloram	OTH.	0.2 (a, 2003)	N	0,0	0,0	0,0	0,0	0,0	0,0
25	Picolinafen	OTH.	0.014 (a, 2002)	EU	3,5	5,0	5,1	5,7	5,0	6,5
26	Picoxystrobin	OTH.	0.043 (a, 2003)	EU	1,5	1,7	1,7	1,9	1,7	2,1
27	Piperonyl									
28	butoxide	OTH.	0.2 (a, 2001)	N	13,2	11,2	15,5	11,3	19,4	13,4
29	Pretilachlor	OTH.	0.018 (a, 1988)	N	0,1	0,2	0,3	0,2	0,6	0,3
30	Procymidone	OTH.	0.025 (a, 2003)	EU/N	35,6	46,6	40,1	61,6	27,4	45,8
31	Prohexadione									
32	calcium	OTH.	0.2 (a, 2000)	EU/N	0,5	0,5	0,5	0,5	0,5	0,6
33	Propachlor	OTH.	0.013 (c, 1992)	N	0,0	0,0	0,0	0,0	0,0	0,0
34	Propaquizafop	OTH.	0.003 (a, 1995)	N	1,6	1,8	2,5	2,5	1,5	2,7
35	Propargite	OTH.	0.02 (a, 1995)	EU/N	19,9	24,8	21,9	22,1	14,3	27,7
36	Propyzamide	OTH.	0.085 (a, 2003)	EU/N	0,6	1,0	0,9	1,5	1,0	1,8
37	Pyraclostrobin	OTH.	0.03 (a, 2004)	EU/N	11,6	14,2	12,7	18,7	10,3	19,6
38	Pyraflufen-ethyl	OTH.	0.2 (a, 2001)	EU	0,1	0,1	0,1	0,2	0,2	0,2
39	Pyrethrins	OTH.	0.04 (a, -)	EU/N	34,8	42,2	46,4	47,0	49,5	52,1
40	Pyridabene	OTH.	0.008 (a, 1990)	N	2,5	3,2	2,7	2,7	1,9	3,5
41	Pyridate	OTH.	0.036 (a, 2001)	EU/N	2,6	2,7	2,6	2,8	2,5	2,8
42	Pyrifenox	OTH.	0.007 (d, -)	N	2,1	3,0	2,7	2,7	1,9	3,6
43	Pyrimethanil	OTH.	0.17 (a, 2006)	N	1,7	2,2	2,0	2,6	1,4	2,6
44	Pyriproxyfen	OTH.	0.07 (a, 1993)	N	0,1	0,1	0,2	0,1	0,0	0,1
45	Quinclorac	OTH.	0.3 (d, -)	N	0,0	0,0	0,0	0,0	0,0	0,0
46	Quinmerac	OTH.	0.08 (a, 1993)	N	0,1	0,1	0,1	0,1	0,1	0,1
47	Quinoxyfen	OTH.	0.2 (a, 2004)	N	0,8	0,5	0,5	0,4	0,2	0,3
48	Quintozene	OTH.	0.1 (a, -)	EU/N	0,3	0,3	0,3	0,3	0,3	0,4
49	Quizalofop-									
50	Ethyl	OTH.	0.009 (a, -)	N	2,8	4,5	4,1	4,8	3,6	5,7
51	Sethoxydim	OTH.	0.09 (c, 1989)	N	3,8	6,1	5,8	7,2	4,8	7,9
52	Silthiopham	OTH.	0.064 (a, 2003)	EU	0,8	1,1	1,1	1,2	1,0	1,4
53	Spiroxamine	OTH.	0.025 (a, 1999)	EU/N	5,7	5,0	4,6	5,4	3,8	5,5
54	Sulfosate	OTH.	0.2 (a, 2001)	N	5,9	4,8	6,0	5,0	6,2	5,0
55	Tebufenozide	OTH.	0.02 (a, 1993)	N	7,6	8,4	7,3	8,0	6,5	10,0

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3	Tecnazene	OTH.	0.02 (a, -)	EU/N	4,1	3,9	3,9	4,3	3,4	4,4
4	Tetradifon	OTH.	0.0075 (a, -)	N	58,2	74,5	62,4	70,8	42,0	81,9
5	Tolyfluanide	OTH.	0.1 (a, 2005)	N	2,4	4,0	3,2	3,6	2,4	5,1
6	Tralkoxydime	OTH.	0.005 (a, 1991)	N	0,9	0,7	0,8	0,7	0,6	0,6
7	Triclopyr	OTH.	0.03 (a, 2005)	N	1,7	1,9	4,0	2,5	7,6	4,0
8	Tridemorph	OTH.	0.01 (a, 2000)	EU/N	8,4	8,1	8,2	9,0	7,7	9,3
9	Trifloxystrobin	OTH.	0.1 (a, 2003)	EU	5,6	5,2	4,5	5,1	2,5	4,7
10	Trifluralin	OTH.	0.015 (a, 2005)	N	0,4	0,9	0,7	0,8	0,8	1,0
11	Triforine	OTH.	0.02 (a, -)	EU/N	15,7	26,3	22,5	25,4	16,8	30,0
12	Trinexapac - ethyl	OTH.	0.32 (a, 2005)	N	0,1	0,1	0,1	0,1	0,1	0,1
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14	No ADI available									
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