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# QuEChERS Combined with an Agilent 7000 Series Triple Quadrupole GC/MS System for the Analysis of Over 200 Pesticide Residues in Leek and Garlic

# **Application Note**

Food

# Abstract

This application note describes a simple and high-throughput method for the analysis of 213 pesticides in leek and garlic using an Agilent QuEChERS kit combined with Agilent gas chromatography-triple quadrupole mass spectrometry (GC-MS/MS). A matrix-matched standard calibration method was used to avoid quantitation bias from matrix interference. It shows that the method has a linearity more than two orders of magnitude (2–400 µg/kg), with linear regression coefficients (R<sup>2</sup>) of 0.99 or above for the majority of pesticides. The limits of quantification (LOQs) ranged between 2 and 10 µg/kg, and the majority of the pesticides had an LOQ of 2 µg/kg, which is below the regulatory maximum residue limits. A spiking test showed that most recoveries at 2, 5, 10, 20, 50, 100, and 200 µg/kg were in the range of 80–120% (n = 6) with associated RSDs below 20%. Leek and garlic samples were analyzed for method application. This method can be applied for routine analysis of these pesticide residues in leek and garlic.



# Introduction

Leek and garlic are important vegetables in China. China is by far the largest producer of garlic, producing two thirds of the world's total with 409 million cwt in 2012, and ranked fifth in leek production, with 127,308 tons, in 2010. The protective effect of garlic on the development of cancer has been reported in *in vitro* and *in vivo* experimental studies. Leeks are reported to have similar anticancer medical value [1].

Leek and garlic are known as troublesome matrices in pesticide analysis. They each contain large amounts of sulfur-containing compounds that may cause significant interferences, especially when using a single mass spectrometry (MS) detector. To overcome this problem, some sample preparation methods, such as supercritical fluid extraction and microwave heating combined with AgNO<sub>3</sub>-loaded solid-phase extraction (SPE) column cleanup or gel permeation chromatography [2], have been reported to remove interferences from sulfur compounds. However, these methods require a large amount of solvent and time-consuming operation steps.

The quick, easy, cheap, effective, rugged, and safe (QuEChERS) method for pesticide multiresidue analysis has been accepted worldwide since it was first introduced by Anastassiades, *et al.* [3] in 2003. Most of the applications were dedicated to pesticide multiresidue analysis in food matrices. This topic has been thoroughly reviewed in recent years by the researchers.

Previously, several studies have reported multiresidue pesticide analysis based on the QuEChERS procedure combined with GC-MS/MS detection for fruit and vegetables including leek and garlic [1,4,5]. However, there are over 200 pesticides not analyzed in these reports. This application note describes a recently published study of QuEChERS combined with GC-MS/MS for the analysis of 213 pesticide residues in leek and garlic [6]. It is a rapid multiresidue method based on QuEChERS sample preparation, combined with GC-MS/MS detection, attempting to detect more than 200 pesticide targets in leek and garlic.

# **Materials and Methods**

Acetonitrile and ethyl acetate of HPLC grade; QuEChERS extraction salt packets with ceramic homogenizer (p/n 5982-5650CH), QuEChERS dispersive SPE kit (p/n 5982-5056 for garlic and 5982-5256 for leek).

The standard pesticides were bought from Chemservice (West Chester, PA, USA) and Dr. Ehrenstorfer (Ausberg, Germany). Stock standard solution of 5  $\mu$ g/mL (mixture of pesticides divided into two groups), and internal standard solution (Heptachlor epoxide B, 1  $\mu$ g/mL) were prepared in ethyl acetate, and stored at -20 °C until use.

#### Instrument conditions

| GC conditions               |   |
|-----------------------------|---|
| GC system                   | Agilent 7890A, coupled with an<br>Agilent 7693 autosampler  |
| Column                      | Agilent VF-1701ms, 30 m × 0.25 mm, 0.25 μm<br>(p/n CP9151)  |
| Oven temperature            | 40 °C hold 1 minute,<br>at 40 °C/min to 120 °C,<br>at 5 °C/min to 240 °C,<br>at 12 °C/min to 300 °C, hold 6 minutes |
| Carrier gas                 | Helium  |
| Flow rate                   | 1.0 mL/min  |
| Injection port temperature  | 280 °C  |
| Injection volume            | 1.0 μL  |
| Injection mode              | Splitless, purge on after 1.5 minutes   |
| MS conditions               |   |
| MS system                   | Agilent 7000B Triple Quadrupole GC/MS<br>System*  |
| lon source                  | EI  |
| lonization voltage          | 70 eV   |
| lon source temperature      | 280 °C  |
| Quadrupole temperature      | Q1 150 °C, Q2 150 °C  |
| Interface temperature       | 280 °C  |
| Solvent delay               | 3.0 minutes   |
| The specific MRM transition | ns for all the test pesticides and other paramete   |

The specific MRM transitions for all the test pesticides and other parameters are given in the appendix.

\* The Agilent 7000C and 7010 GC-MS/MS are available, and have demonstrated better results.

### **Sample preparation**

Weigh 10 g of minced sample into a 50-mL centrifuge tube. Add 10 mL of acetonitrile and a ceramic homogenizer, followed by the QuEChERS extraction salt packet. Immediately, seal the tube and shake vigorously by hand for one minute. Centrifuge the tube for five minutes at 4,000 rpm.

Transfer 6 mL of the supernatant into a 15-mL QuEChERS dispersive centrifuge tube. Vortex the extract with the sorbent for one minute, then centrifuge the tube for five minutes at 4,000 rpm.

Transfer 3 mL of the supernatant into a 10-mL glass centrifuge tube, and add 75 μL of internal standard solution. Evaporate the supernatant to dryness under a stream of nitrogen in a 40 °C water bath.

Redissolve the residue in 1.5 mL of ethyl acetate, and filter through a PTEE filter (0.22  $\mu$ m) for GC-MS/MS analysis.

#### **Method validation**

A recovery study was carried out to determine the method accuracy and precision. For each blank matrix, seven levels 2, 5, 10, 20, 50, 100, and 200  $\mu$ g/kg were fortified. After fortification, the spiked samples were left at room temperature for 30 minutes prior to extraction. To avoid quantitative errors, matrix-matched calibration standards were used to calculate the analyte recoveries. Solvent-based standards were also analyzed to assess the matrix effects. The limits of quantification (LOQs) for each pesticide was based on the recovery results, and defined as the lowest validated spike level meeting the requirement of recovery and relative standard deviation (RSD) for different fortification levels.

### **Results and Discussion**

#### Matrix effect

The matrix effect (ME) is regarded as a signal suppression or enhancement of the analyte due to the coelution of matrix components. It is reported that signal enhancement is always observed in GC-MS/MS analysis. The enhancement appears because matrix components block active sites (silanols, metal ions, and so forth) present in the column or inlet. Suppression or enhancement can vary considerably from matrix to matrix and differ substantially in pure solvent and matrix. Matrix effects also depend heavily on the chemical properties of the analyte and sample preparation procedure. Therefore, it is essential to take into account the matrix effects. The matrix effect is calculated by the equation:

$$ME (\%) = \left(\frac{m_{matrix} - m_{solvent}}{m_{solvent}} - 1\right) \times 100$$

Where *ME* is matrix effect, and  $m_{matrix}$  and  $m_{solvent}$  are the slopes of the calibration curves obtained in the matrix and solvent, respectively.

Soft matrix effects (suppression or enhancement of 0–20%) are negligible. However, if the pesticides suffer medium (suppression or enhancement of 20–50%) or strong (suppression or enhancement >50%) matrix effects, it is necessary to use certain methods to overcome the influence of the matrix.

It is indicated that there was no statistical difference between leek and garlic in respect to ME. Most of the pesticides exhibited matrix enhancement effects. Approximately 37% of the pesticides exhibited soft matrix effects, 30% exhibited medium matrix effects, and 32% exhibited strong matrix effects. The results proved that the matrix-matched calibration standards were indispensable for accurate quantification by GC-MS/MS.

#### Linearity and LOQs

Due to the matrix effect, matrix-matched standard was used for quantification. Linearity was determined in all matrices, and the linear range was between 2 and 400 µg/kg (internal standard method was applied with concentration of 50 µg/L). In the two matrices, the correlation coefficient of detection  $(R^2)$  for all of the pesticides was equal to or higher than 0.99, which would guarantee accurate guantification. There were 213 pesticides spiked at 2, 5, 10, 20, 50, 100, and 200,  $\mu$ g/kg (n = 6) in leek and garlic matrix for recovery and RSD analysis. The LOQs for the pesticides were determined based on the recovery and RSD results, and defined as the selected lowest validated spike level meeting the requirement of recovery and RSD for different fortification levels, as described in Document No. SANCO/12495/2013 [7]. The LOQs for the 213 pesticides ranged between 2 and 10 µg/kg. In leek, 196 out of 213 pesticides had LOQs at 2  $\mu$ g/kg, and in garlic, 176 out of 213 pesticides had LOQs of 2 µg/kg.

#### **Recovery and precision**

The proposed modified QuEChERS method was evaluated for 213 pesticides in leek and garlic. A recovery study was carried out to determine the method's accuracy by comparing the real concentration of each pesticide measured. This was accomplished by performing the complete procedure with a known pesticide concentration initially fortified to the blank matrix at seven levels 2, 5, 10, 20, 50, 100, and 200  $\mu$ g/kg at replicates n = 6. For recovery experiments, most of the 213 pesticides were in the range of 80–120% with the RSD below 20%. Figure 1 shows the recoveries of all pesticides in leek and garlic at 10 and 100  $\mu$ g/kg.

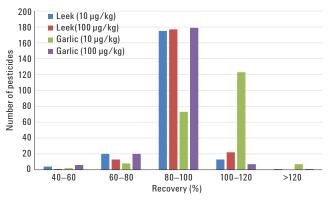


Figure 1. The distribution of recoveries in leek and garlic at 10 and  $100 \ \mu g/kg$ .

#### **Real sample analysis**

To prove the effectiveness of the proposed method, eight leek and garlic samples from three local markets were analyzed according to the method described above. No pesticide was detected in the garlic samples, whereas 17 pesticides were detected in the eight leek samples. Table 1 shows the maximum residue limit (MRL) of the detected pesticides, and the concentrations of leek samples according to China, Japan, the US Environmental Protection Agency (EPA), and the European Union (EU). All the pesticides detected were insecticides and fungicides. The detection frequency for chlorpyrifos, procymidone, and triazophos was very high. The concentrations of chlorpyrifos, procymidone, pyrimethanil, and triazophos in some samples exceeded the linearity range, and up to 3.33, 2.66, 1.73, and 4.27 mg/kg were detected, respectively. The residue levels of chlorpyrifos (sample 5) and procymidone (samples 1 and 4) exceeded the MRLs in China. It should be noted that the following government-banned pesticides, isazofos, phorate, and phorate sulfone (the metabolite of phorate) were detected in several samples.

|                 |       | MR    | L(mg/kg) |      |  |  |                    | Leek samı         | oles (mg/k  | g)  |                                |                     |
|-----------------|-------|-------|----------|------|--|--|--------------------|-------------------|---|---|--------------------------------|---------------------|
| Pesticide       | China | Japan | EPA      | EU   | 1  | 2  | 3                  | 4                 | 5   | 6   | 7                              | 8                   |
| Bifenthrin      | -     | 0.5   | 0.05     | 0.05 | ND   | ND   | ND                 | 0.00815           | ND  | ND  | ND                             | ND                  |
| Chlorpyrifos    | 0.1   | 0.2   | 0.1      | 0.5  | < LOQ  | 0.0158   | 0.0139             | 0.0120            | 3.33 <sup>a</sup>   | 0.0237                                    | 0.0192                         | <l00< td=""></l00<> |
| Cypermethrin    | 0.05  | 5     | 6        | 0.5  | ND   | 0.353  | 0.272              | ND                | 0.0275  | ND  | ND                             | ND                  |
| Cyprodinil      | _     | 4     | 4        | 0.05 | 0.0426   | 0.00222  | 0.00635            | ND                | ND  | ND  | ND                             | ND                  |
| Difenoconazol   | _     | 6     | 6        | 0.5  | 0.0185   | 0.00251  | 0.00399            | ND                | ND  | ND  | LOQ                            | ND                  |
| Fipronil        | 0.02  | 0.002 | _        | 0.01 | ND   | ND   | ND                 | 0.0131            | ND  | ND  | ND                             | ND                  |
| Isazofos        | Р     | В     | В        | В    | 0.00204  | <l00< td=""><td>ND</td><td>ND</td><td>ND</td><td><l00< td=""><td>ND</td><td>ND</td></l00<></td></l00<>     | ND                 | ND                | ND  | <l00< td=""><td>ND</td><td>ND</td></l00<> | ND                             | ND                  |
| Metalaxyl       | _     | 0.2   | 10       | 0.2  | <l00< td=""><td>ND</td><td>ND</td><td>0.00576</td><td>ND</td><td>ND</td><td>ND</td><td>ND</td></l00<>                                  | ND   | ND                 | 0.00576           | ND  | ND  | ND                             | ND                  |
| Myclobutanil    | -     | 1     | -        | 0.02 | ND   | ND   | ND                 | ND                | 0.110   | ND  | <l00< td=""><td>ND</td></l00<> | ND                  |
| Phorate         | Р     | 0.3   | _        | В    | 0.00317  | 0.0153   | 0.00267            | ND                | ND  | ND  | ND                             | ND                  |
| Phorate sulfone | -     | -     | -        | -    | 0.120  | 0.0158   | 0.0151             | ND                | ND  | ND  | ND                             | ND                  |
| Procymidone     | 0.2   | 5     | _        | 0.01 | 0.456 <sup>a</sup>   | 0.0358   | 0.0615             | 2.66 <sup>a</sup> | 0.0460  | 0.00623                                   | ND                             | ND                  |
| Profenofos      | _     | 0.05  | _        | В    | ND   | 0.136  | 0.254              | 0.00299           | ND  | ND  | ND                             | ND                  |
| Pyrimethanil    | -     | 3     | 3        | 1    | 1.74 <sup>a</sup>  | 0.737 <sup>a</sup>   | 1.09 <sup>a</sup>  | 0.0130            | ND  | ND  | ND                             | ND                  |
| Triadimefon     | -     | 0.1   | -        | 0.1  | ND   | ND   | ND                 | ND                | 0.0201  | ND  | ND                             | ND                  |
| Triadimenol     | -     | 0.2   | -        | 0.1  | <l00< td=""><td><l00< td=""><td>ND</td><td>ND</td><td>0.0644</td><td>ND</td><td><l00< td=""><td>ND</td></l00<></td></l00<></td></l00<> | <l00< td=""><td>ND</td><td>ND</td><td>0.0644</td><td>ND</td><td><l00< td=""><td>ND</td></l00<></td></l00<> | ND                 | ND                | 0.0644  | ND  | <l00< td=""><td>ND</td></l00<> | ND                  |
| Triazophos      | _     | _     | _        | В    | 4.27 <sup>a</sup>  | 0.154  | 0.447 <sup>a</sup> | 0.00562           | <l00< td=""><td><l00< td=""><td>ND</td><td>ND</td></l00<></td></l00<> | <l00< td=""><td>ND</td><td>ND</td></l00<> | ND                             | ND                  |

Table 1. Pesticide Concentrations (mg/kg) of Real Leek Samples from Local Markets

<sup>a</sup> These samples were diluted to make sure that the concentrations were within the linearity range.

ND = not detected

B = banned pesticide

P =prohibited to use in fruit and vegetable

# Comparison of the proposed method to other works

The presence of pesticide residues in bulb vegetables has been reported in some works recently. This proposed method shows the following advantages over previous methods:

- Over 200 pesticides were discovered in leek and garlic, whereas other published works found many fewer pesticides.
- In the extraction procedure, a ceramic homogenizer was used to improve extraction efficiency and repeatability.
- Seven spiking levels were carried out to ensure reliable method validation.
- Less extraction time and a simpler extraction procedure were needed for sample extraction.
- Very low LOQs (2 µg/kg) were obtained for the majority of pesticides.

### Conclusions

The proposed method was successful and reliable for the multiresidue analysis of 213 pesticides in leek and garlic with satisfactory recovery, precision, and accuracy, demonstrating the suitability of the method for the routine analysis of pesticide residue in leek and garlic. Compared to other works relating to pesticide residue analysis in leek and other bulb vegetables, this method presents many advantages in respect to the target number, LOQ, sample extraction procedure, and method validation.

# References

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# Appendix

#### Acquisition and chromatographic parameters for the selected pesticides

| Pesticides                                | t <sub>R</sub> (min) | MRM1        | CE1(V) | MRM2        | CE2(V) |
|---|----------------------|-------------|--------|-------------|--------|
| Group A                                   |                      |             |        |             |        |
| Dichlorvos                                | 8.52                 | 109→79      | 5      | 184.9→93    | 10     |
| Disulfoton sulfoxide                      | 9.09                 | 153→96.9    | 10     | 213→97      | 20     |
| Methamidophos                             | 10.12                | 141→95      | 5      | 95→79       | 10     |
| Dichlorobenzonitrile(2,6- (Dichlobenil) ) | 10.71                | 171→100     | 25     | 171→136.1   | 15     |
| Mevinphos                                 | 12.46                | 127→109     | 10     | 127→95      | 15     |
| Methacrifos                               | 12.8                 | 207.9→180.1 | 5      | 207.9→93    | 10     |
| Molinate                                  | 13.33                | 126.2→55.1  | 10     | 126.2→83.1  | 5      |
| Cycloate                                  | 14.89                | 154.1→83.1  | 5      | 83→55.1     | 5      |
| Isoprocarb                                | 14.94                | 121→77.1    | 20     | 136→121.1   | 10     |
| Acephate                                  | 15.32                | 142→96      | 5      | 136→94      | 10     |
| Hexachlorobenzene                         | 15.51                | 283.8→213.9 | 30     | 283.8→248.8 | 15     |
| Ethoprophos                               | 15.88                | 157.9→114   | 5      | 157.9→97    | 15     |
| Ethalfluralin                             | 16.21                | 275.9→202.1 | 15     | 315.9→275.9 | 10     |
| Chlordimeform                             | 16.42                | 151.9→117.1 | 10     | 195.9→181   | 5      |
| Propoxur                                  | 16.97                | 110→63      | 25     | 110→64      | 15     |
| Sulfotep                                  | 16.97                | 237.8→145.9 | 10     | 201.8→145.9 | 10     |
| BHC-alpha                                 | 17.55                | 217→181     | 5      | 218.9→183   | 5      |
| Atrazine-desethyl                         | 18.4                 | 172→94      | 15     | 187→172     | 5      |
| Terbufos                                  | 18.46                | 230.9→175   | 10     | 230.9→129   | 20     |
| Triallate                                 | 18.69                | 268→184.1   | 20     | 142.9→83    | 15     |
| Profluralin                               | 18.72                | 317.9→199   | 15     | 317.9→54.8  | 10     |
| Tebupirimfos                              | 19.06                | 233.9→110.1 | 15     | 260.8→137.2 | 15     |
| Dioxathion                                | 19.19                | 152.9→96.9  | 10     | 271→96.9    | 30     |
| Propazine                                 | 19.4                 | 214.2→172.2 | 10     | 229.1→58.1  | 10     |
|   |                      |             |        |             |        |

| Pesticides        | t <sub>R</sub> (min) | MRM1        | CE1(V) | MRM2        | CE2(V) |
|-------------------|----------------------|-------------|--------|-------------|--------|
| Dicloran          | 19.59                | 206.1→176   | 10     | 160.1→124.1 | 10     |
| Propetamphos      | 19.7                 | 138→110     | 10     | 138→64      | 15     |
| Iprobenfos        | 20.21                | 203.9→91    | 5      | 121.9→121   | 15     |
| Dichlofenthion    | 20.35                | 278.9→222.9 | 15     | 222.9→204.9 | 15     |
| Pirimicarb        | 20.39                | 238→166.2   | 10     | 166→55.1    | 20     |
| Dimethoate        | 20.82                | 86.9→46     | 15     | 142.9→111   | 10     |
| Monocrotophos     | 20.87                | 127.1→109   | 10     | 127.1→95    | 15     |
| Acetochlor        | 21.21                | 174→146.1   | 10     | 222.9→147.2 | 5      |
| Alachlor          | 21.59                | 188.1→160.2 | 10     | 160→132.1   | 10     |
| Pirimiphos-methyl | 21.82                | 290→125     | 20     | 232.9→151   | 5      |
| Paraoxon-methyl   | 21.88                | 229.9→136.1 | 5      | 229.9→106.1 | 15     |
| Vinclozolin       | 22.04                | 187→124     | 20     | 197.9→145   | 15     |
| Metribuzin        | 22.23                | 198→82      | 15     | 198→55      | 30     |
| Metalaxyl         | 22.3                 | 234→146.1   | 20     | 220→192.1   | 5      |
| Thiobencarb       | 22.57                | 100→72      | 5      | 124.9→89    | 15     |
| Metolachlor       | 22.95                | 238→162.2   | 10     | 162.2→133.2 | 15     |
| Formothion        | 22.97                | 170→93      | 5      | 197.9→92.9  | 10     |
| Bromophos         | 23.38                | 330.8→315.8 | 15     | 328.8→313.8 | 15     |
| Fenthion          | 23.5                 | 278→169     | 15     | 278→109     | 15     |
| Paraoxon          | 23.56                | 148.9→119   | 5      | 108.9→81    | 10     |
| Triadimefon       | 24.11                | 208→181.1   | 5      | 208→111     | 20     |
| Parathion         | 24.25                | 290.9→109   | 10     | 138.9→109   | 5      |
| Isofenphos-methyl | 24.34                | 199→121     | 10     | 241.1→199.1 | 10     |
| Isofenphos        | 24.68                | 212.9→121.1 | 10     | 212.9→185.1 | 5      |
| Quinalphos        | 24.89                | 146→118     | 10     | 146→91      | 30     |
| Penconazole       | 25.15                | 248→192.1   | 15     | 248→157.1   | 25     |
| Phorate Sulfone   | 25.46                | 153→97      | 10     | 124.9→96.9  | 5      |
| Fosthiazate       | 25.58                | 195→103     | 5      | 195→60      | 20     |
| DDE-p,p'          | 25.73                | 246.1→176.2 | 30     | 315.8→246   | 15     |
| Fenothiocarb      | 25.86                | 160.1→72.1  | 10     | 72→56       | 10     |
| Terbufos sulfone  | 26.12                | 198.9→143   | 10     | 152.9→96.9  | 10     |
| DEF (Tribufos)    | 26.17                | 202→147     | 5      | 169→57.1    | 5      |
| Mepanipyrim       | 26.18                | 223.2→222.2 | 10     | 222.2→207.2 | 15     |
| Bromacil          | 26.31                | 205→188     | 15     | 207→190     | 15     |
| triadimenol       | 26.39                | 168→70      | 10     | 128→65      | 25     |
| Bromfenvinfos     | 26.45                | 266.9→159.1 | 15     | 268.9→161.1 | 15     |
| Pretilachlor      | 26.57                | 262→202     | 5      | 162.1→132.2 | 20     |
| DDD-o,p'          | 26.78                | 235→165.2   | 20     | 237→165.2   | 20     |
| Ditalimfos        | 26.88                | 130→102.1   | 10     | 148→130.1   | 10     |
| Kresoxim-methyl   | 26.89                | 116→89      | 15     | 116→63      | 30     |
| Oxadiazon         | 26.94                | 174.9→112   | 15     | 174.9→76    | 35     |
| DDT-o,p'          | 27.36                | 235→165.2   | 20     | 237→165.2   | 20     |
| Cyflufenamid      | 27.62                | 188.1→88    | 35     | 118.1→89    | 25     |
| Mephosfolan       | 27.69                | 196→139.9   | 15     | 196→59.9    | 30     |
| Bupirimate        | 27.85                | 272.9→193.1 | 5      | 272.9→108   | 15     |
|                   |                      |             |        |             |        |

| Pesticides         | t <sub>R</sub> (min) | MRM1        | CE1(V) | MRM2        | CE2(V) |
|--------------------|----------------------|-------------|--------|-------------|--------|
| Oxyfluorfen        | 28.08                | 252→196     | 20     | 252→146     | 30     |
| Chlorthiophos      | 28.21                | 324.8→268.9 | 10     | 296.8→268.9 | 5      |
| Flutolanil         | 28.21                | 173→145.1   | 15     | 280.9→173   | 10     |
| DDD-p,p'           | 28.41                | 234.9→165.1 | 20     | 236.9→165.2 | 20     |
| Carbophenothion    | 28.45                | 153→96.9    | 10     | 199→143     | 10     |
| Quinoxyfen         | 28.76                | 237→208.1   | 30     | 271.9→237.1 | 10     |
| Aclonifen          | 28.85                | 212.1→182.2 | 10     | 264.1→194.2 | 15     |
| Trifloxystrobin    | 28.88                | 116→89      | 15     | 116→63      | 30     |
| Piperonyl butoxide | 29.18                | 176.1→103.1 | 25     | 176.1→131.1 | 15     |
| Edifenphos         | 29.53                | 172.9→109   | 5      | 201→109     | 10     |
| Fensulfothion      | 29.6                 | 140→125     | 10     | 291.8→156   | 15     |
| Triazophos         | 29.71                | 161.2→134.2 | 5      | 161.2→106.1 | 10     |
| Bifenthrin         | 29.76                | 181.2→165.2 | 25     | 181.2→166.2 | 10     |
| Tebufenpyrad       | 30.28                | 275.9→171.1 | 10     | 332.9→171   | 15     |
| Bromopropylate     | 30.46                | 183→155     | 15     | 185→157     | 15     |
| Epoxiconazole      | 30.5                 | 192→138.1   | 10     | 192→111     | 25     |
| Tetramethrin       | 30.63                | 164→107.1   | 10     | 164→77.1    | 25     |
| Tebuconazole       | 30.64                | 250→125     | 20     | 125→89      | 15     |
| Pyriproxyfen       | 30.95                | 136.1→96    | 15     | 136.1→78.1  | 20     |
| Piperophos         | 30.99                | 320→122     | 10     | 140→98.1    | 10     |
| EPN                | 31.07                | 169→141.1   | 5      | 169→77.1    | 25     |
| Hexazinone         | 31.08                | 171→71.1    | 10     | 171→85.1    | 10     |
| Fenamidone         | 31.17                | 238→237.2   | 10     | 268→180.2   | 20     |
| Tetradifon         | 31.47                | 226.9→199   | 15     | 158.9→131   | 10     |
| Anilofos           | 31.54                | 225.9→184   | 5      | 225.9→157   | 10     |
| pyrazophos         | 32.09                | 221→193.1   | 10     | 232→204.1   | 10     |
| Fenarimol          | 32.2                 | 251→139.1   | 10     | 219→107.1   | 10     |
| Permethrin         | 32.2                 | 183.1→168.1 | 10     | 183.1→153   | 10     |
| Pyridaben          | 32.53                | 147.2→117.1 | 20     | 147.2→132.2 | 10     |
| Cypermethrin       | 33.88                | 163→127     | 5      | 163→91      | 10     |
| Boscalid           | 34.6                 | 140→112     | 10     | 140→76      | 25     |
| Fenvalerate        | 35.17                | 167→125.1   | 5      | 224.9→119   | 15     |
| Deltamethrin       | 36.75                | 252.9→93    | 15     | 181→152.1   | 25     |
| Group B            |                      |             |        |             |        |
| Ethiolate          | 6.82                 | 100→72      | 5      | 161→72      | 15     |
| Naled              | 8.41                 | 144.9→109   | 15     | 108.9→79    | 5      |
| Biphenyl           | 9.88                 | 154.1→153.1 | 15     | 153.1→152.1 | 15     |
| Etridiazole        | 11.26                | 211.1→183   | 10     | 183→140     | 15     |
| Chloroneb          | 13.19                | 206→191.1   | 10     | 208→193.1   | 10     |
| Tecnazene (TCNB)   | 14.52                | 260.9→203   | 10     | 214.9→179   | 10     |
| iechazene (IGND)   | 11.02                |             |        | 214.0 - 170 | 10     |

| Pentachloronitrobenzene17.69236.9 +118.925.236.9 +142.930Omethoate18.2155.9 +1105109.9 +7915Atraton18.44211 +169.15169 +154.15Diazinon18.5137.1 -8410137.1 +5420Clomazone18.65204.1 +107.120125 +8815Dirotofos18.72127 +10915186 +118.335BHC-gamma19.09117 +181.15181 +14515Carbofuran19.39181 +153.15181 +153.15BHC-gamma19.52214.9 +58.110214.9 +200.25Simazine19.32214.9 +58.110214.9 +200.25Simazine19.62201.1 +17.15161 +118.25Terbuthylazine19.78288.9 +171.15155 +127.15Isacofos20.27161 +119.15161 +114.15Pentachloronailine20.38262.8 +192.920264.9 +13420Ponamide21.42205 +269.915264.9 +21410Ponamide21.32285 +369.915175 +14715Chlorpyrifos-methyl21.82226 +184.210199 +184.15Desmetryn21.32235 +269.915266.9 +27215Desmetryn21.32226 +184.210199 +184.15Dirotofos-methyl21.32226 +184.210199 +184.115 </th <th>Pesticides</th> <th>t<sub>R</sub>(min)</th> <th>MRM1</th> <th>CE1(V)</th> <th>MRM2</th> <th>CE2(V)</th>   | Pesticides              | t <sub>R</sub> (min) | MRM1        | CE1(V) | MRM2        | CE2(V) |
|---|-------------------------|----------------------|-------------|--------|-------------|--------|
| Benfuralin16.65292-2645292-20510phorate16.98260 - 75523.0.9-128.925Chlopropham17.26153 - 110153 - 9023.0.9-128.930Omethoate17.69236.9-118.95109.9-7915Daraton18.2155.9-1105109.1-15.45Diazinon18.537.1-841019.1-54.910Clomazone18.65204.1-107.120125-98.015Diactofos18.72127-191.5138-11.835BHC-gamma19.19217-181.35184-11.915Carbofuran19.39181 - 153.15168 + 153.15Atrazine19.39181 - 153.15124.9-200.25Simazine19.32214 + 6110155 + 217.910Monolinuron20214 + 6110155 + 217.910Sizazofos0.21141 - 119.15161 - 116.15Pronamide20.22161 - 119.15161 - 116.15Pronamide20.32262 + 192.930264 + 91.410Pronamide21.32285 - 452.915264 + 92.220Addrin21.32285 - 250.915263 + 92.920Addrin21.32262 - 429.915264 + 92.915Dicofos enethyl21.44265 - 250.915264 + 92.915Dicofos enethyl21.44  | Diphenylamine           | 16.08                | 169→168.2   | 15     | 168→167.2   | 15     |
| Instruct   | Fenobucarb              | 16.26                | 121→77      | 20     | 121→103.1   | 15     |
| No<br>Pentachloronitrobenzene7.26153-+125.110153-+9025Pentachloronitrobenzene17.69236.9-+118.925236.9-+142.930Omethoate18.2155.9-+1105169-+154.15Atraton18.44211-+169.15169-+154.15Diazinon18.5137.1-8410137.1-5420Clomazone18.65204.1-107.120127-96.915Diariono18.72127-+10915127-95.915Diariotofos18.72127-+108.15181+15.15BHC-gamma19.19217-+181.15181+15.15Carbofuran19.38164.2-+149.110149.1-121.15Atrazine19.52214.9-458.110214.9-200.25Simazine19.62201.1-173.15101-146.25Monolinuron19.62201.1-173.15161-1465Pentachloroaniline19.78228.9-173.15172.9-17210Isazofos20.27161+119.15161+214.55Pentachloroaniline20.38262.8-192.220264.9-292.920Pronamide21.44173+14515175-+14715Chlorpyrifos-methyl21.32226>+26.915266.9-26325Prometryn21.32226>+26.915268.9-27215Desmetryn21.32236268.9-269.915268.9-269.9 </td <td>Benfluralin</td> <td>16.65</td> <td>292→264</td> <td>5</td> <td>292→206</td> <td>10</td>   | Benfluralin             | 16.65                | 292→264     | 5      | 292→206     | 10     |
| Pentachloronitrobenzene17.6923.6.9–118.92523.6.9–142.93Omethoate18.2155.9–1105109.9–7915Atraton18.44211-169.15169-154.15Diaziono18.50204.1–107.120127-9015Diazone18.65204.1–107.150127-9515Diarotofos18.72127-910815127-9515BHC-gamma19.19217-918.115188-118.35Carbofuran19.38164.2–149.110419.1–121.15Atrazine19.39181+153.15168+153.15Simazine19.62214.9–58.110214.9–200.25Monolinuron20214-951.10155+12.710Isazofos0.21161-119.15161-146.55Pentachloroaniline20.38262.8–132.20264.9–134.220Pronamide20.44173-1451515-17.215Chlorpyrifos-methyl21.32285-269.915264.9–220.215Desmetryn21.39213+58.110213+71.25Prometryn21.39213+58.110213+11.215Delohopyrifos-methyl21.42265-25015265-92.915Desmetryn21.39213+58.110213+11.215Dirotofora22.37261.422.110285.427.915Dirotofora22.37<  | phorate                 | 16.98                | 260→75      | 5      | 230.9→128.9 | 25     |
| Omethoate18.2155.9-1105109.9-7915Atraton18.44211-169.15169-154.15Diazinon18.5137.1-\$410137.1-\$420Clomazone18.65204.1-107.120125-8915Dircotofos18.72127-10915127-9515pyrimethanil19198-118.315188-118.335BHC-gamma19.19217-181.15188-118.516Carbofuran19.39181-153.15188-153.55Atrazine19.52214.9-58.110214.9-200.25Simazine19.52201.1-173.15164.9-120.25Simazine19.62201.1-173.15161-116.55Pentachloroanline20.27161-118.15161-116.55Pentachloroanline20.38262.9-132.15254.9-220.220Pronamide20.44173-145.515156-127.115Pentachloroanline21.32285-92.920284.9-132.220Promamide21.42285-92.935254.9-220.220Ronnel (Fenchlorphos)21.32285-250.915265.9-32.220Pormetryn21.34265-250.715265-93.215Pordetryn21.44265-250.715265-93.215Pordetryn21.4222.727-78.11616Pordetryn21.42268-  | Chlorpropham            | 17.26                | 153→125.1   | 10     | 153→90      | 25     |
| Araton18.44211->16.9.15169->15.4.15Diazinon18.5137.1->8410137.1->5420Clomazone18.65204.1->107.120125->8915Dicrotofos18.72127->10815198->11835Diractofos18.72127->10815198->11835BHC-gamma19.19217->181.15181->14.516Carbofuran19.38164.2->149.110214.9-200.25Arrazine19.52214.9-58.110214.9-200.25Simazine19.62214.9-58.110214.9-200.25Simazine19.62214.9-58.110214.9-200.25Simazine19.62214.9-58.110214.9-200.25Simazine19.62214.9-58.110214.9-200.25Simazine19.62214.9-58.110214.9-200.25Simazine19.62214.9-58.110214.9-200.25Simazine19.62214.9-58.110214.9-200.25Simazine19.62214.9-58.110214.9-200.25Simazine19.62214.9-58.110214.9-200.25Simazine19.72214.9-58.110214.9-200.25Simazine20.2214.9-51.1151515Simazine20.2214.9-51.115284.9-200.210Simazine20.221.521   | Pentachloronitrobenzene | 17.69                | 236.9→118.9 | 25     | 236.9→142.9 | 30     |
| Diazinon18.5137.1-8410137.1-5420Clomazone18.65204.1-107.120125-89.15Dicrotofos18.72127-10.15127-95.15pyrimethanil19198-18.315198-118.35BHC-gamma19.19217-181.15181-112.15Carbofuran19.38184-2-149.110149.1+121.15Etrimfos19.39181-153.15168-153.15Atrazine19.52214.9-58.110214.9-20.25Simazine19.62201.1+17.315161-1186.25Monolinuron20214+6110155-12710Isazofos20.27161-119.15161-1465Pentachloroaniline20.38262.8-192.220264.9-19420Promamide20.44173-14515175-14715Chlorpyrifos-methyl20.82285.9-92.920287.9-92.920Adrin21.17262.9-192.935254.9-20225Desmetryn21.32255-250.915286.9-372.015Desmetryn21.32225-182.110213-171.25Dichofos-methyl21.4220227-95.11015Discos-methyl21.42236188.9-17115196.9-169Diropetryn22.34236.1236.1236.1236.1Dipropetryn22.37241.1-170.2<   | Omethoate               | 18.2                 | 155.9→110   | 5      | 109.9→79    | 15     |
| Clomazone18.65204.1+07.12015-12-9.8015Dicrotofos18.72127-181.1518-11.835pyrimethanil19198-118.315184-11.835BHC-gamma19.19217-181.15181-145.15Carbofuran19.38164.2+14.110149.1+121.15Etrimfos19.39181-153.15168-153.15Atrazine19.52214.9-58.110214.9+20.25Simazine19.62201.1+17.315161-11.625Terbuthylazine19.62214-6110155+12710Monolinuron20214-6110155+12710Sazofos20.27161-11.15161-14.65Pentachloroaniline20.38262.8-19220264.9-19410Pronamide20.44173-14515175-14715Chlorpyrifos-methyl20.82285.9-92.920287.9-92.920Adrin21.17262.9-192.935254.9-22020Prometryn21.32285-268.915286.9-27215Desmetryn21.32226-184.210199-184.15BHC-beta22.1217-181.15181-14515Ametryn22.37221-171.115196.9-16915Ametryn22.37227-170.11025.1-160.110Dipropetryn22.34236-182.2 <td< td=""><td>Atraton</td><td>18.44</td><td>211→169.1</td><td>5</td><td>169→154.1</td><td>5</td></td<>   | Atraton                 | 18.44                | 211→169.1   | 5      | 169→154.1   | 5      |
| Dicrotofos18.72127-1091517-9515pyrimethanil19198-18315189-11835BHC-gamma19.19217-181.15181-145.15Carbofuran19.39181-153.15168-153.15Etrimfos19.39181-153.15168-153.15Atrazine19.52214.9-58.110214.9-200.25Simazine19.62201.1+173.15201.1+186.25Terbuthylazine19.78228.9-173.15172.9-1725Monolinuron20214-6110155-12710Isazofos20.27161-119.15161-1465Pentachloroaniline20.38262.8-19220264.9-19420Pronamide20.44173-145151515Chlorpyrifos-methyl20.82285.9-92.920286.9-27215Desmetryn21.32213-58.110213-171.25Desmetryn21.39213-58.110199-184.15BHC-beta22.1217-171.115186.9-27.915Chlorpyrifos-methyl21.32224-184.210199-184.15BHC-beta22.1217-181.15181-14515Chlorpyrifos23.3127-917.110227-58.110Dipropetryn23.323.4138.1-162.110188.1-162.1Dipropetryn23.3127-917.1   | Diazinon                | 18.5                 | 137.1→84    | 10     | 137.1→54    | 20     |
| pyrimethanil19198~18315198~11835BHC-gamma19.19217~181.15181~121.15Carbofuran19.38164.2~149.110149.1~121.15Etrimfos19.39181~153.15168~153.15Atrazine19.52214.9~58.110214.9~200.25Simazine19.62201.1~173.15201.1~186.25Terbuthylazine19.78228.9~173.15172.9~17.25Monolinuron20214~6110155~12.710Isazofos20.27161~119.15161~1465Pentachloroaniline20.38262.8~19220264.9~19420Pronamide20.44173~14515155~12715Chlorpyrifos-methyl20.82285.9~92.920287.9~92.220Aldrin21.17265~269.915266.9~27215Desmetryn21.32285-269.915266.9~27215Desmetryn21.32213~58.110213~171.25Tolclofos-methyl21.34213~171.2515265.9Desmetryn21.32227~170.110227~58.110Diorpyrifos22.37227+170.110227~58.110Diorpyrifos22.3722.717.115186.970.115Anetryn23.3127.92.910288.8~270.910Dipopetryn23.3127   | Clomazone               | 18.65                | 204.1→107.1 | 20     | 125→89      | 15     |
| HeC-gamma19.19 $217 \rightarrow 181.1$ 5 $181 \rightarrow 145$ 15Carbofuran19.38 $164.2 \rightarrow 149.1$ 10 $149.1 \rightarrow 121.1$ 5Etrimfos19.39 $181 \rightarrow 153.1$ 5 $168 \rightarrow 153.1$ 5Atrazine19.52 $214.9 \rightarrow 58.1$ 10 $214.9 \rightarrow 200.2$ 5Simazine19.62 $201.1 \rightarrow 173.1$ 5 $201.1 \rightarrow 186.2$ 5Terbuthylazine19.78 $228.9 \rightarrow 173.1$ 5 $172.9 \rightarrow 172$ 5Monolinuron20 $214 \rightarrow 61$ 10 $155 \rightarrow 127$ 10Isazofos $20.27$ $161 \rightarrow 119.1$ 5 $161 \rightarrow 146$ 5Pentachloroaniline20.38 $262.8 \rightarrow 192$ 20 $264.9 \rightarrow 194$ 20Pronamide $20.44$ $173 \rightarrow 145$ 15 $175 \rightarrow 147$ 15Chlorpyrifos-methyl $20.82$ $285.9 \rightarrow 92.9$ 20 $287.9 \rightarrow 92.9$ 20Aldrin $21.17$ $282.9 \rightarrow 192.9$ 20 $284.9 \rightarrow 220.2$ 20Ronnel (Fenchlorphos) $21.32$ $285.9 \rightarrow 92.9$ 20 $287.9 \rightarrow 92.9$ 20Prometryn $21.32$ $285.9 \rightarrow 92.9$ 20 $286.9 \rightarrow 272.2$ 15Desmetryn $21.32$ $285.9 \rightarrow 92.9$ 20 $286.9 \rightarrow 272.2$ 15Desmetryn $21.32$ $285.9 \rightarrow 272.9$ 15 $265.9 \rightarrow 33.2$ 25Prometryn $21.32$ $286.9 \rightarrow 272.1$ 15 $186.9 \rightarrow 105.1$ 16Desmetryn $21.32$ $286.9 \rightarrow 272.1$ 15 $186.9 \rightarrow 105.1$ 16Dipropetryn $22.37$ $22.$  | Dicrotofos              | 18.72                | 127→109     | 15     | 127→95      | 15     |
| Not<br>Description19.38164.2~149.110149.1~121.15Etrimfos19.39181~153.15168~153.15Atrazine19.52214.9~58.110214.9~20.25Simazine19.62201.1~173.15201.1~186.25Terbuthylazine19.78228.9~173.15172.9~1725Monolinuron20214~6110155~12710Isazofos20.27161~119.15161~1465Pentachloroaniline20.38262.8~19220264.9~19420Pronamide20.44173~14515155~12715Chlorpyrifos-methyl20.82285.9~92.920287.9~92.920Aldrin21.17262.9~192.935254.9~22.020Ronnel (Fenchlorphos)21.32285~269.915266.9~32.115Desmetryn21.3921.3~58.11021.3~171.25Tolclofos-methyl21.44265~25015265~9325Prometryn21.88226~184.210199~184.15BHC-beta22.71296.8~268.910227~58.110Chlorpyrifos22.37241.1~170.215155.1~160.110Dipopetryn22.79255.1~222.110255.1~160.112Dipopetryn23.31127~9515157.8~1255Fenitrothion23.3172.9~9915157.8~1255Pinim   | pyrimethanil            | 19                   | 198→183     | 15     | 198→118     | 35     |
| Etrimfos19.39181→153.15168→153.15Atrazine19.52214.9→58.110214.9→20.25Simazine19.6220.1.1→173.1520.1.1→186.25Terbuthylazine19.78228.9→173.15172.9→172.5Monolinuron20214→6110155→127.10Isazofos20.27161→119.15161→146.5Pentachloroaniline20.38262.8→192.20264.9→194.20Pronamide20.44173→145.15155→127.15Chlorpyrifos-methyl20.82285.9→92.920287.9→92.920Aldrin21.37262.9→192.935254.9→22.020Ronnel (Fenchlorphos)21.32285→269.915265.9+33.25Desmetryn21.3921.3→58.11021.3→171.25Tolclofos-methyl21.44265→25015265.9+33.25Prometryn21.88226→184.21019.9→184.15BHC-beta22.37227.→170.11022.7→58.110Chlorpyrifos22.3722.7→170.11022.7→58.110Ametryn22.3722.7→170.11025.1→180.12Dipopetryn22.3723.121.1→170.21515Frichloronat23.30172.9→991518.1→145.115Pirmiphos-ethyl23.1318.1→166.110318.1→162.110Pir  | BHC-gamma               | 19.19                | 217→181.1   | 5      | 181→145     | 15     |
| Atrazine19.52214.9 $\rightarrow$ 58.110214.9 $\rightarrow$ 200.25Simazine19.62201.1 $\rightarrow$ 173.15201.1 $\rightarrow$ 186.25Terbuthylazine19.72228.9 $\rightarrow$ 173.15172.9 $\rightarrow$ 1725Monolinuron20214 $\rightarrow$ 6110155 $\rightarrow$ 12710Isazofos20.27161 $\rightarrow$ 119.15161 $\rightarrow$ 1465Pentachloroaniline20.38262.8 $\rightarrow$ 19220264.9 $\rightarrow$ 19420Pronamide20.44173 $\rightarrow$ 14515175 $\rightarrow$ 14715Chlorpyrifos-methyl20.82285.9 $\rightarrow$ 22.920287.9 $\rightarrow$ 22.920Aldrin21.17262.9 $\rightarrow$ 192.935254.9 $\rightarrow$ 22.020Ronnel (Fenchlorphos)21.32285 $\rightarrow$ 269.915286.9 $\rightarrow$ 27.215Desmetryn21.39213 $\rightarrow$ 58.110213 $\rightarrow$ 17.15Tolclofos-methyl21.44265 $\rightarrow$ 25015265 $\rightarrow$ 9325Prometryn21.88226 $\rightarrow$ 184.210199 $\rightarrow$ 184.15BHC-beta22.121.7 $\rightarrow$ 181.15181 $\rightarrow$ 14515Chlorpyrifos22.3722.7 $\rightarrow$ 170.11022.7 $\rightarrow$ 58.110Dipropetryn22.3725.1 $\rightarrow$ 222.110298.8 $\rightarrow$ 270.910Dipropetryn22.3725.1 $\rightarrow$ 222.11015161 $\rightarrow$ 111.15Prindudon23.112.7 $\rightarrow$ 951515.7 $\rightarrow$ 109.115Prindupon23.112.7 $\rightarrow$ 951515.7 $\rightarrow$ 109.115Prindupon23.312.   | Carbofuran              | 19.38                | 164.2→149.1 | 10     | 149.1→121.1 | 5      |
| Simazine19.62201.1→173.15201.1→186.25Terbuthylazine19.78228.9→173.15172.9→1725Monolinuron20214~6110155~12710Isazofos20.27161~119.15161~1465Pentachloroaniline20.38262.8~19220264.9~19420Pronamide20.34173~14515175~14715Chlorpyrifos-methyl20.82285.9~92.920287.9~92.920Aldrin21.17262.9~192.935254.9~22020Ronnel (Fenchlorphos)21.32285~269.915286.9~27215Desmetryn21.39213~58.110213~171.25Tolclofs-methyl21.44265~25015265~9325Prometryn21.88226~184.210199~184.15BHC-beta22.1217~181.15181~14515Chlorpyrifos22.37227+170.110227~58.110Terbutryn22.37227+170.110255.1~180.120Dipropetryn22.79255.1~222.110255.1~180.120BHC-delta23.31127~9515181~14515Pirimiphos-ethyl23.31127.9515157.8~1255Fenitrothion23.52277.2605277.1~10915Mathoprene23.61133~111.15161.105.110Mathoprene23.61 </td <td>Etrimfos</td> <td>19.39</td> <td>181→153.1</td> <td>5</td> <td>168→153.1</td> <td>5</td>   | Etrimfos                | 19.39                | 181→153.1   | 5      | 168→153.1   | 5      |
| Terbuthylazine19.78 $228.9 \rightarrow 173.1$ 5 $172.9 \rightarrow 172$ 5Monolinuron20 $214 \rightarrow 61$ 10 $155 \rightarrow 127$ 10Isazofos $20.27$ $161 \rightarrow 119.1$ 5 $161 \rightarrow 146$ 5Pentachloroaniline $20.38$ $262.8 \rightarrow 192$ 20 $264.9 \rightarrow 194$ 20Pronamide $20.44$ $173 \rightarrow 145$ 15 $175 \rightarrow 147$ 15Chlorpyrifos-methyl $20.82$ $285.9 \rightarrow 92.9$ 20 $287.9 \rightarrow 92.9$ 20Aldrin $21.17$ $262.9 \rightarrow 192.9$ 35 $254.9 \rightarrow 220$ 20Ronnel (Fenchlorphos) $21.32$ $285 \rightarrow 269.9$ 15 $286.9 \rightarrow 272$ 15Desmetryn $21.39$ $213 \rightarrow 58.1$ 10 $213 \rightarrow 171.2$ 5Tolclofos-methyl $21.44$ $265 \rightarrow 250$ 15 $265 \rightarrow 93$ 25Prometryn $21.88$ $226 \rightarrow 184.2$ 10 $199 \rightarrow 184.1$ 5BHC-beta $22.1$ $217 \rightarrow 181.1$ 5 $181 \rightarrow 145$ 15Chlorpyrifos $22.36$ $198.9 \rightarrow 171$ 15 $196.9 \rightarrow 169$ 15Ametryn $22.37$ $27 \rightarrow 170.1$ 10 $227 \rightarrow 58.1$ 10Terbutryn $22.37$ $271 \rightarrow 181.1$ 5 $181 \rightarrow 145$ 15Trichloronat $22.99$ $217 \rightarrow 181.1$ 5 $181 \rightarrow 145$ 15Dipropetryn $23.13$ $127 \rightarrow 95$ 15 $127 \rightarrow 109$ 10Malathion $23.31$ $127 \rightarrow 95$ 15 $127 \rightarrow 109$ 15Malathion $23.6$ $277 \rightarrow 260$ 5 $27.$  | Atrazine                | 19.52                | 214.9→58.1  | 10     | 214.9→200.2 | 5      |
| Monolinuron20214~6110155~12710Isazofos20.27161~119.15161~1465Pentachloroaniline20.38262.8~19220264.9~19420Pronamide20.44173~14515175~14715Chlorpyrifos-methyl20.82285.9~92.920287.9~92.920Aldrin21.17262.9~192.935254.9~22020Ronnel (Fenchlorphos)21.32285~269.915266.9~27215Desmetryn21.39213~58.110213~171.25Tolclofos-methyl21.44265~25015265~93325Prometryn21.88226~184.210199~184.15BHC-beta22.1217~181.15181~14515Chlorpyrifos22.37227~170.110227~58.110Terbutryn22.37221.117.288.+270.910Dipropetryn22.37217~181.15185~170.15BHC-deta22.99217~181.15181~14515Primiphos-ethyl23.1318.1~166.110318.1~18210Phosphamidon23.3172.9~9915157.8~1255Fenitrothion23.6277~2605277.1~10915Mathoine23.6153~111.15161~105.110Mathoine23.620.9~161.15161~105.110Cyprodinil23.7620.9~216  | Simazine                | 19.62                | 201.1→173.1 | 5      | 201.1→186.2 | 5      |
| Isazofos $20.27$ $161 \rightarrow 119.1$ $5$ $161 \rightarrow 146$ $5$ Pentachloroaniline $20.38$ $262.8 \rightarrow 192$ $20$ $264.9 \rightarrow 194$ $20$ Pronamide $20.44$ $173 \rightarrow 145$ $15$ $175 \rightarrow 147$ $15$ Chlorpyrifos-methyl $20.82$ $285.9 \rightarrow 92.9$ $20$ $287.9 \rightarrow 92.9$ $20$ Aldrin $21.17$ $262.9 \rightarrow 192.9$ $35$ $254.9 \rightarrow 220$ $20$ Ronnel (Fenchlorphos) $21.32$ $285 \rightarrow 269.9$ $15$ $286.9 \rightarrow 272$ $15$ Desmetryn $21.39$ $213 \rightarrow 58.1$ $10$ $213 \rightarrow 171.2$ $5$ Tolclofos-methyl $21.44$ $265 \rightarrow 250$ $15$ $265 \rightarrow 93$ $25$ Prometryn $21.88$ $226 \rightarrow 184.2$ $10$ $199 \rightarrow 184.1$ $5$ BHC-beta $22.1$ $217 \rightarrow 181.1$ $5$ $181 \rightarrow 145$ $15$ Chlorpyrifos $22.36$ $198.9 \rightarrow 171$ $15$ $196.9 \rightarrow 169$ $15$ Ametryn $22.37$ $227 \rightarrow 170.1$ $10$ $227 \rightarrow 58.1$ $10$ Terbutryn $22.37$ $217 \rightarrow 170.1$ $10$ $298.8 \rightarrow 270.9$ $10$ Dipropetryn $22.79$ $255.1 \rightarrow 222.1$ $10$ $298.8 \rightarrow 270.9$ $10$ Dipropetryn $23.31$ $127 \rightarrow 95$ $15$ $181 \rightarrow 145$ $15$ Primiphos-ethyl $23.13$ $127 \rightarrow 95$ $15$ $157.8 \rightarrow 125$ $5$ Fenitrothion $23.3$ $172.9 \rightarrow 99$ $15$ $157.8 \rightarrow 125$ $5$ Hotoprene $23.6$ $153 \rightarrow 111.1$ $5$ $161 \rightarrow 105.1$ <td>Terbuthylazine</td> <td>19.78</td> <td>228.9→173.1</td> <td>5</td> <td>172.9→172</td> <td>5</td> | Terbuthylazine          | 19.78                | 228.9→173.1 | 5      | 172.9→172   | 5      |
| Pentachloroaniline20.38 $262.8 \rightarrow 192$ 20 $264.9 \rightarrow 194$ 20Pronamide $20.44$ $173 \rightarrow 145$ $15$ $175 \rightarrow 147$ $15$ Chlorpyrifos-methyl $20.82$ $285.9 \rightarrow 92.9$ $20$ $287.9 \rightarrow 92.9$ $20$ Aldrin $21.17$ $262.9 \rightarrow 192.9$ $35$ $254.9 \rightarrow 220$ $210$ Ronnel (Fenchlorphos) $21.32$ $285 \rightarrow 269.9$ $15$ $286.9 \rightarrow 272$ $15$ Desmetryn $21.39$ $213 \rightarrow 58.1$ $10$ $213 \rightarrow 171.2$ $5$ Tolclofos-methyl $21.44$ $265 \rightarrow 250$ $15$ $265 \rightarrow 93$ $25$ Prometryn $21.88$ $226 \rightarrow 184.2$ $10$ $199 \rightarrow 184.1$ $5$ BHC-beta $22.14$ $217 \rightarrow 181.1$ $5$ $181 \rightarrow 145$ $15$ Ametryn $22.36$ $198.9 \rightarrow 171$ $10$ $227 \rightarrow 58.1$ $10$ Terbutryn $22.37$ $27 \rightarrow 170.1$ $10$ $227 \rightarrow 58.1$ $10$ Dipropetryn $22.37$ $251.9 \rightarrow 222.1$ $10$ $298.8 \rightarrow 270.9$ $10$ Dipropetryn $22.37$ $217 \rightarrow 181.1$ $5$ $181 \rightarrow 145$ $15$ Primiphos-ethyl $23.13$ $127 \rightarrow 95$ $10$ $298.8 \rightarrow 270.9$ $10$ Dipropetryn $23.31$ $127.9 \rightarrow 99$ $15$ $127 \rightarrow 109$ $10$ Phosphamidon $23.31$ $127.9 \rightarrow 99$ $15$ $127.9 \rightarrow 109$ $15$ Methoprene $23.61$ $153 \rightarrow 111.1$ $5$ $11.1 \rightarrow 55$ $15$ Ethofumesate $23.76$ $206.9 \rightarrow 161.1$ $5$ $161 \rightarrow 105.1$  | Monolinuron             | 20                   | 214→61      | 10     | 155→127     | 10     |
| Pronamide20.44173 $\rightarrow$ 14515175 $\rightarrow$ 14715Chlorpyrifos-methyl20.82285.9 $\rightarrow$ 92.920287.9 $\rightarrow$ 92.920Aldrin21.17262.9 $\rightarrow$ 192.935254.9 $\rightarrow$ 22020Ronnel (Fenchlorphos)21.32285 $\rightarrow$ 269.915286.9 $\rightarrow$ 27215Desmetryn21.39213 $\rightarrow$ 58.110213 $\rightarrow$ 171.25Tolclofos-methyl21.44265 $\rightarrow$ 25015265 $\rightarrow$ 9325Prometryn21.88226 $\rightarrow$ 184.210199 $\rightarrow$ 184.15BHC-beta22.1217 $\rightarrow$ 181.15181 $\rightarrow$ 14515Chlorpyrifos22.36198.9 $\rightarrow$ 17115196.9 $\rightarrow$ 16915Ametryn22.37227 $\rightarrow$ 77.0.110227 $\rightarrow$ 58.110Trichloronat22.77255.1 $\rightarrow$ 222.110298.8 $\rightarrow$ 270.910Dipropetryn22.79255.1 $\rightarrow$ 222.11028.8 $\rightarrow$ 270.915BHC-delta22.99217 $\rightarrow$ 181.15181 $\rightarrow$ 14515Pirimiphos-ethyl23.13127 $\rightarrow$ 9515127 $\rightarrow$ 10910Malathion23.3172.9 $\rightarrow$ 9915157.8 $\rightarrow$ 1255Fenitrothion23.6153 $\rightarrow$ 111.15161 $\rightarrow$ 105.110Methoprene23.6153 $\rightarrow$ 111.15161 $\rightarrow$ 105.110Cyprodinil23.78225.2 $\rightarrow$ 224.310224.2 $\rightarrow$ 208.220Isofenphos oxon24.1229 $\rightarrow$ 200.910229 $\rightarrow$ 21125Prodimitehlain23.78252 $\rightarrow$  | Isazofos                | 20.27                | 161→119.1   | 5      | 161→146     | 5      |
| Chlorpyrifos-methyl20.82285.9 $\rightarrow$ 92.920287.9 $\rightarrow$ 92.920Aldrin21.17262.9 $\rightarrow$ 192.935254.9 $\rightarrow$ 22020Ronnel (Fenchlorphos)21.32285 $\rightarrow$ 269.915286.9 $\rightarrow$ 27215Desmetryn21.39213 $\rightarrow$ 58.110213 $\rightarrow$ 171.25Tolclofos-methyl21.44265 $\rightarrow$ 25015265 $\rightarrow$ 9325Prometryn21.88226 $\rightarrow$ 184.210199 $\rightarrow$ 184.15BHC-beta22.1217 $\rightarrow$ 181.15181 $\rightarrow$ 14515Chlorpyrifos22.36198.9 $\rightarrow$ 17115196.9 $\rightarrow$ 16915Ametryn22.37227 $\rightarrow$ 170.110227 $\rightarrow$ 58.110Terbutryn22.37241.1 $\rightarrow$ 170.215185 $\rightarrow$ 170.15Trichloronat22.71296.8 $\rightarrow$ 268.910298.8 $\rightarrow$ 270.910Dipropetryn22.79255.1 $\rightarrow$ 222.110255.1 $\rightarrow$ 180.120BHC-delta22.99217 $\rightarrow$ 181.15181 $\rightarrow$ 14515Primiphos-ethyl23.13127 $\rightarrow$ 9515127 $\rightarrow$ 10910Malathion23.3122 $\rightarrow$ 99.9915157.8 $\rightarrow$ 1255Fenitrothion23.6153 $\rightarrow$ 111.15111 $\rightarrow$ 5515Ethofumesate23.78225.2 $\rightarrow$ 224.310224.2 $\rightarrow$ 208.220Isofenphos oxon24.1229 $\rightarrow$ 200.910224.2 $\rightarrow$ 208.220Isofenphos oxon24.1229 $\rightarrow$ 200.910214 $\rightarrow$ 1115   | Pentachloroaniline      | 20.38                | 262.8→192   | 20     | 264.9→194   | 20     |
| Aldrin21.17 $262.9 \rightarrow 192.9$ $35$ $254.9 \rightarrow 220$ $20$ Ronnel (Fenchlorphos)21.32 $285 \rightarrow 269.9$ $15$ $286.9 \rightarrow 272$ $15$ Desmetryn21.39 $213 \rightarrow 58.1$ $10$ $213 \rightarrow 171.2$ $5$ Tolclofos-methyl $21.44$ $265 \rightarrow 250$ $15$ $265 \rightarrow 93$ $25$ Prometryn $21.88$ $226 \rightarrow 184.2$ $10$ $199 \rightarrow 184.1$ $5$ BHC-beta $22.1$ $217 \rightarrow 181.1$ $5$ $181 \rightarrow 145$ $15$ Chlorpyrifos $22.36$ $198.9 \rightarrow 171$ $15$ $196.9 \rightarrow 169$ $15$ Ametryn $22.37$ $227 \rightarrow 170.1$ $10$ $227 \rightarrow 58.1$ $10$ Terbutryn $22.37$ $241.1 \rightarrow 170.2$ $15$ $185 \rightarrow 170.1$ $5$ Trichloronat $22.79$ $255.1 \rightarrow 222.1$ $10$ $298.8 \rightarrow 270.9$ $10$ Dipropetryn $22.79$ $255.1 \rightarrow 222.1$ $10$ $298.8 \rightarrow 270.9$ $10$ Dipropetryn $22.37$ $217 \rightarrow 181.1$ $5$ $181 \rightarrow 145$ $15$ Primiphos-ethyl $23.13$ $127 \rightarrow 95$ $15$ $127 \rightarrow 109$ $10$ Malathion $23.3$ $172.9 \rightarrow 99$ $15$ $157.8 \rightarrow 125$ $5$ Fenitrothion $23.6$ $153 \rightarrow 111.1$ $5$ $111.1 \rightarrow 55$ $15$ Ethofumesate $23.78$ $225.2 \rightarrow 224.3$ $10$ $224.2 \rightarrow 208.2$ $20$ Isofenphos oxon $24.1$ $229 \rightarrow 200.9$ $10$ $229 \rightarrow 121$ $25$ Pendimethalin $24.5$ $251.8 \rightarrow 162.2$ $10$ $251.8 \rightarrow 161.1$  | Pronamide               | 20.44                | 173→145     | 15     | 175→147     | 15     |
| Ronnel (Fenchlorphos) $21.32$ $285 \rightarrow 269.9$ $15$ $286.9 \rightarrow 272$ $15$ Desmetryn $21.39$ $213 \rightarrow 58.1$ $10$ $213 \rightarrow 171.2$ $5$ Tolclofos-methyl $21.44$ $265 \rightarrow 250$ $15$ $265 \rightarrow 93$ $25$ Prometryn $21.88$ $226 \rightarrow 184.2$ $10$ $199 \rightarrow 184.1$ $5$ BHC-beta $22.1$ $217 \rightarrow 181.1$ $5$ $181 \rightarrow 145$ $15$ Chlorpyrifos $22.36$ $198.9 \rightarrow 171$ $15$ $196.9 \rightarrow 169$ $15$ Ametryn $22.37$ $227 \rightarrow 170.1$ $10$ $227 \rightarrow 58.1$ $10$ Terbutryn $22.37$ $241.1 \rightarrow 170.2$ $15$ $185 \rightarrow 170.1$ $5$ Trichloronat $22.71$ $296.8 \rightarrow 268.9$ $10$ $298.8 \rightarrow 270.9$ $10$ Dipropetryn $22.79$ $255.1 \rightarrow 222.1$ $10$ $255.1 \rightarrow 180.1$ $20$ BHC-delta $22.99$ $217 \rightarrow 181.1$ $5$ $181 \rightarrow 145$ $15$ Primiphos-ethyl $23.13$ $127 \rightarrow 95$ $15$ $127 \rightarrow 109$ $10$ Malathion $23.3$ $172.9 \rightarrow 99$ $15$ $157.8 \rightarrow 125$ $5$ Fenitrothion $23.6$ $153 \rightarrow 111.1$ $5$ $161 \rightarrow 105.1$ $10$ Cyprodinil $23.78$ $225.2 \rightarrow 224.3$ $10$ $224.2 \rightarrow 208.2$ $20$ Isofenphos oxon $24.1$ $229 \rightarrow 200.9$ $10$ $229 \rightarrow 121$ $25$   | Chlorpyrifos-methyl     | 20.82                | 285.9→92.9  | 20     | 287.9→92.9  | 20     |
| Desmetryn $21.39$ $213\rightarrow58.1$ $10$ $213\rightarrow171.2$ $5$ Tolclofos-methyl $21.44$ $265\rightarrow250$ $15$ $265\rightarrow93$ $25$ Prometryn $21.88$ $226\rightarrow184.2$ $10$ $199\rightarrow184.1$ $5$ BHC-beta $22.1$ $217\rightarrow181.1$ $5$ $181\rightarrow145$ $15$ Chlorpyrifos $22.36$ $198.9\rightarrow171$ $15$ $196.9\rightarrow169$ $15$ Ametryn $22.37$ $227\rightarrow170.1$ $10$ $227\rightarrow58.1$ $10$ Terbutryn $22.37$ $241.1\rightarrow170.2$ $15$ $185\rightarrow170.1$ $5$ Trichloronat $22.79$ $255.1\rightarrow222.1$ $10$ $298.8\rightarrow270.9$ $10$ Dipropetryn $22.79$ $255.1\rightarrow222.1$ $10$ $255.1\rightarrow180.1$ $20$ BHC-delta $22.99$ $217\rightarrow181.1$ $5$ $181\rightarrow145$ $15$ Primiphos-ethyl $23.1$ $318.1\rightarrow166.1$ $10$ $318.1\rightarrow162$ $10$ Malathion $23.3$ $172.9\rightarrow99$ $15$ $157.8\rightarrow125$ $5$ Fenitrothion $23.6$ $153\rightarrow111.1$ $5$ $111.1\rightarrow55$ $15$ Ethofumesate $23.76$ $206.9\rightarrow161.1$ $5$ $161\rightarrow105.1$ $10$ Cyprodinil $23.78$ $225.2\rightarrow224.3$ $10$ $224.2\rightarrow208.2$ $20$ Isofenphos oxon $24.1$ $229\rightarrow200.9$ $10$ $229\rightarrow121$ $25$ Pendimethalin $24.15$ $251.8\rightarrow162.2$ $10$ $251.8\rightarrow161.1$ $15$  | Aldrin                  | 21.17                | 262.9→192.9 | 35     | 254.9→220   | 20     |
| Tolclofos-methyl $21.44$ $265 \rightarrow 250$ $15$ $265 \rightarrow 93$ $25$ Prometryn $21.88$ $226 \rightarrow 184.2$ $10$ $199 \rightarrow 184.1$ $5$ BHC-beta $22.1$ $217 \rightarrow 181.1$ $5$ $181 \rightarrow 145$ $15$ Chlorpyrifos $22.36$ $198.9 \rightarrow 171$ $15$ $196.9 \rightarrow 169$ $15$ Ametryn $22.37$ $227 \rightarrow 170.1$ $10$ $227 \rightarrow 58.1$ $10$ Terbutryn $22.37$ $241.1 \rightarrow 170.2$ $15$ $185 \rightarrow 170.1$ $5$ Trichloronat $22.71$ $296.8 \rightarrow 268.9$ $10$ $298.8 \rightarrow 270.9$ $10$ Dipropetryn $22.79$ $255.1 \rightarrow 222.1$ $10$ $255.1 \rightarrow 180.1$ $20$ BHC-delta $22.99$ $217 \rightarrow 181.1$ $5$ $181 \rightarrow 145$ $15$ Primiphos-ethyl $23.13$ $127 \rightarrow 95$ $15$ $127 \rightarrow 109$ $10$ Malathion $23.3$ $172.9 \rightarrow 99$ $15$ $157.8 \rightarrow 125$ $5$ Fenitrothion $23.6$ $153 \rightarrow 111.1$ $5$ $111.1 \rightarrow 55$ $15$ Methoprene $23.6$ $153 \rightarrow 111.1$ $5$ $161 \rightarrow 105.1$ $10$ Cyprodinil $23.78$ $225.2 \rightarrow 224.3$ $10$ $224.2 \rightarrow 208.2$ $20$ Isofenphos oxon $24.1$ $229 \rightarrow 200.9$ $10$ $229 \rightarrow 121$ $25$   | Ronnel (Fenchlorphos)   | 21.32                | 285→269.9   | 15     | 286.9→272   | 15     |
| Prometryn21.88226→184.210199→184.15BHC-beta22.1217→181.15181→14515Chlorpyrifos22.36198.9→17115196.9→16915Ametryn22.37227→170.110227→58.110Terbutryn22.37241.1→170.215185→170.15Trichloronat22.71296.8→268.910298.8→270.910Dipropetryn22.79255.1→222.110255.1→180.120BHC-delta22.99217→181.15181→14515Pirimiphos-ethyl23.13127→9515127→10910Malathion23.3172.9→9915157.8→1255Fenitrothion23.6153→111.15111.1→5515Methoprene23.6206.9→161.15161→105.110Cyprodinil23.78225.2→224.310224.2→208.220Isofenphos oxon24.1229→200.910229→12125   | Desmetryn               | 21.39                | 213→58.1    | 10     | 213→171.2   | 5      |
| BHC-beta22.1 $217 \rightarrow 181.1$ 5 $181 \rightarrow 145$ 15Chlorpyrifos22.36 $198.9 \rightarrow 171$ 15 $196.9 \rightarrow 169$ 15Ametryn22.37 $227 \rightarrow 170.1$ 10 $227 \rightarrow 58.1$ 10Terbutryn22.37 $241.1 \rightarrow 170.2$ 15 $185 \rightarrow 170.1$ 5Trichloronat22.71 $296.8 \rightarrow 268.9$ 10 $298.8 \rightarrow 270.9$ 10Dipropetryn22.79 $255.1 \rightarrow 222.1$ 10 $255.1 \rightarrow 180.1$ 20BHC-delta22.99 $217 \rightarrow 181.1$ 5 $181 \rightarrow 145$ 15Pirimiphos-ethyl23.1 $318.1 \rightarrow 166.1$ 10 $318.1 \rightarrow 182$ 10Phosphamidon23.3 $127 \rightarrow 95$ 15 $127 \rightarrow 109$ 10Malathion23.5 $277 \rightarrow 260$ 5 $277.1 \rightarrow 109$ 15Methoprene23.6 $153 \rightarrow 111.1$ 5 $161 \rightarrow 105.1$ 10Cyprodinil23.78 $225.2 \rightarrow 224.3$ 10 $224.2 \rightarrow 208.2$ 20Isofenphos oxon24.1 $229 \rightarrow 200.9$ 10 $229 \rightarrow 121$ 25Pendimethalin24.15 $251.8 \rightarrow 162.2$ 10 $251.8 \rightarrow 161.1$ 15  | Tolclofos-methyl        | 21.44                | 265→250     | 15     | 265→93      | 25     |
| Chlorpyrifos $22.36$ $198.9 \rightarrow 171$ $15$ $196.9 \rightarrow 169$ $15$ Ametryn $22.37$ $227 \rightarrow 170.1$ $10$ $227 \rightarrow 58.1$ $10$ Terbutryn $22.37$ $241.1 \rightarrow 170.2$ $15$ $185 \rightarrow 170.1$ $5$ Trichloronat $22.71$ $296.8 \rightarrow 268.9$ $10$ $298.8 \rightarrow 270.9$ $10$ Dipropetryn $22.79$ $255.1 \rightarrow 222.1$ $10$ $255.1 \rightarrow 180.1$ $20$ BHC-delta $22.99$ $217 \rightarrow 181.1$ $5$ $181 \rightarrow 145$ $15$ Pirimiphos-ethyl $23.13$ $127 \rightarrow 95$ $15$ $127 \rightarrow 109$ $10$ Malathion $23.3$ $172.9 \rightarrow 99$ $15$ $157.8 \rightarrow 125$ $5$ Fenitrothion $23.6$ $153 \rightarrow 111.1$ $5$ $111.1 \rightarrow 55$ $15$ Methoprene $23.76$ $206.9 \rightarrow 161.1$ $5$ $161 \rightarrow 105.1$ $10$ Cyprodinil $23.78$ $225.2 \rightarrow 224.3$ $10$ $224.2 \rightarrow 208.2$ $20$ Isofenphos oxon $24.15$ $251.8 \rightarrow 162.2$ $10$ $251.8 \rightarrow 161.1$ $15$  | Prometryn               | 21.88                | 226→184.2   | 10     | 199→184.1   | 5      |
| Ametryn $22.37$ $227 \rightarrow 170.1$ $10$ $227 \rightarrow 58.1$ $10$ Terbutryn $22.37$ $241.1 \rightarrow 170.2$ $15$ $185 \rightarrow 170.1$ $5$ Trichloronat $22.71$ $296.8 \rightarrow 268.9$ $10$ $298.8 \rightarrow 270.9$ $10$ Dipropetryn $22.79$ $255.1 \rightarrow 222.1$ $10$ $255.1 \rightarrow 180.1$ $20$ BHC-delta $22.99$ $217 \rightarrow 181.1$ $5$ $181 \rightarrow 145$ $15$ Pirimiphos-ethyl $23.1$ $318.1 \rightarrow 166.1$ $10$ $318.1 \rightarrow 182$ $10$ Phosphamidon $23.3$ $127 \rightarrow 95$ $15$ $127 \rightarrow 109$ $10$ Malathion $23.5$ $277 \rightarrow 260$ $5$ $277.1 \rightarrow 109$ $15$ Fenitrothion $23.6$ $153 \rightarrow 111.1$ $5$ $161 \rightarrow 105.1$ $10$ Cyprodinil $23.78$ $225.2 \rightarrow 224.3$ $10$ $224.2 \rightarrow 208.2$ $20$ Isofenphos oxon $24.1$ $229 \rightarrow 200.9$ $10$ $229 \rightarrow 121$ $25$ Pendimethalin $24.15$ $251.8 \rightarrow 162.2$ $10$ $251.8 \rightarrow 161.1$ $15$   | BHC-beta                | 22.1                 | 217→181.1   | 5      | 181→145     | 15     |
| Terbutryn $22.37$ $241.1 \rightarrow 170.2$ $15$ $185 \rightarrow 170.1$ $5$ Trichloronat $22.71$ $296.8 \rightarrow 268.9$ $10$ $298.8 \rightarrow 270.9$ $10$ Dipropetryn $22.79$ $255.1 \rightarrow 222.1$ $10$ $255.1 \rightarrow 180.1$ $20$ BHC-delta $22.99$ $217 \rightarrow 181.1$ $5$ $181 \rightarrow 145$ $15$ Pirimiphos-ethyl $23.1$ $318.1 \rightarrow 166.1$ $10$ $318.1 \rightarrow 182$ $10$ Phosphamidon $23.3$ $127 \rightarrow 95$ $15$ $127 \rightarrow 109$ $10$ Malathion $23.3$ $172.9 \rightarrow 99$ $15$ $157.8 \rightarrow 125$ $5$ Fenitrothion $23.5$ $277 \rightarrow 260$ $5$ $277.1 \rightarrow 109$ $15$ Methoprene $23.6$ $153 \rightarrow 111.1$ $5$ $161 \rightarrow 105.1$ $10$ Cyprodinil $23.78$ $225.2 \rightarrow 224.3$ $10$ $224.2 \rightarrow 208.2$ $20$ Isofenphos oxon $24.1$ $229 \rightarrow 200.9$ $10$ $229 \rightarrow 121$ $25$ Pendimethalin $24.15$ $251.8 \rightarrow 162.2$ $10$ $251.8 \rightarrow 161.1$ $15$  | Chlorpyrifos            | 22.36                | 198.9→171   | 15     | 196.9→169   | 15     |
| Trichloronat $22.71$ $296.8 \rightarrow 268.9$ $10$ $298.8 \rightarrow 270.9$ $10$ Dipropetryn $22.79$ $255.1 \rightarrow 222.1$ $10$ $255.1 \rightarrow 180.1$ $20$ BHC-delta $22.99$ $217 \rightarrow 181.1$ $5$ $181 \rightarrow 145$ $15$ Pirimiphos-ethyl $23.1$ $318.1 \rightarrow 166.1$ $10$ $318.1 \rightarrow 182$ $10$ Phosphamidon $23.3$ $127 \rightarrow 95$ $15$ $127 \rightarrow 109$ $10$ Malathion $23.3$ $172.9 \rightarrow 99$ $15$ $157.8 \rightarrow 125$ $5$ Fenitrothion $23.5$ $277 \rightarrow 260$ $5$ $277.1 \rightarrow 109$ $15$ Methoprene $23.6$ $153 \rightarrow 111.1$ $5$ $111.1 \rightarrow 55$ $15$ Ethofumesate $23.78$ $225.2 \rightarrow 224.3$ $10$ $224.2 \rightarrow 208.2$ $20$ Isofenphos oxon $24.1$ $229 \rightarrow 200.9$ $10$ $229 \rightarrow 121$ $25$ Pendimethalin $24.15$ $251.8 \rightarrow 162.2$ $10$ $251.8 \rightarrow 161.1$ $15$  | Ametryn                 | 22.37                | 227→170.1   | 10     | 227→58.1    | 10     |
| Dipropetryn $22.79$ $255.1 \rightarrow 222.1$ $10$ $255.1 \rightarrow 180.1$ $20$ BHC-delta $22.99$ $217 \rightarrow 181.1$ $5$ $181 \rightarrow 145$ $15$ Pirimiphos-ethyl $23.1$ $318.1 \rightarrow 166.1$ $10$ $318.1 \rightarrow 182$ $10$ Phosphamidon $23.13$ $127 \rightarrow 95$ $15$ $127 \rightarrow 109$ $10$ Malathion $23.3$ $172.9 \rightarrow 99$ $15$ $157.8 \rightarrow 125$ $5$ Fenitrothion $23.5$ $277 \rightarrow 260$ $5$ $277.1 \rightarrow 109$ $15$ Methoprene $23.6$ $153 \rightarrow 111.1$ $5$ $111.1 \rightarrow 55$ $15$ Ethofumesate $23.76$ $206.9 \rightarrow 161.1$ $5$ $161 \rightarrow 105.1$ $10$ Cyprodinil $23.78$ $225.2 \rightarrow 224.3$ $10$ $224.2 \rightarrow 208.2$ $20$ Isofenphos oxon $24.15$ $251.8 \rightarrow 162.2$ $10$ $251.8 \rightarrow 161.1$ $15$   | Terbutryn               | 22.37                | 241.1→170.2 | 15     | 185→170.1   | 5      |
| BHC-delta $22.99$ $217 \rightarrow 181.1$ $5$ $181 \rightarrow 145$ $15$ Pirimiphos-ethyl $23.1$ $318.1 \rightarrow 166.1$ $10$ $318.1 \rightarrow 182$ $10$ Phosphamidon $23.13$ $127 \rightarrow 95$ $15$ $127 \rightarrow 109$ $10$ Malathion $23.3$ $172.9 \rightarrow 99$ $15$ $157.8 \rightarrow 125$ $5$ Fenitrothion $23.5$ $277 \rightarrow 260$ $5$ $277.1 \rightarrow 109$ $15$ Methoprene $23.6$ $153 \rightarrow 111.1$ $5$ $111.1 \rightarrow 55$ $15$ Ethofumesate $23.76$ $206.9 \rightarrow 161.1$ $5$ $161 \rightarrow 105.1$ $10$ Cyprodinil $23.78$ $225.2 \rightarrow 224.3$ $10$ $224.2 \rightarrow 208.2$ $20$ Isofenphos oxon $24.1$ $229 \rightarrow 200.9$ $10$ $229 \rightarrow 121$ $25$ Pendimethalin $24.15$ $251.8 \rightarrow 162.2$ $10$ $251.8 \rightarrow 161.1$ $15$  | Trichloronat            | 22.71                | 296.8→268.9 | 10     | 298.8→270.9 | 10     |
| Pirimiphos-ethyl $23.1$ $318.1 \rightarrow 166.1$ $10$ $318.1 \rightarrow 182$ $10$ Phosphamidon $23.13$ $127 \rightarrow 95$ $15$ $127 \rightarrow 109$ $10$ Malathion $23.3$ $172.9 \rightarrow 99$ $15$ $157.8 \rightarrow 125$ $5$ Fenitrothion $23.5$ $277 \rightarrow 260$ $5$ $277.1 \rightarrow 109$ $15$ Methoprene $23.6$ $153 \rightarrow 111.1$ $5$ $111.1 \rightarrow 55$ $15$ Ethofumesate $23.76$ $206.9 \rightarrow 161.1$ $5$ $161 \rightarrow 105.1$ $10$ Cyprodinil $23.78$ $225.2 \rightarrow 224.3$ $10$ $224.2 \rightarrow 208.2$ $20$ Isofenphos oxon $24.1$ $229 \rightarrow 200.9$ $10$ $229 \rightarrow 121$ $25$ Pendimethalin $24.15$ $251.8 \rightarrow 162.2$ $10$ $251.8 \rightarrow 161.1$ $15$   | Dipropetryn             | 22.79                | 255.1→222.1 | 10     | 255.1→180.1 | 20     |
| Phosphamidon $23.13$ $127 \rightarrow 95$ $15$ $127 \rightarrow 109$ $10$ Malathion $23.3$ $172.9 \rightarrow 99$ $15$ $157.8 \rightarrow 125$ $5$ Fenitrothion $23.5$ $277 \rightarrow 260$ $5$ $277.1 \rightarrow 109$ $15$ Methoprene $23.6$ $153 \rightarrow 111.1$ $5$ $111.1 \rightarrow 55$ $15$ Ethofumesate $23.76$ $206.9 \rightarrow 161.1$ $5$ $161 \rightarrow 105.1$ $10$ Cyprodinil $23.78$ $225.2 \rightarrow 224.3$ $10$ $224.2 \rightarrow 208.2$ $20$ Isofenphos oxon $24.1$ $229 \rightarrow 200.9$ $10$ $229 \rightarrow 121$ $25$ Pendimethalin $24.15$ $251.8 \rightarrow 162.2$ $10$ $251.8 \rightarrow 161.1$ $15$   | BHC-delta               | 22.99                | 217→181.1   | 5      | 181→145     | 15     |
| Malathion $23.3$ $172.9 \rightarrow 99$ $15$ $157.8 \rightarrow 125$ $5$ Fenitrothion $23.5$ $277 \rightarrow 260$ $5$ $277.1 \rightarrow 109$ $15$ Methoprene $23.6$ $153 \rightarrow 111.1$ $5$ $111.1 \rightarrow 55$ $15$ Ethofumesate $23.76$ $206.9 \rightarrow 161.1$ $5$ $161 \rightarrow 105.1$ $10$ Cyprodinil $23.78$ $225.2 \rightarrow 224.3$ $10$ $224.2 \rightarrow 208.2$ $20$ Isofenphos oxon $24.1$ $229 \rightarrow 200.9$ $10$ $229 \rightarrow 121$ $25$ Pendimethalin $24.15$ $251.8 \rightarrow 162.2$ $10$ $251.8 \rightarrow 161.1$ $15$   | Pirimiphos-ethyl        | 23.1                 | 318.1→166.1 | 10     | 318.1→182   | 10     |
| Fenitrothion $23.5$ $277 \rightarrow 260$ $5$ $277.1 \rightarrow 109$ $15$ Methoprene $23.6$ $153 \rightarrow 111.1$ $5$ $111.1 \rightarrow 55$ $15$ Ethofumesate $23.76$ $206.9 \rightarrow 161.1$ $5$ $161 \rightarrow 105.1$ $10$ Cyprodinil $23.78$ $225.2 \rightarrow 224.3$ $10$ $224.2 \rightarrow 208.2$ $20$ Isofenphos oxon $24.1$ $229 \rightarrow 200.9$ $10$ $229 \rightarrow 121$ $25$ Pendimethalin $24.15$ $251.8 \rightarrow 162.2$ $10$ $251.8 \rightarrow 161.1$ $15$  | Phosphamidon            | 23.13                | 127→95      | 15     | 127→109     | 10     |
| Methoprene23.6 $153 \rightarrow 111.1$ 5 $111.1 \rightarrow 55$ 15Ethofumesate23.76 $206.9 \rightarrow 161.1$ 5 $161 \rightarrow 105.1$ 10Cyprodinil23.78 $225.2 \rightarrow 224.3$ 10 $224.2 \rightarrow 208.2$ 20Isofenphos oxon24.1 $229 \rightarrow 200.9$ 10 $229 \rightarrow 121$ 25Pendimethalin24.15 $251.8 \rightarrow 162.2$ 10 $251.8 \rightarrow 161.1$ 15  | Malathion               | 23.3                 | 172.9→99    | 15     | 157.8→125   | 5      |
| the state $23.76$ $206.9 \rightarrow 161.1$ $5$ $161 \rightarrow 105.1$ $10$ Cyprodinil $23.78$ $225.2 \rightarrow 224.3$ $10$ $224.2 \rightarrow 208.2$ $20$ Isofenphos oxon $24.1$ $229 \rightarrow 200.9$ $10$ $229 \rightarrow 121$ $25$ Pendimethalin $24.15$ $251.8 \rightarrow 162.2$ $10$ $251.8 \rightarrow 161.1$ $15$  | Fenitrothion            | 23.5                 | 277→260     | 5      | 277.1→109   | 15     |
| Cyprodinil $23.78$ $225.2 \rightarrow 224.3$ 10 $224.2 \rightarrow 208.2$ 20Isofenphos oxon $24.1$ $229 \rightarrow 200.9$ 10 $229 \rightarrow 121$ 25Pendimethalin $24.15$ $251.8 \rightarrow 162.2$ 10 $251.8 \rightarrow 161.1$ 15   | Methoprene              | 23.6                 | 153→111.1   | 5      | 111.1→55    | 15     |
| Isofenphos oxon $24.1$ $229 \rightarrow 200.9$ 10 $229 \rightarrow 121$ 25Pendimethalin $24.15$ $251.8 \rightarrow 162.2$ 10 $251.8 \rightarrow 161.1$ 15   | Ethofumesate            | 23.76                | 206.9→161.1 | 5      | 161→105.1   | 10     |
| Pendimethalin 24.15 251.8→162.2 10 251.8→161.1 15   | Cyprodinil              | 23.78                | 225.2→224.3 | 10     | 224.2→208.2 | 20     |
|   | Isofenphos oxon         | 24.1                 | 229→200.9   | 10     | 229→121     | 25     |
| DDE-o,p' 24.43 246→176.2 30 248→176.2 30  | Pendimethalin           | 24.15                | 251.8→162.2 | 10     | 251.8→161.1 | 15     |
|   | DDE-o,p'                | 24.43                | 246→176.2   | 30     | 248→176.2   | 30     |

| Pesticides         | t <sub>R</sub> (min) | MRM1        | CE1(V) | MRM2        | CE2(V) |
|--------------------|----------------------|-------------|--------|-------------|--------|
| Bromophos-ethyl    | 24.66                | 358.7→302.8 | 15     | 302.8→284.7 | 15     |
| Propanil (DCPA)    | 24.7                 | 161→99      | 30     | 161→90      | 25     |
| isocarbophos       | 24.85                | 135.9→108   | 15     | 135.9→69    | 30     |
| Chlorfenvinphos    | 24.88                | 266.9→159.1 | 15     | 322.8→266.8 | 10     |
| Chlordane-trans    | 24.97                | 372.8→265.8 | 15     | 271.7→236.9 | 15     |
| Tetraconazole      | 25.39                | 336→217.9   | 20     | 170.9→136   | 10     |
| Butachlor          | 25.53                | 236.9→160.2 | 5      | 176.1→147.1 | 10     |
| Prothiofos         | 25.78                | 266.9→239   | 5      | 266.9→221   | 20     |
| Tetrachlorvinphose | 26.1                 | 328.9→109   | 22     | 330.9→109   | 22     |
| Dieldrin           | 26.17                | 277→241     | 5      | 262.9→193   | 35     |
| Beflubutamid       | 26.27                | 221→193.1   | 5      | 176.1→91.1  | 10     |
| Methidathion       | 26.4                 | 144.9→85    | 5      | 144.9→58.1  | 15     |
| Procymidone        | 26.50                | 96→67.1     | 10     | 96→53.1     | 15     |
| profenofos         | 26.57                | 207.9→63    | 30     | 338.8→268.7 | 15     |
| napropamide        | 26.77                | 128→72.1    | 5      | 128→100.1   | 10     |
| Butamifos          | 26.89                | 285.9→202   | 15     | 200→92      | 10     |
| Hexaconazole       | 26.96                | 231→175     | 10     | 256→82.1    | 10     |
| Chlorfenson        | 27.22                | 175→111     | 10     | 111→75      | 15     |
| Paclobutrazol      | 27.35                | 236→125.1   | 10     | 125.1→89    | 20     |
| Fluazifop-butyl    | 27.44                | 281.9→238   | 20     | 281.9→91    | 20     |
| lsoprothiolane     | 27.52                | 162.1→85    | 20     | 162.1→134   | 5      |
| Phosfolan          | 27.69                | 196→140     | 10     | 168→140     | 5      |
| methoprotryne      | 27.83                | 256→212.1   | 15     | 256→170.1   | 25     |
| Chlorobenzilate    | 27.97                | 251.1→139.1 | 15     | 139.1→111   | 10     |
| Nitrofen           | 28.17                | 202→139.1   | 20     | 282.9→253   | 10     |
| Disulfoton sulfone | 28.33                | 213→153     | 5      | 213→96.9    | 15     |
| Ethion             | 28.45                | 230.9→129   | 20     | 230.9→175   | 10     |
| Fluorodifen        | 28.68                | 190→126.1   | 10     | 190→75      | 20     |
| Diniconazole       | 28.87                | 267.9→232.1 | 10     | 269.9→232.1 | 10     |
| fipronil           | 28.97                | 366.8→212.8 | 25     | 368.8→214.8 | 25     |
| Myclobutanil       | 28.98                | 179→125.1   | 10     | 179→90      | 30     |
| Cyproconazole      | 29.01                | 139→111     | 15     | 139→75      | 30     |
| DDT-p,p'           | 29.02                | 235→165.2   | 20     | 237→165.2   | 20     |
| Benalaxyl          | 29.05                | 148→77      | 35     | 148→105.1   | 20     |
| Methoxychlor- o,p' | 29.11                | 227.1→121.1 | 10     | 227.1→91.1  | 35     |
| Diclofop-methyl    | 29.51                | 339.9→252.9 | 10     | 253→162.1   | 15     |
| Propiconazole      | 29.53                | 172.9→74    | 45     | 258.8→69    | 10     |
| Fenthion sulfone   | 30.07                | 309.9→105   | 10     | 135.9→92    | 10     |
| Fludioxonil        | 30.28                | 248→154.1   | 20     | 248→182.1   | 10     |
| Oxadixyl           | 30.35                | 163→132.1   | 5      | 163→117.1   | 25     |
| Etoxazole          | 30.45                | 141→63.1    | 30     | 141→113     | 15     |
| Famphur            | 30.57                | 218→109     | 15     | 217→92.9    | 10     |
| Fenpropathrin      | 30.69                | 264.9→210   | 10     | 207.9→181   | 5      |
| Leptophos          | 30.96                | 171→77.1    | 15     | 154.9→77.1  | 15     |
| Pyridaphenthion    | 31.03                | 340→199     | 5      | 204→203.1   | 5      |
| -                  |                      |             |        |             |        |

| Pesticides                    | t <sub>R</sub> (min) | MRM1        | CE1(V) | MRM2        | CE2(V) |
|-------------------------------|----------------------|-------------|--------|-------------|--------|
| Phosmet                       | 31.33                | 160→77.1    | 20     | 160→133.1   | 10     |
| Bifenox                       | 31.49                | 340.9→309.9 | 10     | 189.1→126   | 20     |
| Acrinathrin                   | 31.88                | 207.8→181.1 | 10     | 181→127     | 30     |
| Cyhalothrin ( <i>lambda</i> ) | 31.88                | 208→181     | 5      | 181.1→152   | 25     |
| Phosalone                     | 31.89                | 182→111     | 15     | 182→102.1   | 15     |
| Mefenacet                     | 32.05                | 192→136.1   | 15     | 192→109.1   | 30     |
| Azinphos-ethyl                | 32.56                | 132→77.1    | 15     | 160→77.1    | 20     |
| Fluquinconazole               | 32.98                | 340→298     | 15     | 108→57      | 15     |
| Coumaphos                     | 33.75                | 361.9→109   | 15     | 210→182     | 10     |
| Cyfluthrin                    | 33.88                | 162.9→127   | 5      | 198.9→170.1 | 25     |
| Flucythrinate                 | 34.31                | 156.9→107.1 | 15     | 198.9→157   | 10     |
| Fenbuconazole                 | 34.78                | 197.9→129   | 5      | 128.9→102.1 | 15     |
| Fluvalinate- <i>tau</i>       | 35.83                | 250→55      | 40     | 250→200     | 40     |
| Difenoconazole                | 36.42                | 322.8→264.8 | 15     | 264.9→202   | 20     |
|                               |                      |             |        |             |        |

# **For More Information**

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