APPLICATION NOTE 65606

Trace level quantitation of pesticide residues in high water content vegetables using LC-(HESI)-MS/MS

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Keywords: QuEChERS, LC-MS/MS, pesticide residues, cucumber, tomato, TraceFinder, TSQ Quantis

Goal

A simple and sensitive method for trace level quantification of pesticides in high water content vegetables by using LC-MS/MS. The optimized method was validated as per SANTE guidelines and evaluated for the Food Safety Standards Authority of India (FSSAI) as well as European Commission (EC) maximum residue levels (MRLs) compliance in tomato and cucumber.

Introduction

Tomatoes and cucumbers are used in many dishes including salads. To ensure the quality of the products, agrochemicals are used to kill pests, including insects, rodents, fungi, and unwanted plants or weeds[1]. These pesticides must be used safely and disposed of properly due to their toxic effects on humans.

The EC and FSSAI set the MRLs for these chemicals, and their metabolites in tomato and cucumber[2, 3]. The QuEChERS (quick, easy, cheap, effective, rugged, and safe) method is well known for its applicability in simultaneous analysis of many pesticides in a variety of fruits and vegetable samples[4].

The QuEChERS method has already received worldwide acceptance because of its simplicity and high throughput, enabling a laboratory to process more samples in a given time as compared to the earlier methods. Along with sample preparation, the instrument method plays an important role to deliver accurate and precise results within the stipulated timeframe and to meet the regulatory requirement.

The aim of this work was the optimization and method validation of a multi-residue method for pesticides in tomato and cucumber by using LC-MS/MS with the Thermo Scientific™ TSQ Quantis™ Triple Quadrupole Mass Spectrometer. The data acquisition and processing was carried out by using Thermo Scientific™ TraceFinder™ software. The optimized method was validated according to the SANTE/11813/2017 guidelines[5]. This method was applied to the real samples to demonstrate the workflow meets the SANTE guideline requirements in terms of identification and quantitation of positives.

Experimental

Chemicals and apparatus

- Acetonitrile, Fisher Scientific™ Optima™ LC-MS grade
- Methanol, Fisher Scientific™ Optima™ LC-MS grade
- Water, Fisher Scientific™ Optima™ LC-MS grade
- Formic acid (85%), Fisher Scientific™
- Acetic acid (100%), Fisher Scientific™
- Ammonium formate, Fisher Scientific™ LC-MS grade
- Magnesium sulfate anhydrous, Thermo Scientific™
- Sodium acetate, Fisher Scientific™
- Reference standards (Restek, Bellefonte, PA)
- Analytical balance (Aczet, CY2202, San Diego, CA) and precision balance (Aczet, CY205C, San Diego, CA)
- Vortex mixer, Thermo Scientific™ (P/N 88880017TS, also known as 88880017)
- Refrigerated centrifuge (Thermo Scientific™ Sorvall™ ST8 ventilated benchtop centrifuge)
- Variable volume micropipettes (Thermo Scientific)

LC-MS/MS analysis

A Thermo Scientific™ Vanquish™ Flex Binary UHPLC system was coupled with a TSQ Quantis triple quadrupole mass spectrometer configured with advanced electron ionization (EI). The optimized LC-MS/MS conditions are given in Table 1. The UHPLC gradient program used was from previously reported application note[7].

Table 1. LC-MS/MS instrument conditions

a) Liquid chromatography method				
Instrumentation	Vanquish Flex Binary UHPLC			
Column	Thermo Scientific™ Accucore™ aQ column, 100 x 2.1 mm, 2.6 µm			
Sample compartment temp.	10 °C			
Column compartment temp.	25 °C			
Mobile phase	A: 5 mM ammonium formate + 0.1% formic acid in water: methanol (98:2) B: 5 mM ammonium formate + 0.1% formic acid in methanol: water (98:2)			
Total run time	15.0 min			
LC gradient program	**Time (min)**	**Flow rate (mL/min)**	**% B**	**Curve**
	0.000	0.300	0	5
	0.500	0.300	0	5
	7.000	0.300	70	5
	9.000	0.300	100	5
	12.000	0.300	100	5
	12.100	0.300	0	5
	15.000	0.300	0	5
b) Mass spectrometry method				
Instrumentation	TSQ Quantis triple quadrupole mass spectrometer			
Method type	Acquisition-timed (SRM mode)			
Ion source type	HESI			
Spray voltage	Static Positive: 3700 V Negative: 2500 V			
Sheath gas	30 Arb			
Aux gas	6 Arb			
Sweep gas	1 Arb			
Ion transfer tube temp.	325 °C			
Vaporizer temp.	350 °C			

Sample preparation

The tomato and cucumber matrix collected from a local marked was homogenized by using a mixer and grinder to get small and uniform particle size. The QuEChERS method was used for extraction as below[4].

Sample extraction and clean-up

- Homogenized sample (15 g) was weighed into a 50 mL extraction tube.
- For the recovery experiment, the samples were spiked before the addition of an extraction solvent.
- Acetonitrile (containing 1% acetic acid) (15 mL) was added to the tube.
- The tube was shaken vigorously for 1 minute on a vortex mixer at 2500 rpm.
- QuEChERS salts (6 g $MgSO_4$ and 1.5 g sodium acetate) were added to the tube and it was again mixed vigorously for 1 minute on a vortex mixer at 2500 rpm.
- The tube was centrifuged at 5000 rpm for 5 min at room temperature.
- The supernatant (1 mL) was transferred into an Eppendorf tube and 50 mg primary secondary amine (PSA) with 150 mg $MgSO_4$ were added.
- The samples were shaken vigorously and vortexed for 1 min on a vortex mixer at 2500 rpm.
- The samples were centrifuged at 7500 rpm for 5 min.
- The supernatant (0.250 mL) was diluted with 0.75 mL water (1:4 ratio, v/v).
- The diluted extract was transferred into an LC vial for instrumental analysis.
- The unspiked samples were verified for positive detection of target analytes. After assurance of pesticide-free matrix, the same was utilized for recovery experiment as well as matrix-matched calibration standards preparation.

Data acquisition and processing

The data acquisition and processing were carried out by using Thermo Scientific™ TraceFinder™ software, version 4.1. The data were acquired in t-SRM mode, which includes two or more transitions per analyte. The target list of analytes is given in Table 2 with their transition, collision energies, and retention time (min). For data processing, the ion ratio (±30%), retention time (±0.1 min), linearity (>0.99 with residuals ±20), recovery (70–120%) and precision (±20%) were set as criteria with user filters as per SANTE guidelines[6].

Table 2. Preparation of matrix-matched standard

Matrix (µL)	Std stock (µg/mL)	Std volume (µL)	Water (µL)	Final concentration (ng/mL)
250	0.1	5	745	0.5
250	0.1	10	740	1.0
250	0.1	25	725	2.5
250	0.1	50	700	5.0
250	0.1	100	650	10.0
250	1.0	25	725	25.0
250	1.0	50	700	50.0
250	1.0	100	650	100.0

Results and discussion

LC-MS/MS analysis

The liquid chromatographic method was selected from the previously published application note, which offered excellent separation and peak shape for the target analytes and absence of an isobaric interference from matrix[7]. The extracted ion chromatogram (XIC) is shown in Figure 1 for 194 compounds. As per the gradient program, the distribution of analytes was predominantly observed in 4–12 min. For good peak shape, the number of data points per peak depended on the dwell time required to monitor the transition. In this method, automatic optimized dwell time was in the range of 0.3–50 ms per transition (Figure 2). This optimized dwell time offered >12 points (scans) per peak.

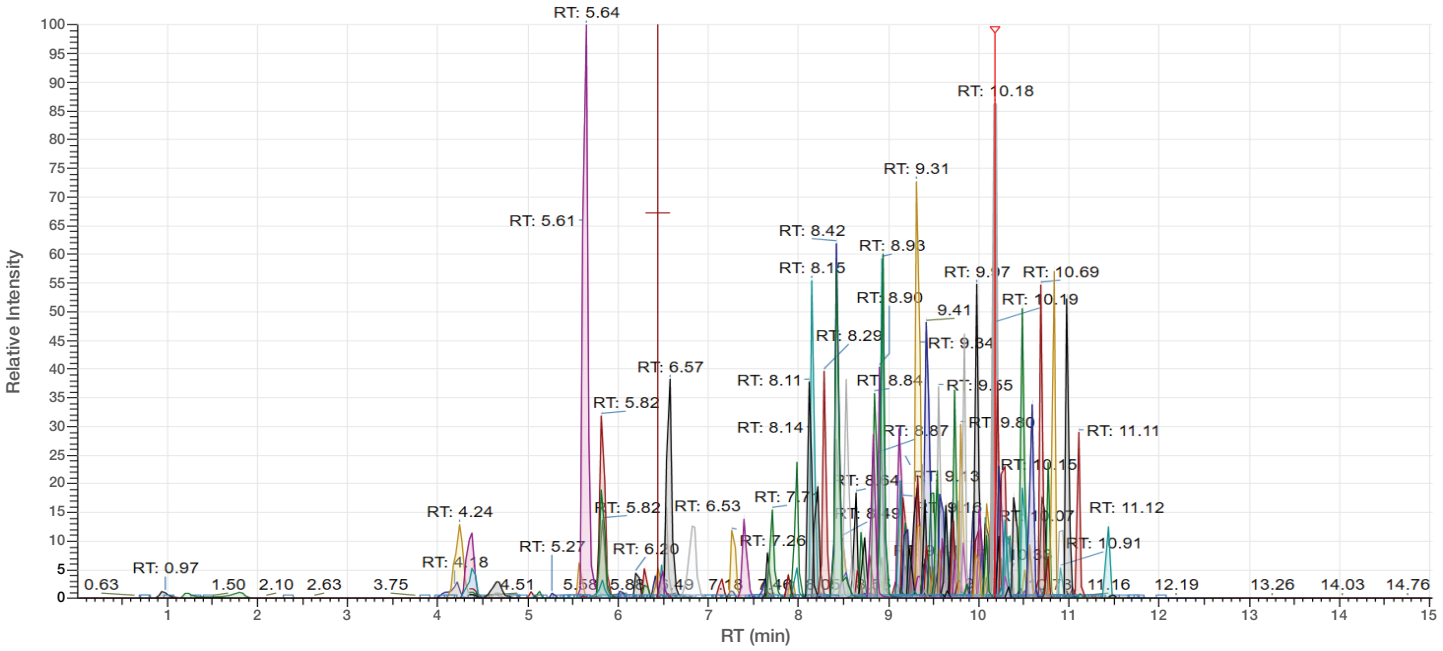

Figure 1. Total ion chromatograms with overlay extraction ions (184 compounds) in a single window

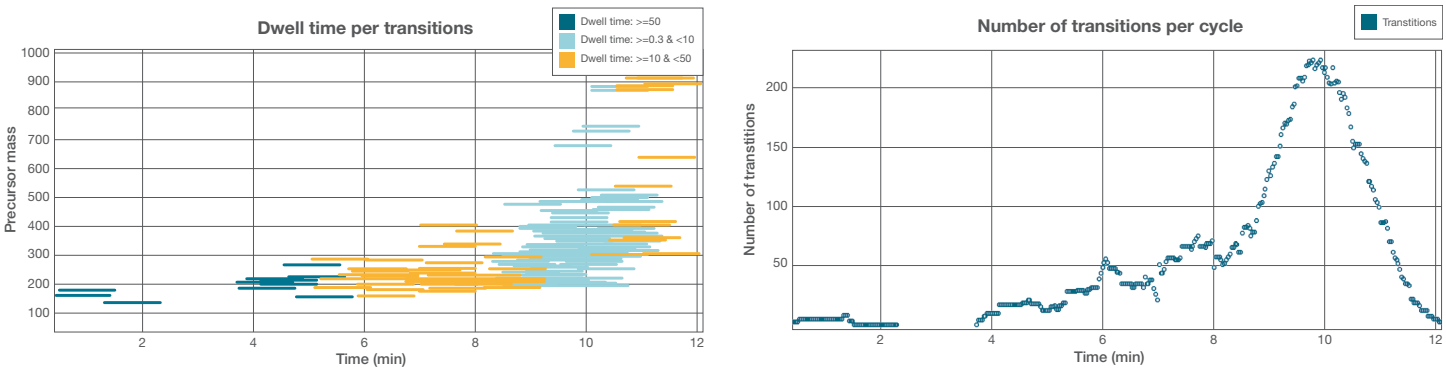

Figure 2. Representation of SRM transitions with auto-optimized dwell time

Etoxazole with qualifier and quantifier ion has more than 12 points per peak shown in Figure 3. The optimized instrument conditions provided excellent selectivity, repeatability, and reproducibility.

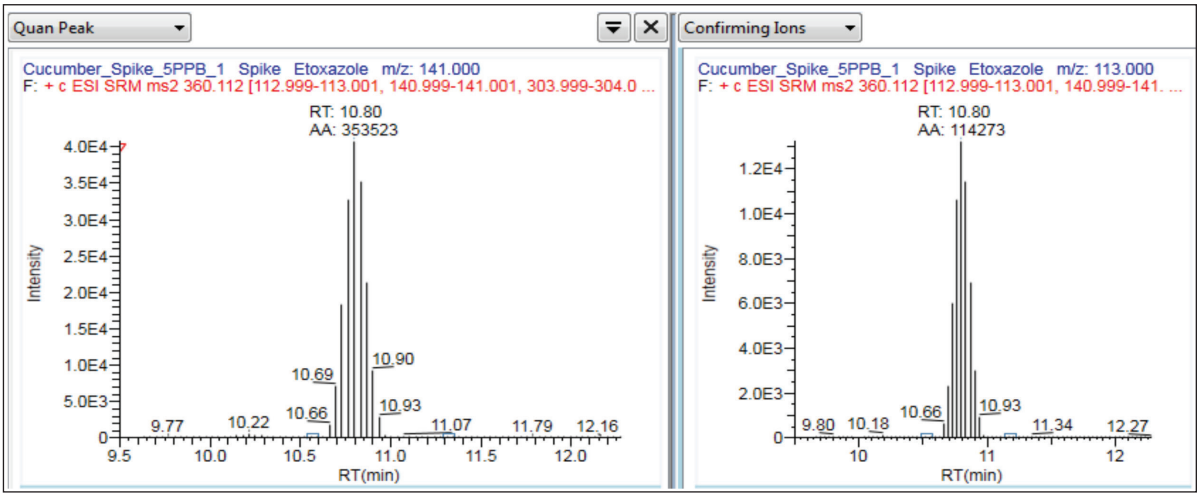

Figure 3. Impact of optimized dwell time on the data points per peak

Identification and quantitation

Based on the user-defined criteria, the raw data was processed automatically with flagging to show when parameters were out of tolerance. Colored-coded flags indicate whether the results pass or fail as per the acceptance criteria given in the processing method (master method). The green flag indicates the results passed as per pre-defined criteria (SANTE guidelines) (Figure 4), which minimizes the time required for review. Where there is a red flag, the user is directed to the data that needs to be reviewed further. For the demonstration of identification and confirmation criteria, acetamiprid is shown here with two transitions (223.0→126.0 and 223.0→99.0) at the same retention time (6.78 min) and ion ratio 10.56% (7.39–13.73%) in comparison with a neat standard. The linearity for acetamiprid provided correlation coefficient >0.999 with <20% residuals.

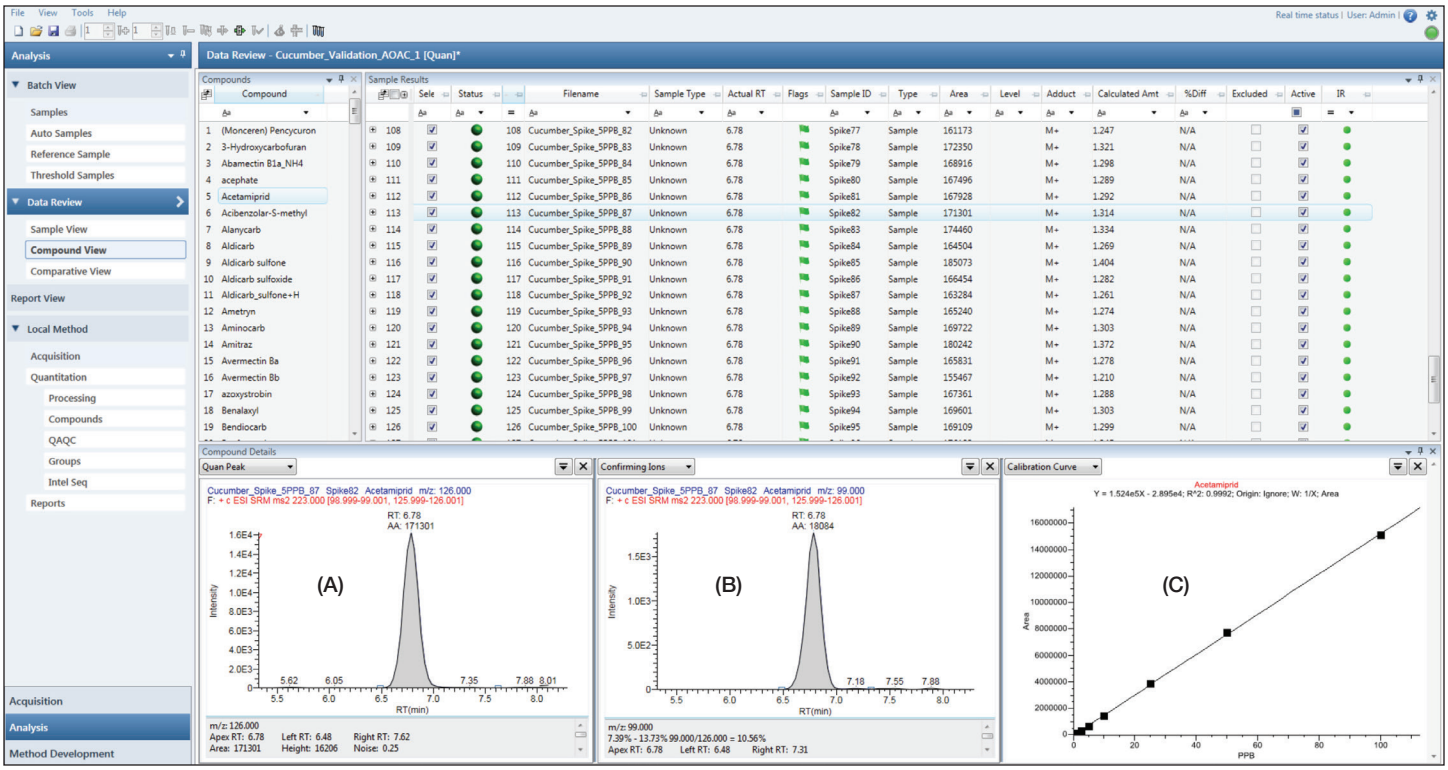

Figure 4. (A) Extracted ion chromatogram for quantifier ion of acetamiprid, (B) Identification based on confirmatory ion with ion ratio, and (C) calibration curve

Method performance

In this method, the linearity was plotted in the range of 0.0005–0.100 mg/kg. This range offered an excellent correlation coefficient (>0.99) with <20% residuals for all the target analytes in both solvents as well as in both matrices. Based on the lower calibration level (0.0005 mg/kg), the data showed good sensitivity with ≥10:1 signal-to-noise ratio. As per extraction protocol, the sample gets diluted (4X), so the ion suppression was observed for very few analytes (<15%). The rest of the analytes have less than 20% ion suppression in both matrices. So the matrix-matched calibration was used in both matrices without an internal standard to harmonize the results. Hence, the limit of quantitation (LOQ) values observed in both matrices was 0.005 mg/kg (equivalent to 0.00125 mg/kg). The recovery experiment was carried out at 0.005 (LOQ) and 0.01 (LOQx2) mg/kg to demonstrate the method accuracy and precision (n=6). Average recoveries were observed in the range of 72–120% with <15% RSD (Figure 5, Table 3) which were within acceptance criteria (improvement 70–120% and precision <20%) of SANTE guidelines[5].

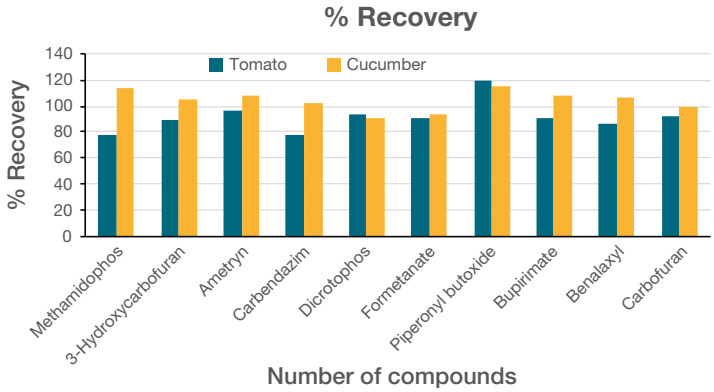

Figure 5. % Recoveries observed in tomato and cucumber spiked samples at 0.005 mg/kg

Also, the optimized method was tested for repeatability of results obtained in large batches for spiked tomato (n=62) and cucumber (n=100) samples with replicate injections by considering the commercial food testing lab schedule for 24 h. The repeatability was <15% for the area without internal standard correction and <±0.05 min retention time in both matrices. This reveals that the optimized method offered excellent repeatability in results. The area repeatability for a few compounds is shown in Figure 6.

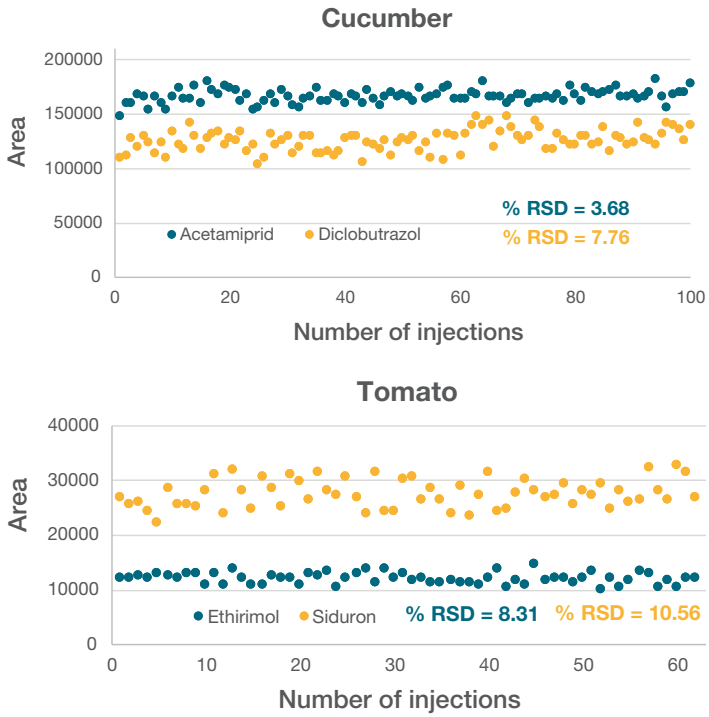

Figure 6. Area repeatability for ethirimol and siduron in tomato (n=62); acetamiprid and diclobutrazol in cucumber (n=100)

Table 2. List of pesticides with selected reaction monitoring (SRM) transitions used

Sr. No.	Compound	RT (min)	ESI	Precursor ion (*m/z*)	Product ion (*m/z*)	Collision energy (V)
1	3-Hydroxycarbofuran	6.48	Positive	238.1	163	19
2	3-Hydroxycarbofuran	6.48	Positive	238.1	181	15
3	Abamectin B1a	11.19	Positive	890.526	305.238	23.72
4	Abamectin B1a	11.19	Positive	890.526	307.238	19.21
5	Abamectin B1a	11.19	Positive	890.526	567.304	12.99
6	Acibenzolar S methyl	9.79	Positive	211	91.2	29
7	Acibenzolar S methyl	9.79	Positive	211	136.2	41
8	Acetamiprid	6.78	Positive	223	99	53
9	Acetamiprid	6.78	Positive	223	126	29
10	Aldicarb	7.5	Positive	208.1	89	23
11	Aldicarb	7.5	Positive	208.1	116	11
12	Aldicarb sulfone	5.82	Positive	223.112	86.06	16
13	Aldicarb sulfone	5.82	Positive	223.112	148.04	10
14	Aldicarb sulfone	5.82	Positive	223.112	166.03	9
15	Ametryn	8.87	Positive	228.1	96	35
16	Ametryn	8.87	Positive	228.1	186.1	25
17	Aminocarb	4.34	Positive	209.074	122	38.21
18	Aminocarb	4.34	Positive	209.074	136.929	23.69
19	Aminocarb	4.34	Positive	209.074	152.155	13.87
20	Amitraz	10.15	Positive	294.2	91.2	57
21	Amitraz	10.15	Positive	294.2	148.3	22
22	Avermectin Ba	11.05	Positive	890.5	305	35
23	Avermectin Ba	11.05	Positive	890.5	567.5	17
24	Azoxystrobin	9.28	Positive	404.07	329	30.74

Sr. No.	Compound	RT (min)	ESI	Precursor ion (*m/z*)	Product ion (*m/z*)	Collision energy (V)
25	Azoxystrobin	9.28	Positive	404.07	344.054	24.97
26	Azoxystrobin	9.28	Positive	404.07	371.982	14.21
27	Benalaxyl	10.15	Positive	326.2	148.1	29
28	Benalaxyl	10.15	Positive	326.2	294.1	15
29	Bendiocarb	5.78	Positive	224.025	81.071	31.84
30	Bendiocarb	5.78	Positive	224.025	108.917	17.7
31	Bendiocarb	5.78	Positive	224.025	167.071	10.23
32	Benzoximate	10.27	Positive	364.05	77.071	50.79
33	Benzoximate	10.27	Positive	364.05	104.988	24.44
34	Benzoximate	10.27	Positive	364.05	198.988	10.23
35	Bitertanol	9.91	Positive	338.2	70	29
36	Bitertanol	9.91	Positive	338.2	269.2	13
37	Boscalid	9.44	Positive	343.04	270.911	35.02
38	Boscalid	9.44	Positive	343.04	271.982	30.24
39	Boscalid	9.44	Positive	343.04	306.988	20.61
40	Bromuconazole	9.72	Positive	377.785	158.988	29.52
41	Bromuconazole	9.72	Positive	377.785	160.988	30.89
42	Bromuconazole	9.72	Positive	377.785	172.887	30.02
43	Bupirimate	9.78	Positive	317.122	166.125	24.33
44	Bupirimate	9.78	Positive	317.122	210.155	24.14
45	Bupirimate	9.78	Positive	317.122	272.125	19.59
46	Buprofezin	10.64	Positive	306.098	57.071	22.81
47	Buprofezin	10.64	Positive	306.098	106	27.06
48	Buprofezin	10.64	Positive	306.098	116	16.14
49	Buprofezin	10.64	Positive	306.098	201.054	12.05
50	Butafenacil	9.66	Positive	492.075	330.97	24.1
51	Butafenacil	9.66	Positive	492.075	348.97	14.78
52	Butafenacil	9.66	Positive	492.075	417.042	12.77
53	Butafenacil	9.66	Positive	492.075	475.071	10.23
54	Butocarboxim	7.23	Positive	213.1	75.1	19
55	Butocarboxim	7.23	Positive	213.1	116	17
56	Butoxycarboxim	5.82	Positive	223.024	46.083	25.88
57	Butoxycarboxim	5.82	Positive	223.024	121	26.95
58	Butoxycarboxim	5.82	Positive	223.024	166.125	15.31
59	Carbaryl	8.36	Positive	202.04	117.071	23.95
60	Carbaryl	8.36	Positive	202.04	127	28.88
61	Carbaryl	8.36	Positive	202.04	145.071	10.23
62	Carbendazim	5.61	Positive	192.05	90	41.16
63	Carbendazim	5.61	Positive	192.05	105	37.07
64	Carbendazim	5.61	Positive	192.05	117	32.33
65	Carbendazim	5.61	Positive	192.05	132	30.43
66	Carbendazim	5.61	Positive	192.05	160.071	18.19
67	Carbetamide	7.64	Positive	237.074	72.083	23.84
68	Carbetamide	7.64	Positive	237.074	120	16.18
69	Carbetamide	7.64	Positive	237.074	192	10.23
70	Carbofuran	9.01	Positive	222.048	77.071	42.64
71	Carbofuran	9.01	Positive	222.048	123	21.75

Sr. No.	Compound	RT (min)	ESI	Precursor ion (*m/z*)	Product ion (*m/z*)	Collision energy (V)
72	Carbofuran	9.01	Positive	222.048	165.054	12.09
73	Carboxin	8.33	Positive	236.1	87	33
74	Carboxin	8.33	Positive	236.1	143	21
75	Carfentrazone ethyl	10	Positive	411.962	345.988	23.31
76	Carfentrazone ethyl	10	Positive	411.962	365.917	17.85
77	Carfentrazone ethyl	10	Positive	411.962	383.988	14.44
78	Chlorantraniliprole	9.03	Positive	481.942	176.988	44.27
79	Chlorantraniliprole	9.03	Positive	481.942	283.887	12.09
80	Chlorantraniliprole	9.03	Positive	481.942	450.833	17.81
81	Chlorantraniliprole	9.03	Positive	484	285.9	17
82	Chlorantraniliprole	9.03	Positive	484	452.9	21
83	Chlorfluazuron	11.03	Positive	541.75	158.042	19.86
84	Chlorfluazuron	11.03	Positive	541.75	346.988	40.52
85	Chlorfluazuron	11.03	Positive	541.75	348.929	41.35
86	Chlorfluazuron	11.03	Positive	541.75	384.917	21.3
87	Chlorotoluron	8.74	Positive	212.987	46.012	16.1
88	Chlorotoluron	8.74	Positive	212.987	72.071	18.45
89	Chlorotoluron	8.74	Positive	212.987	168	18
90	Chloroxuron	9.78	Positive	291.012	46.012	19.4
91	Chloroxuron	9.78	Positive	291.012	72.071	20.5
92	Chloroxuron	9.78	Positive	291.012	218	26.11
93	Clethodim	10.51	Positive	360.14	164.07	18
94	Clethodim	10.51	Positive	360.14	166.09	24
95	Clethodim	10.51	Positive	360.14	268.14	12
96	Clofentezine	10.49	Positive	303	102	51
97	Clofentezine	10.49	Positive	303	138	19
98	Clothianidin	6.27	Positive	249.974	112.988	26.23
99	Clothianidin	6.27	Positive	249.974	131.917	16.56
100	Clothianidin	6.27	Positive	249.974	169.042	12.69
101	Cyazofamid	9.85	Positive	324.962	107.917	13.72
102	Cyazofamid	9.85	Positive	324.962	215.94	17.54
103	Cyazofamid	9.85	Positive	324.962	217.042	18.11
104	Cycluron	9.01	Positive	199.087	41.083	35.13
105	Cycluron	9.01	Positive	199.087	46.071	16.44
106	Cycluron	9.01	Positive	199.087	69.071	21.3
107	Cycluron	9.01	Positive	199.087	72.071	22.09
108	Cyproconazole I	9.56	Positive	292	70	31
109	Cyproconazole I	9.56	Positive	292	125	29
110	Cyproconazole II	9.56	Positive	292.001	70	31
111	Cyproconazole II	9.56	Positive	292.001	125	29
112	Cyprodinil	10.17	Positive	226	77	61
113	Cyprodinil	10.17	Positive	226	93	47
114	Cyromazine	0.89	Positive	167.024	85.071	18.57
115	Cyromazine	0.89	Positive	167.024	108	21.22
116	Cyromazine	0.89	Positive	167.024	125.071	17.51
117	Desmedipham	8.99	Positive	301.3	108.03	32.1
118	Desmedipham	8.99	Positive	301.3	136	20.08

Sr. No.	Compound	RT (min)	ESI	Precursor ion (*m/z*)	Product ion (*m/z*)	Collision energy (V)
119	Desmedipham	8.99	Positive	301.3	182	10.23
120	Diclobutrazol	9.89	Positive	328.012	70	21.94
121	Diclobutrazol	9.89	Positive	328.012	123	54.09
122	Diclobutrazol	9.89	Positive	328.012	158.988	37.94
123	Dicrotophos	6.03	Positive	237.975	108.917	32.37
124	Dicrotophos	6.03	Positive	237.975	126.988	17.77
125	Dicrotophos	6.03	Positive	237.975	192.542	10.23
126	Diethofencarb	9.19	Positive	268.012	124	31.95
127	Diethofencarb	9.19	Positive	268.012	152.071	23
128	Diethofencarb	9.19	Positive	268.012	180	18.04
129	Diethofencarb	9.19	Positive	268.012	226.083	10.23
130	Difenoconazole	10.45	Positive	406.012	187.988	44.5
131	Difenoconazole	10.45	Positive	406.012	250.97	25.54
132	Difenoconazole	10.45	Positive	406.012	337.042	17.58
133	Diflubenzuron	9.99	Positive	311.012	113.042	51.97
134	Diflubenzuron	9.99	Positive	311.012	141.06	32.1
135	Diflubenzuron	9.99	Positive	311.012	158	13.26
136	Dimethoate	6.47	Positive	229.822	124.917	21.71
137	Dimethoate	6.47	Positive	229.822	170.988	15.27
138	Dimethoate	6.47	Positive	229.822	198.815	10.23
139	Dimethomorph	9.54	Positive	388.068	165.071	31.5
140	Dimethomorph	9.54	Positive	388.068	273.071	30.51
141	Dimethomorph	9.54	Positive	388.068	301	20.8
142	Dimoxystrobin	10.01	Positive	327.15	115.911	21.98
143	Dimoxystrobin	10.01	Positive	327.15	204.929	10.23
144	Dimoxystrobin	10.01	Positive	327.15	238.101	10.64
145	Dimoxystrobin	10.01	Positive	327.15	280.054	10.23
146	Diniconazole	10.39	Positive	326.03	70	25.85
147	Diniconazole	10.39	Positive	326.03	159.06	31.15
148	Diniconazole	10.39	Positive	326.03	172.875	26.98
149	Dinotefuran	4.62	Positive	203.047	113.071	10.23
150	Dinotefuran	4.62	Positive	203.047	114.071	12.54
151	Dinotefuran	4.62	Positive	203.047	129.071	11.63
152	Dinotefuran	4.62	Positive	203.047	157.155	10.23
153	Dioxacarb	6.44	Positive	224.1	123	21
154	Dioxacarb	6.44	Positive	224.1	167	11
155	Diuron	8.5	Positive	232.975	46.012	16.79
156	Diuron	8.5	Positive	232.975	72.071	18.68
157	Diuron	8.5	Positive	232.975	132.887	40.94
158	Diuron	8.5	Positive	232.975	159.958	26.87
159	Doramectin	11.36	Positive	916.542	331.208	24.06
160	Doramectin	11.36	Positive	916.542	333.238	19.44
161	Doramectin	11.36	Positive	916.542	593.405	12.5
162	Emamectin Benzoate	10.71	Positive	886.531	126	38.47
163	Emamectin Benzoate	10.71	Positive	886.531	158.083	35.51
164	Emamectin Benzoate	10.71	Positive	886.531	302.208	28.99
165	Epoxiconazole	9.88	Positive	330.042	100.929	43.66

Sr. No.	Compound	RT (min)	ESI	Precursor ion (*m/z*)	Product ion (*m/z*)	Collision energy (V)
166	Epoxiconazole	9.88	Positive	330.042	121	21.11
167	Epoxiconazole	9.88	Positive	330.042	123	17.62
168	Eprinomectin	11.23	Positive	914.6	154.2	49
169	Eprinomectin	11.23	Positive	914.6	186.2	25
170	Etaconazol	9.88	Positive	328.012	55.054	21.37
171	Etaconazol	9.88	Positive	328.012	158.97	27.21
172	Etaconazol	9.88	Positive	328.012	204.631	17.43
173	Ethiofencarb	9.28	Positive	226.024	107	15.76
174	Ethiofencarb	9.28	Positive	226.024	121	18.98
175	Ethiofencarb	9.28	Positive	226.024	169.071	10.23
176	Ethiprole	9.3	Positive	396.925	212.958	49.88
177	Ethiprole	9.3	Positive	396.925	227.958	49.73
178	Ethiprole	9.3	Positive	396.925	254.988	35.82
179	Ethiprole	9.3	Positive	396.925	350.887	21.18
180	Ethirimol	7.23	Positive	209.824	98	27.29
181	Ethirimol	7.23	Positive	209.824	140.083	22.43
182	Ethirimol	7.23	Positive	209.824	182.054	20.92
183	Ethofumesate	9.26	Positive	287.062	121	16.41
184	Ethofumesate	9.26	Positive	287.062	161.054	20.01
185	Ethofumesate	9.26	Positive	287.062	241.071	10.23
186	Ethofumesate	9.26	Positive	287.062	259.071	10.23
187	Etoxazole	10.94	Positive	360.112	113	54.24
188	Etoxazole	10.94	Positive	360.112	141	30.78
189	Etoxazole	10.94	Positive	360.112	304	18.15
190	Etoxazole	10.94	Positive	360.112	317.083	17.13
191	Famoxadone	10.16	Positive	392	238	23
192	Famoxadone	10.16	Positive	392	331	13
193	Fenamidone	9.33	Positive	312.062	65	46.96
194	Fenamidone	9.33	Positive	312.062	92.042	25.01
195	Fenamidone	9.33	Positive	312.062	236.083	14.7
196	Fenamidone	9.33	Positive	312.062	264.083	10.23
197	Fenbuconazole	9.91	Positive	337.082	70.071	20.96
198	Fenbuconazole	9.91	Positive	337.082	90.97	33.09
199	Fenbuconazole	9.91	Positive	337.082	124.988	30.93
200	Fenhexamid	9.67	Positive	301.982	55.012	35.32
201	Fenhexamid	9.67	Positive	301.982	97	23.42
202	Fenhexamid	9.67	Positive	301.982	143	30.7
203	Fenobucarb	9.21	Positive	208.062	94.97	14.74
204	Fenobucarb	9.21	Positive	208.062	152.054	10.23
205	Fenoxycarb	9.98	Positive	301.99	88.042	18.91
206	Fenoxycarb	9.98	Positive	301.99	160.988	27.97
207	Fenpropimorph	9.26	Positive	304	117	65
208	Fenpropimorph	9.26	Positive	304	147	39
209	Fenpyroximate	11.12	Positive	422.162	214.083	29.94
210	Fenpyroximate	11.12	Positive	422.162	231.083	24.79
211	Fenpyroximate	11.12	Positive	422.162	366.155	15.76
212	Fenuron	6.4	Positive	164.825	46.083	14.59

Sr. No.	Compound	RT (min)	ESI	Precursor ion (*m/z*)	Product ion (*m/z*)	Collision energy (V)
213	Fenuron	6.4	Positive	164.825	72.071	15.35
214	Fenuron	6.4	Positive	164.825	92	22.66
215	Fenuron	6.4	Positive	164.825	120	17.39
216	Fipronil	9.89	Negative	435	250	35
217	Fipronil	9.89	Negative	435	330	20
218	Flonicamid	5.14	Positive	230.1	174	25
219	Flonicamid	5.14	Positive	230.1	203.1	23
220	Fluazinam	10.65	Negative	462.825	369.958	34.34
221	Fluazinam	10.65	Negative	462.825	386.958	15.99
222	Fluazinam	10.65	Negative	462.825	397.958	15.95
223	Fluazinam	10.65	Negative	462.825	415.887	19.25
224	Flufenacet	9.75	Positive	364.024	97	43.82
225	Flufenacet	9.75	Positive	364.024	124	31.84
226	Flufenacet	9.75	Positive	364.024	152.071	18.61
227	Flufenacet	9.75	Positive	364.024	194	10
228	Flufenoxuron	10.88	Positive	489.165	140.929	40.59
229	Flufenoxuron	10.88	Positive	489.165	158.083	17.81
230	Fluometuron	8.53	Positive	232.937	46.083	17.92
231	Fluometuron	8.53	Positive	232.937	72	18.87
232	Fluometuron	8.53	Positive	232.937	160.042	27.14
233	Fluometuron	8.53	Positive	232.937	187.917	20.73
234	Fluoxastrobin	9.72	Positive	459.062	187.988	34.68
235	Fluoxastrobin	9.72	Positive	459.062	367	23.69
236	Fluoxastrobin	9.72	Positive	459.062	426.97	17.43
237	Fluquinoconazole	9.75	Positive	375.9	108	50
238	Fluquinoconazole	9.75	Positive	375.9	307.1	26
239	Fluquinoconazole	9.75	Positive	375.9	349	19
240	Flusilazole	9.98	Positive	316.085	165.054	27.17
241	Flusilazole	9.98	Positive	316.085	219.071	30.7
242	Flusilazole	9.98	Positive	316.085	247.054	18.19
243	Flutolanil	9.47	Positive	324.1	242.1	35
244	Flutolanil	9.47	Positive	324.1	262.1	31
245	Flutriafol	8.71	Positive	302.034	70	18.8
246	Flutriafol	8.71	Positive	302.034	109	29.45
247	Flutriafol	8.71	Positive	302.034	123	27.97
248	Forchlorfenuron	9.01	Positive	248.037	93	32.52
249	Forchlorfenuron	9.01	Positive	248.037	128.97	17.54
250	Forchlorfenuron	9.01	Positive	248.037	154.97	15.12
251	Formetanate hydrochloride	4.39	Positive	222.074	92.97	35.4
252	Formetanate hydrochloride	4.39	Positive	222.074	120	26.83
253	Formetanate hydrochloride	4.39	Positive	222.074	165.125	15.31
254	Fuberidazole	6.54	Positive	185.05	65.071	42.94
255	Fuberidazole	6.54	Positive	185.05	129	35.4
256	Fuberidazole	6.54	Positive	185.05	157.054	21.71
257	Furalaxyl	9.26	Positive	302.1	95	39

Sr. No.	Compound	RT (min)	ESI	Precursor ion (*m/z*)	Product ion (*m/z*)	Collision energy (V)
258	Furalaxyl	9.26	Positive	302.1	242.1	21
259	Furathiocarb	10.6	Positive	383.074	162.071	33.5
260	Furathiocarb	10.6	Positive	383.074	167.143	24.33
261	Furathiocarb	10.6	Positive	383.074	194.929	18.49
262	Furathiocarb	10.6	Positive	383.074	252.054	12.73
263	Halofenozide pos	9.37	Positive	331.01	105	18.19
264	Halofenozide pos	9.37	Positive	331.01	275.071	10.23
265	Hexaconazole	10.22	Positive	313.975	70	20.99
266	Hexaconazole	10.22	Positive	313.975	158.958	31.72
267	Hexaconazole	10.22	Positive	313.975	184.887	22.7
268	Hexaflumuron	9.68	Negative	458.832	174.958	35.74
269	Hexaflumuron	9.68	Negative	458.832	275.917	19.14
270	Hexaflumuron	9.68	Negative	458.832	438.917	10.23
271	Hexythiazox	10.84	Positive	353.062	168.042	25.01
272	Hexythiazox	10.84	Positive	353.062	228	15.27
273	Hexythiazox	10.84	Positive	353.062	271.042	13.37
274	Hydramethylnon	10.4	Positive	495.2	151.1	65
275	Hydramethylnon	10.4	Positive	495.2	323.2	41
276	Imazalil	8.67	Positive	296.998	158.988	23.23
277	Imazalil	8.67	Positive	296.998	176.042	20.43
278	Imazalil	8.67	Positive	296.998	200.917	18.15
279	Imazalil	8.67	Positive	296.998	254.97	17.92
280	Imidacloprid	6.27	Positive	255.975	128	20.12
281	Imidacloprid	6.27	Positive	255.975	175.071	18.91
282	Imidacloprid	6.27	Positive	255.975	209	16.44
283	Indoxacarb	10.37	Positive	528.005	149.97	23.61
284	Indoxacarb	10.37	Positive	528.005	203	38.32
285	Indoxacarb	10.37	Positive	528.005	292.917	14.17
286	Ipconazole	10.5	Positive	334.2	70	37
286	Ipconazole	10.5	Positive	334.2	70	37
287	Ipconazole	10.5	Positive	334.2	125	47
288	Iprovalicarb	9.67	Positive	321.175	91	45.33
289	Iprovalicarb	9.67	Positive	321.175	116.071	20.01
290	Iprovalicarb	9.67	Positive	321.175	119.071	19.36
291	Isocarbophos	8.81	Positive	307	121	33.58
292	Isocarbophos	8.81	Positive	307	198.845	29.11
293	Isocarbophos	8.81	Positive	307	230.988	15.65
294	Isocarbophos	8.81	Positive	307	273	10.23
295	Isoprocarb	8.66	Positive	194.062	77.071	34.38
296	Isoprocarb	8.66	Positive	194.062	94.97	15.12
297	Isoprocarb	8.66	Positive	194.062	137.054	10.23
298	Isoproturon	8.87	Positive	207.062	46.083	17.47
299	Isoproturon	8.87	Positive	207.062	72.071	18.53
300	Isoproturon	8.87	Positive	207.062	165.071	14.36
301	Ivermectin	11.6	Positive	892.542	307.238	23.08
302	Ivermectin	11.6	Positive	892.542	551.333	21.26
303	Ivermectin	11.6	Positive	892.542	569.304	13.72

Sr. No.	Compound	RT (min)	ESI	Precursor ion (*m/z*)	Product ion (*m/z*)	Collision energy (V)
304	Kresoxim methyl	10.02	Positive	314.078	206.054	10.23
305	Kresoxim methyl	10.02	Positive	314.078	222.083	13.11
306	Kresoxim methyl	10.02	Positive	314.078	267.125	10.23
307	Linuron	9.42	Positive	249.1	160	25
308	Linuron	9.42	Positive	249.1	182.1	21
309	Lufenuron	10.78	Positive	511.1	141.2	61
310	Lufenuron	10.78	Positive	511.1	158.1	27
311	Mandipropamid	9.44	Positive	412.05	124.97	36.01
312	Mandipropamid	9.44	Positive	412.05	328.054	14.93
313	Mandipropamid	9.44	Positive	412.05	356.083	10.23
314	Mefenacet	9.7	Positive	299	91	28.05
315	Mefenacet	9.7	Positive	299	120	24.75
316	Mefenacet	9.7	Positive	299	148.071	14.25
317	Mefenacet	9.7	Positive	299	191.917	10.23
318	Mepanipyrim	9.93	Positive	224	77	55
319	Mepanipyrim	9.93	Positive	224	106	35
320	Mepronil	9.53	Positive	270.1	91	39.84
321	Mepronil	9.53	Positive	270.1	118.929	23.65
322	Mepronil	9.53	Positive	270.1	228.083	15.04
323	Mesotrione	7.5	Positive	340.2	104.1	41
324	Mesotrione	7.5	Positive	340.2	228.2	22
325	Metaflumizone	10.64	Positive	507.1	178.1	33
326	Metaflumizone	10.64	Positive	507.1	287.1	33
327	Metconazole	10.25	Positive	320.1	70.143	23.99
328	Metconazole	10.25	Positive	320.1	124.97	38.24
329	Metconazole	10.25	Positive	320.1	177	22.7
330	Methabenzthiazuron	9.01	Positive	222.037	123.97	29.18
331	Methabenzthiazuron	9.01	Positive	222.037	150	33.05
332	Methabenzthiazuron	9.01	Positive	222.037	165.071	16.52
333	Methamidophos	1.81	Positive	141.924	93.988	14.13
334	Methamidophos	1.81	Positive	141.924	109.917	15.42
335	Methamidophos	1.81	Positive	141.924	124.988	14.13
336	Methiocarb	9.39	Positive	226.074	107	15.69
337	Methiocarb	9.39	Positive	226.074	121	19.02
338	Methiocarb	9.39	Positive	226.074	169.071	10.23
339	Methomyl	5.27	Positive	163.1	58	20.43
340	Methomyl	5.27	Positive	163.1	72.988	27.93
341	Methomyl	5.27	Positive	163.1	87.935	10.23
342	Methomyl	5.27	Positive	163.1	106.06	10.23
343	Methoprotryne	8.91	Positive	272.112	170	28.54
344	Methoprotryne	8.91	Positive	272.112	198	23.04
345	Methoprotryne	8.91	Positive	272.112	240.155	19.06
346	Methoxyfenozide	9.57	Positive	369.162	91	43.48
347	Methoxyfenozide	9.57	Positive	369.162	133.071	25.73
348	Methoxyfenozide	9.57	Positive	369.162	149.071	17.05
349	Methoxyfenozide	9.57	Positive	369.162	313.083	10.23
350	Metobromuron	8.77	Positive	258.912	148.042	15.46

Sr. No.	Compound	RT (min)	ESI	Precursor ion (*m/z*)	Product ion (*m/z*)	Collision energy (V)
351	Metobromuron	8.77	Positive	258.912	169.917	19.02
352	Metribuzin	7.88	Positive	215.1	84.1	31
353	Metribuzin	7.88	Positive	215.1	187.1	25
354	Mevinphos	7.09	Positive	224.988	108.917	31.72
355	Mevinphos	7.09	Positive	224.988	126.988	17.01
356	Mevinphos	7.09	Positive	224.988	192.917	10.23
357	Mexacarbate	5.83	Positive	223.074	136.071	37.49
358	Mexacarbate	5.83	Positive	223.074	151.083	23.99
359	Mexacarbate	5.83	Positive	223.074	166.083	15.12
360	Monocrotophos	5.72	Positive	223.974	98.071	12.58
361	Monocrotophos	5.72	Positive	223.974	126.97	16.44
362	Monocrotophos	5.72	Positive	223.974	192.917	10.23
363	Monolinuron	8.53	Positive	214.974	98.917	33.09
364	Monolinuron	8.53	Positive	214.974	125.988	17.89
365	Monolinuron	8.53	Positive	214.974	148.012	14.59
366	Moxidectin	11.46	Positive	640.384	496.22	10.23
367	Moxidectin	11.46	Positive	640.384	498.292	10.23
368	Myclobutanil	9.6	Positive	289	70	41
369	Myclobutanil	9.6	Positive	289	125	39
370	Neburon	10.04	Positive	274.962	41.083	34.11
371	Neburon	10.04	Positive	274.962	57	21.34
372	Neburon	10.04	Positive	274.962	88.125	16.41
373	Neburon	10.04	Positive	274.962	159.988	30.7
374	Nitenpyram	5.04	Positive	271	126	35
375	Nitenpyram	5.04	Positive	271	225.2	17
376	Novaluron	10.47	Positive	493	141.1	65
377	Novaluron	10.47	Positive	493	158.1	29
378	Nuarimol	9.29	Positive	315.062	243.042	24.56
379	Nuarimol	9.29	Positive	315.062	252.083	22.25
380	Omethoate	4.21	Positive	213.962	124.899	22.28
381	Omethoate	4.21	Positive	213.962	154.97	15.8
382	Omethoate	4.21	Positive	213.962	182.845	10.23
383	Oxadixyl	7.61	Positive	279.062	132.083	31.31
384	Oxadixyl	7.61	Positive	279.062	133.071	21.56
385	Oxadixyl	7.61	Positive	279.062	219.083	10.23
386	Oxamyl	7.64	Positive	237.025	56	43.06
387	Oxamyl	7.64	Positive	237.025	72.071	10.23
388	Oxamyl	7.64	Positive	237.025	90	10.23
389	Oxamyl	7.64	Positive	237.025	220.071	10.23
390	Paclobutrazol	9.5	Positive	294.014	70.071	20.92
391	Paclobutrazol	9.5	Positive	294.014	124.97	37.52
392	Paclobutrazol	9.5	Positive	294.014	165.042	22.85
393	Penconazole	10.15	Positive	284.05	70.071	18.07
394	Penconazole	10.15	Positive	284.05	158.97	30.05
395	Pencycuron	10.34	Positive	329.05	124.988	26.11
396	Pencycuron	10.34	Positive	329.05	210.054	16.79
397	Pencycuron	10.34	Positive	329.05	218.071	15.91

Sr. No.	Compound	RT (min)	ESI	Precursor ion (*m/z*)	Product ion (*m/z*)	Collision energy (V)
398	Pencycuron	10.34	Positive	329.05	261.071	17.7
399	Picoxystrobin	9.95	Positive	368.05	115	45.37
400	Picoxystrobin	9.95	Positive	368.05	117	37.07
401	Picoxystrobin	9.95	Positive	368.05	145.071	21.22
402	Picoxystrobin	9.95	Positive	368.05	205	10.23
403	Piperonyl butoxide	10.74	Positive	356.25	119	33.43
404	Piperonyl butoxide	10.74	Positive	356.25	149.071	31.53
405	Piperonyl butoxide	10.74	Positive	356.25	177.071	10.23
406	Pirimicarb	7.33	Positive	239.088	72	21.49
407	Pirimicarb	7.33	Positive	239.088	108.929	30.78
408	Pirimicarb	7.33	Positive	239.088	182.071	16.07
409	Prochloraz	10.29	Positive	375.952	70.071	25.77
410	Prochloraz	10.29	Positive	375.952	265.988	16.82
411	Prochloraz	10.29	Positive	375.952	307.917	10.23
412	Promecarb	9.49	Positive	208.062	109	16.33
413	Promecarb	9.49	Positive	208.062	151.083	10.23
414	Prometon	8.46	Positive	226.137	100	29.52
415	Prometon	8.46	Positive	226.137	142.071	23.16
416	Prometon	8.46	Positive	226.137	184	18.72
417	Prometryn	9.43	Positive	242.212	68	38.21
418	Prometryn	9.43	Positive	242.212	158	23.65
419	Prometryn	9.43	Positive	242.212	185.929	18.04
420	Prometryn	9.43	Positive	242.212	199.982	18.72
421	Prometryne	9.46	Positive	242.2	158.1	33
422	Prometryne	9.46	Positive	242.2	200.1	25
423	Propamocarb	4.25	Positive	189.062	58.071	27.97
424	Propamocarb	4.25	Positive	189.062	74.071	24.9
425	Propamocarb	4.25	Positive	189.062	102	17.32
426	Propamocarb	4.25	Positive	189.062	144.054	13.18
427	Propargite	10.91	Positive	368.2	175.1	23
428	Propargite	10.91	Positive	368.2	231.1	15
429	Propiconazole	10.22	Positive	342.13	122.929	55
430	Propiconazole	10.22	Positive	342.13	172.762	36.61
431	Propoxur	7.91	Positive	210.012	65.071	35.1
432	Propoxur	7.91	Positive	210.012	92.97	23.91
433	Propoxur	7.91	Positive	210.012	111	14.28
434	Propoxur	7.91	Positive	210.012	168.071	10.23
435	Pymetrozine	4.63	Positive	218.024	78.071	38.62
436	Pymetrozine	4.63	Positive	218.024	79.071	39.84
437	Pymetrozine	4.63	Positive	218.024	104.988	20.16
438	Pyracarbolid	8.15	Positive	218.1	97	37
439	Pyracarbolid	8.15	Positive	218.1	125	25
440	Pyraclostrobin	10.26	Positive	387.762	163.071	23.95
441	Pyraclostrobin	10.26	Positive	387.762	164.054	17.51
442	Pyraclostrobin	10.26	Positive	387.762	194	12.43
443	Pyridaben	11.22	Positive	365	147	33
444	Pyridaben	11.22	Positive	365	309	19

Sr. No.	Compound	RT (min)	ESI	Precursor ion (*m/z*)	Product ion (*m/z*)	Collision energy (V)
445	Pyrimethanil	9.38	Positive	200.074	82	27
446	Pyrimethanil	9.38	Positive	200.074	107	24.52
447	Pyrimethanil	9.38	Positive	200.074	168.071	30.28
448	Pyriproxyfen	10.84	Positive	322	96	21
449	Pyriproxyfen	10.84	Positive	322	185	31
450	Quinoxyfen	11.04	Positive	307.988	161.988	45.37
451	Quinoxyfen	11.04	Positive	307.988	196.917	32.48
452	Quinoxyfen	11.04	Positive	307.988	271.97	27.51
453	Rotenone	9.95	Positive	395.112	192.054	24.18
454	Rotenone	9.95	Positive	395.112	195	34.79
455	Rotenone	9.95	Positive	395.112	213.083	23
456	Secbumeton	8.53	Positive	226.2	100	37
457	Secbumeton	8.53	Positive	226.2	170.1	25
458	Siduron	9.35	Positive	233.3	94	31
459	Siduron	9.35	Positive	233.3	137.2	23
460	Simetryn	8.19	Positive	214.062	96	24.56
461	Simetryn	8.19	Positive	214.062	124.071	19.93
462	Simetryn	8.19	Positive	214.062	144.071	20.69
463	Spinetoram	10.47	Positive	748.5	98.1	65
464	Spinetoram	10.47	Positive	748.5	142.2	43
465	Spinosad (Spinosyn D)	10.47	Positive	746.8	98.3	65
466	Spinosad (Spinosyn D)	10.47	Positive	746.8	142.4	41
467	Spinosad A	10.27	Positive	732.432	98.083	44.95
468	Spinosad A	10.27	Positive	732.432	100.929	46.2
469	Spinosad A	10.27	Positive	732.432	142.083	28.88
470	Spirotetramat	9.71	Positive	374.112	216.083	33.69
471	Spirotetramat	9.71	Positive	374.112	302.083	16.82
472	Spirotetramat	9.71	Positive	374.112	330.155	15.42
473	Spiroxamine	9.46	Positive	298.224	72.083	38.4
474	Spiroxamine	9.46	Positive	298.224	100	30.4
475	Spiroxamine	9.46	Positive	298.224	144.155	20.08
476	Tebuconazole	10.11	Positive	307.974	70.071	22.62
477	Tebuconazole	10.11	Positive	307.974	124.988	37.71
478	Tebuconazole	10.11	Positive	307.974	151.042	25.35
479	Tebuthiuron	8.15	Positive	229.025	115.97	27.02
480	Tebuthiuron	8.15	Positive	229.025	172.071	17.89
481	Teflubenzuron	10.81	Negative	378.932	195.815	21.9
482	Teflubenzuron	10.81	Negative	378.932	338.917	10.23
483	Teflubenzuron	10.81	Negative	378.932	358.958	7
484	Temephos	10.71	Positive	467	405	21
485	Temephos	10.71	Positive	467	419.1	27
486	Terbumeton	8.5	Positive	226.174	142.071	23.08
487	Terbumeton	8.5	Positive	226.174	170.054	17.96
488	Terbumeton	8.5	Positive	226.174	184.071	18.72
489	Terbutryn	9.49	Positive	242.074	90.97	27.55
490	Terbutryn	9.49	Positive	242.074	158.071	23.72
491	Terbutryn	9.49	Positive	242.074	186	18.72
492	Tetraconazole	9.81	Positive	371.95	115.042	50.64

Sr. No.	Compound	RT (min)	ESI	Precursor ion (*m/z*)	Product ion (*m/z*)	Collision energy (V)
493	Tetraconazole	9.81	Positive	371.95	123	54.96
494	Tetraconazole	9.81	Positive	371.95	158.899	30.28
495	Thiabendazole	6.4	Positive	201.978	92	35.63
496	Thiabendazole	6.4	Positive	201.978	131	33.09
497	Thiabendazole	6.4	Positive	201.978	174.97	25.7
498	Thiacloprid	7.23	Positive	252.962	89.97	36.35
499	Thiacloprid	7.23	Positive	252.962	98.917	41.47
500	Thiacloprid	7.23	Positive	252.962	125.988	21.41
501	Thiacloprid	7.23	Positive	252.962	185.917	14.63
502	Thiamethoxam	5.56	Positive	291.95	131.917	22.32
503	Thiamethoxam	5.56	Positive	291.95	180.97	22.36
504	Thiamethoxam	5.56	Positive	291.95	211.071	12.12
505	Thidiazuron	8.12	Positive	220.612	93.97	14.32
506	Thidiazuron	8.12	Positive	220.612	101.917	15.95
507	Thidiazuron	8.12	Positive	220.612	127.917	16.82
508	Thiobencarb	10.38	Positive	258.012	89	48.97
509	Thiobencarb	10.38	Positive	258.012	98.988	47.72
510	Thiobencarb	10.38	Positive	258.012	124.97	19.55
511	Thiophanate methyl	7.93	Positive	342.962	92.97	46.43
512	Thiophanate methyl	7.93	Positive	342.962	151	19.82
513	Thiophanate methyl	7.93	Positive	342.962	267.97	10.23
514	Thiophanate methyl	7.93	Positive	342.962	310.917	10.23
515	Triadimefon	9.6	Positive	293.988	128.988	21.9
516	Triadimefon	9.6	Positive	293.988	140.97	22.43
517	Triadimefon	9.6	Positive	293.988	197	15.65
518	Triadimenol	9.5	Positive	296.1	70	33
519	Triadimenol	9.5	Positive	296.1	227.1	17
520	Trichlorfon	6.21	Positive	256.942	79	30.02
521	Trichlorfon	6.21	Positive	256.942	108.917	17.54
522	Trichlorfon	6.21	Positive	256.942	216.054	10.23
523	Tricyclazole	7.67	Positive	190.012	108.988	35.67
524	Tricyclazole	7.67	Positive	190.012	135.97	28.69
525	Tricyclazole	7.67	Positive	190.012	163.042	22.81
526	Trifloxystrobin	10.4	Positive	409.04	116	22.78
527	Trifloxystrobin	10.4	Positive	409.04	145	43.97
528	Trifloxystrobin	10.4	Positive	409.04	185.97	17.85
529	Triflumizole	10.57	Positive	346.012	43.083	23.19
530	Triflumizole	10.57	Positive	346.012	73.071	16.67
531	Triflumizole	10.57	Positive	346.012	278.113	10.23
532	Triflumuron	10.26	Positive	359.1	139	45
533	Triflumuron	10.26	Positive	359.1	156.2	23
534	Vamidothion	6.52	Positive	287.962	58	36.23
535	Vamidothion	6.52	Positive	287.962	86.071	22.51
536	Vamidothion	6.52	Positive	287.962	117.97	22.7
537	Vamidothion	6.52	Positive	287.962	146.071	12.16
538	Zoxamide	10.19	Positive	336.012	158.988	39.34
539	Zoxamide	10.19	Positive	336.012	186.887	22.17
540	Zoxamide	10.19	Positive	336.012	203.917	16.94

Table 3. Method validation data for cucumber (% recovery, and % RSD)

Sr. No.	Name of compound	0.005 mg/kg		0.01 mg/kg		0.025 mg/kg		Ion ratio range	Ion ratio (0.005 mg/kg)
		% RSD	% Rec	% RSD	% Rec	% RSD	% Rec		
1	3-Hydroxycarbofuran	7.9	106	3.2	99	1.4	100	39.74 - 73.80	60.16
2	Abamectin B1a	15.9	90	18.2	90	14.3	99	39.32 - 73.02	61.62
3	Acetamiprid	4.0	98	1.3	95	1.4	93	7.43 - 13.79	10.17
4	Acibenzolar-S-methyl	17.9	115	14.2	94	16.7	100	12.75 - 23.69	15.23
5	Aldicarb	10.8	95	16.5	84	5.3	85	0.42 - 0.78	0.59
6	Ametryn	3.1	108	2.6	101	3.4	102	9.80 - 18.21	14.03
7	Aminocarb	2.6	106	1.8	101	1.0	98	36.51 - 67.81	52.35
8	Amitraz	12.0	117	9.3	101	3.9	107	8.58 - 15.94	10.16
9	Avermectin Ba	12.6	117	12.6	100	10.9	108	72.37 - 134.40	85.54
10	Azoxystrobin	8.2	107	7.2	108	2.5	105	21.38 - 39.70	27.90
11	Benalaxyl	8.6	106	3.9	104	4.8	110	24.34 - 45.20	33.57
12	Bendiocarb	7.6	106	5.1	103	3.6	93	1.93 - 3.58	2.32
13	Benzoximate	5.2	104	14.4	102	6.2	112	8.49 - 15.77	13.58
14	Bitertanol	15.9	112	19.6	103	12.0	111	1.23 - 2.28	1.39
15	Boscalid	5.4	108	4.1	112	4.9	119	23.83 - 44.26	30.13
16	Bromuconazole I	8.9	107	6.0	104	4.5	95	51.15 - 94.99	82.05
17	Bromuconazole II	13.0	88	12.3	96	1.2	99	51.15 - 94.99	79.29
18	Bupirimate	8.7	108	10.7	103	3.6	98	36.16 - 67.15	41.43
19	Buprofezin	6.0	95	6.7	97	2.5	110	22.97 - 42.66	37.87
20	Butafenacil	8.5	100	6.6	102	5.5	118	12.99 - 24.13	21.95
21	Carbaryl	10.0	119	7.3	114	14.9	100	27.65 - 51.35	43.12
22	Carbendazim	1.5	102	2.6	102	1.1	100	15.86 - 29.46	23.02
23	Carbetamide	4.3	105	3.3	107	2.3	100	40.01 - 74.31	54.47
24	Carboxin	18.7	96	5.8	86	6.8	87	4.17 - 7.74	5.90
25	Carfentrazone-ethyl	8.2	119	13.3	101	19.4	109	15.43 - 28.66	19.36
26	Chlorantraniliprole	5.0	101	5.6	116	3.4	118	20.67 - 38.38	34.53
27	Chlorfluazuron	15.6	93	11.5	111	12.1	111	24.16 - 44.87	42.52
28	Chlorotoluron	4.4	94	8.8	95	2.9	97	22.46 - 41.71	32.22
29	Chloroxuron	14.0	97	10.7	103	6.0	100	8.86 - 16.45	11.36
30	Clethodim	13.1	83	10.1	83	10.9	80	41.55 - 77.17	51.74
31	Clofentezine	4.8	117	5.0	109	11.4	97	16.20 - 30.08	26.29
32	Clothianidin	3.0	94	1.5	99	1.6	99	50.07 - 92.99	80.75
33	Cyazofamid	6.1	98	6.8	105	6.8	104	1.80 - 3.34	2.09
34	Cycluron	10.6	119	8.9	114	5.8	96	30.32 - 56.31	48.42
35	Cyproconazole I	8.4	96	12.5	101	4.6	110	58.30 - 108.27	82.93
36	Cyproconazole II	9.0	96	4.2	110	5.8	99	57.35 - 106.51	73.97
37	Cyprodinil	16.4	94	10.6	101	2.8	85	19.98 - 37.10	36.00
38	Cyromazine	2.5	94	3.3	74	2.2	104	24.39 - 45.30	27.57
39	Desmedipham	18.4	91	16.4	115	19.2	99	34.71 - 64.46	39.11
40	Diclobutrazol	6.1	108	3.7	107	4.7	102	13.96 - 25.93	18.78
41	Dicrotophos	14.2	90	15.4	97	4.7	90	54.37 - 100.97	80.33
42	Diethofencarb	9.4	96	12.3	119	7.3	101	27.34 - 50.77	39.38
43	Difenoconazole	9.9	103	4.5	103	6.6	111	15.81 - 29.36	25.82
44	Diflubenzuron	10.0	100	9.9	119	2.2	118	16.75 - 31.10	29.63
45	Dimethoate	6.5	108	3.9	105	2.8	99	21.82 - 40.52	37.61

Sr. No.	Name of compound	0.005 mg/kg		0.01 mg/kg		0.025 mg/kg		Ion ratio range	Ion ratio (0.005 mg/kg)
		% RSD	% Rec	% RSD	% Rec	% RSD	% Rec		
46	Dimethomorph I	12.8	102	4.7	102	4.8	109	4.2 - 7.89	6.65
47	Dimethomorph II	11.7	102	3.2	113	1.9	105	4.25 - 7.89	7.17
48	Dimoxystrobin	4.9	107	2.8	110	2.6	101	50.31 - 93.43	68.35
49	Diniconazole	8.4	93	10.1	102	3.6	120	8.53 - 15.84	8.89
50	Dinotefuran	10.1	103	4.4	99	7.9	94	57.08 - 106.00	73.16
51	Diuron	5.5	93	3.6	92	4.4	96	13.64 - 25.33	20.50
52	Doramectin	9.7	86	16.9	117	11.8	99	26.02 - 48.33	27.50
53	Emamectin Benzoate	13.1	105	9.9	104	3.8	99	6.16 - 11.44	8.44
54	Epoxiconazole	8.3	89	6.9	106	5.6	107	19.27 - 35.79	32.54
55	Eprinomectin	17.4	110	9.9	105	9.7	106	24.19 - 44.93	36.93
56	Etaconazole	6.1	108	3.7	107	4.7	102	14.25 - 26.46	24.32
57	Ethiofencarb	13.0	91	11.0	103	7.6	98	46.20 - 85.80	71.60
58	Ethiprole	6.2	79	8.9	92	5.6	118	46.27 - 85.94	61.21
59	Ethirimol	10.5	117	7.1	101	5.3	90	57.84 - 107.42	62.32
60	Ethofumesate	12.2	99	7.9	105	4.4	114	16.49 - 30.63	26.07
61	Etoxazole	5.0	113	7.8	100	4.7	92	22.15 - 41.14	29.94
62	Famoxadone	13.5	72	17.5	103	11.4	88	15.89 - 29.50	28.02
63	Fenamidone	10.7	81	10.7	92	2.6	98	22.15 - 41.14	33.89
64	Fenbuconazole	18.0	94	13.1	92	10.9	109	42.76 - 79.42	58.28
65	Fenhexamid	14.2	107	8.3	110	7.7	115	13.29 - 24.68	21.94
66	Fenobucarb	13.1	111	6.8	106	9.4	100	21.63 - 40.16	26.82
67	Fenpropimorph	6.3	92	9.0	90	2.2	88	41.64 - 77.33	76.15
68	Fenpyroximate	6.1	81	6.7	99	5.6	110	7.19 - 13.35	10.64
69	Fenuron	8.3	105	5.8	102	1.9	97	11.37 - 21.12	15.51
70	Fipronil	14.4	119	8.7	110	8.4	99	15.73 - 29.22	21.58
71	Flonicamid	9.8	101	8.8	102	3.3	95	29.55 - 54.88	45.13
72	Fluazinam	12.1	106	19.2	87	7.5	88	9.37 - 17.41	16.97
73	Flufenacet	3.2	107	2.6	101	2.9	113	35.69 - 66.29	47.03
74	Flufenoxuron	5.2	120	8.2	115	7.9	108	57.39 - 106.58	84.20
75	Fluometuron	5.5	95	4.1	97	3.8	96	12.20 - 22.66	15.60
76	Fluoxastrobin	13.6	109	7.5	113	7.7	108	12.77 - 23.71	17.59
77	Fluquinoconazole	16.1	96	12.9	100	6.1	105	40.04 - 74.37	41.15
78	Flusilazole	5.7	110	7.3	117	0.8	119	10.68 - 19.84	11.92
79	Flutolanil	8.7	92	3.6	106	3.9	106	8.28 - 15.37	10.98
80	Flutriafol	6.1	94	5.5	102	3.4	102	36.24 - 67.30	49.58
81	Forchlorfenuron	6.9	95	3.2	119	12.7	119	14.90 - 27.68	19.58
82	Formetanate HCl	12.7	94	19.0	86	3.7	90	4.47 - 8.31	7.60
83	Fuberidazole	3.0	97	2.7	94	0.9	93	7.80 - 14.48	12.29
84	Furalaxyl	10.2	102	5.3	99	7.0	107	71.33 - 132.47	99.38
85	Furathiocarb	19.6	115	11.9	118	9.0	107	41.17 - 76.45	54.24
86	Halofenozide	11.0	115	11.8	79	9.8	115	37.20 - 69.09	50.52
87	Hexaconazole	11.5	99	8.2	117	4.1	119	18.12 - 33.64	24.80
88	Hexaflumuron	18.2	94	19.2	89	14.8	87	9.14 - 16.97	13.53
89	Hexythiazox	8.0	92	5.9	108	9.7	101	44.18 - 82.05	67.04
90	Hydramethylnon	3.4	108	10.4	97	9.4	98	17.00 - 31.57	23.41

Sr. No.	Name of compound	0.005 mg/kg		0.01 mg/kg		0.025 mg/kg		Ion ratio range	Ion ratio (0.005 mg/kg)
		% RSD	% Rec	% RSD	% Rec	% RSD	% Rec		
91	Imazalil	7.0	95	6.7	97	4.6	93	39.47 - 73.31	52.98
92	Imidacloprid	8.0	106	4.3	101	2.5	95	53.96 - 100.20	80.50
93	Indoxacarb	56.7	90	12.4	102	12.6	104	25.3 - 47.02	41.92
94	Ipconazole	6.8	92	9.1	102	4.2	118	23.05 - 42.80	24.63
95	Iprovalicarb	15.2	104	7.1	115	4.4	105	15.66 - 29.08	18.95
96	Isocarbophos	5.2	93	3.5	119	15.1	116	39.49 - 73.34	64.96
97	Isoprocarb	10.9	75	18.8	88	15.8	97	34.90 - 64.82	56.04
98	Isoproturon	7.0	85	3.9	99	3.4	100	18.86 - 35.02	28.06
99	Ivermectin	16.8	105	15.8	110	14.1	98	31.96 - 59.35	57.95
100	Kresoxim-methyl	17.1	117	9.2	114	10.3	103	41.77 - 77.57	57.21
101	Linuron	13.3	99	8.1	105	7.1	115	78.24 - 145.30	96.02
102	Lufenuron	14.1	94	15.9	109	17.0	97	32.62 - 60.58	45.28
103	Mandipropamid	17.2	112	16.0	105	6.5	108	15.24 - 28.30	26.91
104	Mefenacet	7.1	106	1.9	107	3.7	101	40.82 - 75.80	53.06
105	Mepanipyrim	12.8	109	8.8	88	5.2	99	47.00 - 87.28	52.00
106	Mepronil	5.5	100	4.4	112	5.7	104	42.40 - 78.73	53.63
107	Metaflumizone	19.0	107	10.6	98	12.6	84	30.40 - 56.46	44.63
108	Metconazole	8.6	104	11.6	113	6.7	120	14.04 - 26.08	17.04
109	Methabenzthiazuron	4.5	103	1.7	111	2.9	108	28.65 - 53.21	40.84
110	Methamidophos	3.5	113	18.1	111	2.4	118	36.55 - 67.88	49.05
111	Methiocarb	25.0	94	9.4	92	11.4	105	50.69 - 94.14	91.36
112	Methomyl	18.6	86	18.5	80	10.5	93	59.75 - 110.96	92.71
113	Methoprotryne	3.3	101	5.9	99	2.7	100	76.22 - 141.56	99.89
114	Methoxyfenozide	12.0	111	8.6	98	7.2	113	35.28 - 65.52	64.25
115	Metobromuron	7.3	105	6.5	105	3.1	100	74.18 - 137.76	108.33
116	Metribuzin	17.5	81	9.2	86	16.7	89	6.00% - 11.14	9.33
117	Mevinphos	9.9	107	7.4	95	6.2	93	12.39 - 23.01	19.56
118	Mexacarbate	2.6	106	2.5	99	1.7	97	57.14 - 106.11	79.16
119	Monocrotophos	10.4	110	2.9	101	2.8	95	36.61 - 67.98	37.44
120	Monolinuron	10.8	95	5.7	106	5.7	101	61.16 - 113.59	75.26
121	Moxidectin	6.0	119	13.7	114	15.6	109	45.53 - 84.56	73.02
122	Myclobutanil	15.3	89	9.9	99	8.5	104	42.05 - 78.10	58.83
123	Neburon	17.2	118	18.3	114	9.4	107	8.19 - 15.22	12.25
124	Nitenpyram	5.1	94	4.6	82	3.7	79	39.35 - 73.08	61.08
125	Novaluron	13.2	110	16.1	120	19.6	112	47.80 - 88.77	72.10
126	Nuarimol	17.3	48	2.7	71	7.7	93	18.32 - 34.02	29.85
127	Omethoate	2.8	92	2.8	87	1.1	83	66.88 - 124.21	98.74
128	Oxadixyl	13.1	117	8.0	114	4.2	98	23.99 - 44.56	24.84
129	Oxamyl	7.8	111	7.5	105	9.3	98	2.09 - 3.88	2.80
130	Paclobutrazol	1.5	96	2.9	101	1.6	113	9.61 - 17.85	12.90
131	Penconazole	10.2	99	8.9	99	1.6	114	64.12 - 119.09	87.12
132	Pencycuron	4.7	102	4.5	111	1.6	99	1.94 - 3.60	2.04
133	Picoxystrobin	7.8	114	5.3	108	4.0	97	54.69 - 101.57	72.76
134	Piperonyl butoxide	11.1	114	1.7	119	6.0	106	21.86 - 40.59	27.10
135	Pirimicarb	4.5	104	3.3	98	1.9	95	35.21 - 65.39	56.05

Sr. No.	Name of compound	0.005 mg/kg		0.01 mg/kg		0.025 mg/kg		Ion ratio range	Ion ratio (0.005 mg/kg)
		% RSD	% Rec	% RSD	% Rec	% RSD	% Rec		
136	Prochloraz	8.0	106	2.1	106	5.0	100	12.44 - 23.11	21.50
137	Promecarb	25.8	167	10.6	97	8.8	92	57.55 - 106.87	61.21
138	Prometon	3.9	99	2.2	96	2.6	98	52.89 - 98.23	77.79
139	Prometryn	3.2	101	2.3	98	2.0	100	46.76 - 86.85	71.14
140	Prometryne	8.1	102	6.9	98	2.0	98	47.16 - 87.59	71.96
141	Propamocarb	3.2	81	12.7	76	10.2	73	27.93 - 51.87	32.61
142	Propargite	15.7	116	6.3	111	4.6	97	45.25 - 84.03	57.96
143	Propiconazole	11.6	104	7.1	118	7.0	105	16.81 - 31.23	25.72
144	Propoxur	10.4	109	6.8	100	4.4	94	29.98 - 55.69	54.42
145	Pymetrozine	3.0	116	2.9	97	2.3	86	7.12 - 13.22	8.10
146	Pyracarbolid	4.2	115	5.1	106	4.2	99	4.75 - 8.81	7.12
147	Pyraclostrobin	19.9	114	4.9	108	9.7	98	36.94 - 68.60	42.99
148	Pyridaben	8.7	97	4.3	99	6.3	113	52.23 - 96.99	89.88
149	Pyrimethanil	8.8	109	4.8	101	4.0	94	17.76 - 32.99	20.29
150	Pyriproxyfen	6.4	111	9.5	102	5.6	100	13.29 - 24.68	17.95
151	Quinoxyfen	5.5	99	3.2	103	5.0	91	56.59 - 105.09	70.75
152	Rotenone	14.8	109	10.1	120	10.6	113	69.62 - 129.30	94.67
153	Secbumeton	4.3	102	4.2	95	2.4	95	15.18 - 28.20	20.77
154	Siduron	8.2	100	4.7	102	2.7	109	39.39 - 73.15	67.16
155	Simetryn	6.1	97	3.2	95	2.5	94	40.26 - 74.78	57.20
156	Spinetoram	13.3	107	4.5	96	8.4	89	14.37 - 26.68	18.49
157	Spinosad (Spinosyn A)	16.4	99	8.9	83	3.9	90	10.95 - 20.34	15.13
158	Spinosad (Spinosyn D)	14.5	82	17.7	107	18.3	102	7.20 - 13.37	11.93
159	Spirotetramat	13.9	111	14.0	119	7.9	109	67.65 - 125.63	109.67
160	Spiroxamine	3.9	97	4.5	95	4.7	95	20.71 - 38.47	26.06
161	Tebuconazole	9.3	103	4.4	97	2.0	96	7.57 - 14.06	12.63
162	Tebufenpyrad	7.6	93	7.8	100	4.0	110	66.02 - 122.61	97.18
163	Tebuthiuron	4.5	94	2.2	100	2.6	100	19.11 - 35.49	26.98
164	Teflubenzuron	18.1	107	18.9	81	13.0	97	15.41 - 28.62	19.51
165	Temephos	9.1	118	7.0	104	13.0	102	65.20 - 121.09	78.03
166	Terbumeton	2.8	104	2.1	99	2.7	98	51.13 - 94.95	80.73
167	Terbutryn	2.3	100	3.3	99	2.6	100	9.71 - 18.02	14.78
168	Tetraconazole	11.5	80	8.8	103	4.5	112	14.64 - 27.18	20.16
169	Thiabendazole	4.0	104	3.7	97	2.7	92	53.41 - 99.19	71.26
170	Thiacloprid	5.4	101	3.3	104	2.2	106	12.52 - 23.25	17.55
171	Thiamethoxam	1.7	103	3.1	99	0.7	100	22.84 - 42.42	31.46
172	Thidiazuron	13.3	116	6.8	117	3.2	119	10.07 - 18.69	15.81
173	Thiobencarb	6.0	97	4.7	99	4.1	112	14.47 - 26.88	19.28
174	Thiophanate-methyl	10.1	111	5.3	101	5.2	102	16.54 - 30.72	17.95
175	Triadimefon	14.1	111	10.6	106	6.7	113	15.45 - 28.69	19.82
176	Triadimenol	7.1	91	7.6	101	6.6	113	15.22 - 28.26	22.71
177	Trichlorfon	5.8	102	3.0	95	2.8	91	7.95- 14.76	11.86
178	Tricyclazole	5.3	97	4.4	97	1.6	95	32.56 - 60.47	47.40
179	Trifloxystrobin	6.1	111	10.9	106	5.2	104	10.28 - 19.10	17.11
180	Triflumizole	8.3	97	16.2	89	3.9	98	4.79 - 8.89	6.01

Sr. No.	Name of compound	0.005 mg/kg		0.01 mg/kg		0.025 mg/kg		Ion ratio range	Ion ratio (0.005 mg/kg)
		% RSD	% Rec	% RSD	% Rec	% RSD	% Rec		
181	Triflumuron	7.7	94	3.3	119	4.6	111	40.33 - 74.90	58.75
182	Triticonazole	19.9	91	7.6	104	4.2	109	5.98 - 11.11	6.12
183	Vamidothion	2.2	105	2.7	100	2.0	97	22.89 - 42.51	30.91
184	Zoxamide	10.6	104	9.8	98	5.8	117	39.06 - 72.54	50.18

Table 4. Method validation data for tomato (% recovery, and % RSD)

Sr. No.	Name of compound	0.005 mg/kg		0.01 mg/kg		Ion ratio range	Ion ratio (0.005 mg/kg)
		% RSD	% Rec	% RSD	% Rec		
1	3-Hydroxycarbofuran	8.5	89	4.0	89	39.91 - 74.12	57.41
2	Acetamiprid	1.9	91	2.4	87	8.08 - 15.01	13.68
3	Aldicarb sulfone	18.2	98	14.4	85	39.85 - 74.00	46.37
4	Ametryn	8.4	96	3.9	94	13.08 - 24.29	14.92
5	Aminocarb	2.0	85	1.1	82	65.88 - 122.34	96.39
6	Azoxystrobin	3.3	90	2.4	95	3.57 - 6.63	4.97
7	Benalaxyl	4.6	86	4.8	88	82.57 - 153.34	85.37
8	Bendiocarb	6.4	92	3.3	93	14.86 - 27.60	19.00
9	Benzoximate	10.7	80	5.8	81	10.34 - 19.20	14.96
10	Bifenazate	7.1	118	4.2	118	29.60 - 54.96	41.58
11	Bitertanol	15.8	80	9.2	85	62.33 - 115.75	75.89
12	Boscalid	7.7	95	14.3	102	28.64 - 53.18	44.66
13	Bromucanozole Isomer I	14.1	82	3.4	80	5.45 - 10.12	7.24
14	Bromucanozole Isomer II	11.9	88	11.4	85	29.70 - 55.16	36.47
15	Bupirimate	6.1	90	12.9	89	19.95 - 37.05	23.93
16	Buprofezin	4.2	97	4.4	91	19.87 - 36.9	25.36
17	Butafenacil	5.4	91	3.6	119	24.71 - 45.89	32.57
18	Butocarboxim	14.9	116	7.8	97	38.21 - 70.96	41.65
19	Carbendazim	3.4	78	10.7	85	6.18 - 11.48	9.06
20	Carbetamide	8.3	90	5.3	89	74.72 - 138.77	88.29
21	Carbofuran	8.4	91	5.1	96	64.43 - 119.66	77.15
22	Carboxin	8.2	85	3.4	88	5.58 - 10.35	6.64
23	Carfentrazone ethyl	15.2	93	11.6	117	33.35 - 61.94	46.86
24	Chlorantraniliprole	10.0	96	3.2	114	61.13 - 113.52	74.52
25	Chlorfluazuron	19.4	120	10.7	111	25.78 - 47.88	34.84
26	Chlorotoluron	7.5	95	4.8	90	6.55 - 12.16	8.08
27	Chloroxuron	12.7	89	8.0	88	13.99 - 25.98	14.19
28	Clethodim	18.3	117	8.4	115	28.57 - 53.05	33.74
29	Clofentezine	17.5	116	4.1	100	12.87 - 23.89	20.73
30	Clothianidin	6.0	94	5.3	98	63.96 - 118.78	99.04
31	Cyazofamid	3.0	94	6.3	97	15.16 - 28.15	20.96
32	Cycluron	6.8	89	3.4	85	76.33 - 141.76	84.40
33	Cyproconazole	5.4	94	3.0	101	56.82 - 105.53	89.39
34	Cyprodinil	8.8	93	7.7	82	34.75 - 64.54	48.07
35	Cyromazine	12.5	106	9.9	76	29.17 - 54.18	39.19
36	Desmedipham	4.3	89	5.8	94	6.47 - 12.01	10.81

Sr. No.	Name of compound	0.005 mg/kg		0.01 mg/kg		Ion ratio range	Ion ratio (0.005 mg/kg)
		% RSD	% Rec	% RSD	% Rec		
37	Diclobutrazol	8.1	86	6.8	92	2.42 - 4.49	2.95
38	Dicrotophos	3.0	93	3.5	89	63.94 - 118.75	92.53
39	Diethofencarb	10.0	106	6.7	96	18.46 - 34.29	25.79
40	Diflubenzuron	7.7	89	9.1	100	46.74 - 86.80	72.05
41	Dimethoate	6.7	90	6.5	92	36.05 - 66.95	53.08
42	Dimethomorph Isomer 1	2.7	119	4.5	120	34.56 - 64.18	45.62
43	Dimethomorph Isomer 2	5.4	99	8.9	112	34.56 - 64.18	37.29
44	Dimoxystrobin	3.6	92	6.0	87	6.31 - 11.72	8.19
45	Diniconazole	7.3	115	12.5	105	14.76 - 27.41	22.60
46	Dinotefuran	18.2	112	9.5	95	48.93 - 90.87	49.70
47	Dioxacarb	14.5	86	15.8	89	7.81 - 14.50	13.55
48	Epoxiconazole	7.5	98	10.7	95	47.35 - 87.93	60.71
49	Etaconazole	5.9	90	4.9	90	5.91 - 10.97	6.48
50	Ethiprole	11.2	94	4.7	92	35.63 - 66.16	49.67
51	Ethirimol	11.0	80	17.5	70	49.82 - 92.52	87.42
52	Ethofumesate	12.1	103	8.0	101	22.89 - 42.52	28.91
53	Famexadone	16.4	85	10.5	82	22.54 - 41.87	32.98
54	Fenamidone	12.1	78	7.1	87	25.39 - 47.15	42.10
55	Fenbuconazole	12.8	76	11.8	98	51.89 - 96.37	73.81
56	Fenhexamid	7.3	100	13.8	85	22.26 - 41.34	25.81
57	Fenbucarb	12.0	93	12.1	92	18.76 - 34.85	24.51
58	Fenoxycarb	7.9	100	8.4	103	26.86 - 49.88	32.15
59	Fenpropimorph	9.9	91	11.4	90	56.30 - 104.55	86.52
60	Fenpyroximate	3.0	94	11.6	114	1.02 - 1.90	1.23
61	Fenuron	18.9	93	11.2	92	60.27 - 111.94	84.45
62	Fipronil	12.5	96	7.7	83	18.26 - 33.90	20.74
63	Flonicamid	12.7	111	12.1	93	42.41 - 78.76	61.24
64	Flubendiamide	11.7	85	10.9	113	24.50 - 45.50	34.29
65	Fludioxinil	9.1	72	10.5	88	0.36 - 0.68	0.42
66	Flufenacet	11.2	88	5.1	99	30.79 - 57.18	39.55
67	Flufenoxuron	7.1	96	8.1	110	38.68 - 71.84	51.68
68	Fluometuron	8.5	113	12.0	90	9.07 - 16.84	13.49
69	Fluoxastrobin	6.1	94	4.3	95	21.73 - 40.36	29.55
70	Fluquiconazole	15.2	77	10.1	92	22.21 - 41.25	24.85
71	Flusilazole	7.8	81	4.9	92	46.17 - 85.74	70.31
72	Flutolanil	9.3	89	4.0	88	11.61 - 21.57	14.50
73	Flutriafol	6.9	89	7.4	101	31.11 - 57.78	44.49
74	Forchlorfenuron	7.7	95	5.9	106	13.98 - 25.96	20.75
75	Fuberidazole	9.6	91	3.6	85	59.61 - 110.70	65.64
76	Furalaxyl	3.4	87	5.7	86	65.98 - 122.54	87.89
77	Furathiocarb	5.3	100	5.6	110	35.09 - 65.17	51.56
78	Hexaconazole	8.5	89	7.6	89	63.52 - 117.97	84.66
79	Hexythiazox	3.3	105	6.0	107	13.65 - 25.35	16.12
80	Hydramethylnon	18.2	104	6.5	72	17.24 - 32.02	24.13
81	Imazalil	8.4	100	10.2	93	15.03 - 27.92	19.76
82	Imidacloprid	6.1	105	2.1	103	50.66 - 94.08	74.48

Sr. No.	Name of compound	0.005 mg/kg		0.01 mg/kg		Ion ratio range	Ion ratio (0.005 mg/kg)
		% RSD	% Rec	% RSD	% Rec		
83	Indoxacarb	18.4	82	8.6	117	14.04 - 26.08	15.48
84	Ipconazole	12.8	103	8.5	95	13.71 - 25.46	22.71
85	Iprovalicarb	5.6	100	2.2	96	46.13 - 85.67	57.42
86	Isoprocarb	13.9	97	18.8	96	29.72 - 55.20	34.13
87	Isoproturon	8.6	90	5.2	87	8.21 - 15.24	15.15
88	Linuron	6.0	98	8.1	93	72.00 - 133.71	112.24
89	Mandipropamid	10.2	95	7.0	108	21.44 - 39.83	26.43
90	Mefenacet	3.6	90	4.7	89	45.01 - 83.58	58.58
91	Mepanipyrim	6.2	88	14.3	89	53.65 - 99.64	67.35
92	Mepronil	2.2	92	1.5	92	27.90 - 51.81	38.65
93	Metaflumizone	17.8	112	9.7	111	36.36 - 67.53	57.47
94	Metalaxyl	7.1	91	8.6	87	27.42 - 50.91	32.12
95	Metconazole	19.4	83	17.4	91	13.27 - 24.64	20.21
96	Methabenzthiazuron	8.2	93	9.0	89	11.61 - 21.57	16.04
97	Methamidophos	6.2	78	6.6	72	27.58 - 51.22	39.19
98	Methiocarb	15.9	70	6.8	80	47.05 - 87.38	57.22
99	Methoprotryne	11.5	91	9.1	92	43.57 - 80.92	65.57
100	Methoxyfenozide	4.5	82	6.4	100	47.00 - 87.28	61.93
101	Metobromuron	11.1	82	11.9	87	53.99 - 100.26	63.04
102	Metribuzin	12.6	114	18.6	101	7.83 - 14.54	11.92
103	Mexacarbate	1.7	92	1.5	88	43.92 - 81.57	63.63
104	Monceren Pencycuron	4.6	73	3.3	103	1.73 - 3.22	2.57
105	Monocrotophos	8.7	77	4.7	91	20.97 - 38.95	29.55
106	Monolinuron	3.9	101	9.0	91	28.25 - 52.47	40.84
107	Myclobutanil	9.5	89	8.6	96	56.18 - 104.34	67.18
108	Neburon	13.7	109	9.1	89	13.84 - 25.70	24.74
109	Nitenpyram	3.1	106	8.9	80	52.77 - 98.00	66.42
110	Novaluron	18.7	112	16.5	89	37.66 - 69.93	62.22
111	Nuarimol	10.4	81	9.7	113	51.95 - 96.48	84.50
112	Omethoate	1.9	84	0.8	83	45.99 - 85.42	64.41
113	Oxadixyl	3.7	90	3.0	94	18.72 - 34.77	27.88
114	Paclobutrazol	5.0	82	4.5	85	23.24 - 43.16	31.24
115	Penconazole	2.7	94	2.9	87	31.53 - 58.56	48.63
116	Phenmedipham	17.9	91	12.9	90	17.14 - 31.83	31.20
117	Picoxystrobin	9.7	88	5.1	94	58.70 - 109.02	91.12
118	Piperonyl butoxide	7.3	119	6.9	71	7.49 - 13.92	8.02
119	Pirimicarb	6.6	92	1.6	88	46.07 - 85.57	55.58
120	Prochloraz	6.6	89	2.4	92	5.49 - 10.19	6.36
121	Promecarb	6.5	88	11.0	102	59.03 - 109.62	63.85
122	Prometon	6.3	95	5.0	89	45.60 - 84.68	54.82
123	Prometryne	5.5	80	4.3	82	40.56 - 75.32	55.96
124	Propamocarb	3.0	81	1.9	74	13.63 - 25.30	14.18
125	Propargite	5.4	103	2.9	102	31.99 - 59.42	48.19
126	Propiconazole	6.4	80	6.4	85	2.84 - 5.27	2.99
127	Prothioconazole	14.6	77	18.6	80	39.89 - 74.08	41.49
128	Pyraclostrobin	9.8	82	7.8	82	57.12 - 106.08	94.20

Sr. No.	Name of compound	0.005 mg/kg		0.01 mg/kg		Ion ratio range	Ion ratio (0.005 mg/kg)
		% RSD	% Rec	% RSD	% Rec		
129	Pyridaben	6.3	98	4.5	102	48.69 - 90.42	77.25
130	Pyrimethanil	15.1	90	6.0	86	31.85 - 59.15	42.86
131	Pyriproxyfen	18.4	104	11.8	91	13.40 - 24.89	17.71
132	Quinoxyfen	12.7	102	10.9	91	60.03 - 111.48	75.17
133	Rotenone	9.5	94	5.6	116	42.24 - 78.45	50.74
134	Secbumeton	5.3	94	5.3	92	16.16 - 30.02	16.63
135	Siduron	5.8	89	3.4	89	48.46 - 89.99	74.31
136	Simetryn	10.1	97	4.6	87	32.72 - 60.76	37.26
137	Spinetoram	18.5	96	7.7	120	10.85 - 20.16	16.55
138	Spinosad (Spinosyn A)	17.6	83	14.4	119	8.94 - 16.60	16.04
139	Spinosad (Spinosyn D)	14.3	89	10.5	98	11.31 - 21.00	14.91
140	Spirodiclofen	6.8	97	4.0	102	18.90 - 35.10	26.42
141	Spiromesifen	6.1	105	7.8	98	6.48 - 12.03	7.73
142	Spirotetramat	6.3	87	8.2	115	65.61 - 121.85	87.12
143	Spiroxamine	5.4	83	5.6	83	20.88 - 38.77	30.30
144	Tebuconazole	9.1	86	3.9	86	13.75 - 25.53	16.81
145	Tebufenozide	17.5	74	9.4	93	54.68 - 101.55	64.88
146	Tebufenpyrad	7.0	82	8.2	92	26.62 - 49.44	34.91
147	Tebuthiuron	4.5	98	6.0	88	15.63 - 29.03	21.15
148	Temephos	16.7	118	19.7	101	57.51 - 106.81	84.56
149	Terbumeton	6.5	94	4.1	92	6.25 - 11.61	7.64
150	Terbutryn	2.2	85	3.5	90	16.87 - 31.33	23.86
151	Tetraconazole	5.1	90	5.5	89	6.27 - 11.64	8.36
152	Thiabendazole	8.8	81	3.8	80	48.36 - 89.81	77.21
153	Thiacloprid	3.4	97	3.1	92	5.09 - 9.45	5.70
154	Thiamethoxam	4.4	90	2.0	92	12.64 - 23.48	17.75
155	Thidiazuron	10.5	87	4.3	94	14.26 - 26.48	14.79
156	Thiobencarb	4.1	93	4.3	92	7.43 - 13.79	10.87
157	Thiophanate-methyl	ND	ND	14.5	110	3.30 - 6.13	3.64
158	Triadimefon	13.8	101	7.0	97	27.18 - 50.47	31.01
159	Triadimenol	8.0	80	10.7	82	16.40 - 30.46	17.77
160	Trichlorfon	2.8	91	3.2	91	2.19 - 4.07	2.68
161	Tricyclazole	5.9	95	6.2	88	45.81 - 85.07	75.35
162	Trifloxystrobin	7.4	89	6.6	105	18.02 - 33.46	27.46
163	Triflumuron	15.4	79	6.2	97	34.82 - 64.67	43.68
164	Triticonazole	11.5	74	12.3	104	5.56 - 10.33	8.89
165	Vamidothion	3.5	85	3.6	90	5.71 - 10.61	7.01
166	Zoxamide	7.4	97	3.7	93	13.69 - 25.42	18.50

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Conclusion

This application note offers an analytical solution for quantitation of pesticide residues in tomato (166) and cucumber (184) by using a combination of QuEChERS extraction followed by Thermo Scientific LC-HESI-MS/MS analysis. The optimized method results showed that LC separations, in combination with t-SRM windows, allowed maintaining the number of transitions monitored in a single injection by auto-optimized dwell time without compromising data quality. Using this approach, at least 70 injections (standards, samples, blank) could be completed in a day (24 h cycle) and increase the overall high throughput of the commercial food testing laboratory. The method performance was evaluated at the 1X (0.01 mg/kg, reporting limit), and 0.5X reporting limit. These two levels, recoveries, and precision data meet the SANTE guideline criteria. TraceFinder software was used for data acquisition and processing. The software has flagging options that help reduce the time required for data review. Also, this method complies with the EU as well as FSSAI MRLs requirements by achieving the excellent lower limit of quantitation (LOQ).

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