

GC-MS/MS 法同时分析茶叶中 179 种农药残留

GCMSMS-061

摘要：本文建立了气相色谱 – 串联质谱 (GC-MS/MS) 同时分析茶叶中 179 种农药残留的方法。通过检测茶叶空白基质加标样品 (加标浓度为 10 $\mu\text{g/L}$) 对多种农药残留进行灵敏度和重复性考察。结果表明：茶叶基质中 179 种农药峰形良好，信噪比高，重复性实验峰面积的相对标准偏差 (RSD%) 均在 10% 以下。

关键词：GC-MS/MS 农药残留 茶叶

近年来，农药残留超标而引起的食品安全事件时有发生，为避免农药残留对人类和生物造成巨大危害，各国对农药的施用进行了严格的管理，欧盟的农残检测方法主要以 GC-MS 或者 HPLC-MS 的多残留分析方法 (如欧盟标准 EN 12393-1:2013; EN12393-2:2013 和 EN 12393-3:2013 等)，能一次性检测 500 多种农药。并于 2008 年实施欧洲议会第 396/2005 法令，统一了欧盟各成员国所规定的农药最高残留量，并设定 0.01 mg/kg 为最高残留限量农药的默认限值。

近期，我国卫生部与农业部联合发布了 GB 2763-2014《食品安全国家标准食品中农药最大残留限量》于

2014 年 8 月 1 日正式实施，这一新版标准“规定了 387 种农药在 284 种食品中的 3650 项限量指标”基本覆盖了农业生产常用农药品种和公众经常消费的食品种类。

为了满足多种农药残留同时检测的分析要求，本文采用岛津公司三重四极杆气质联用仪 GCMS-TQ8040，结合 Smart MRM 数据库，使用岛津特有的 AART 功能，无需使用标准品即可建立茶叶中 179 种农药残留的检测方法。结果表明，使用岛津 GCMS-TQ8040 在 179 种农药同时分析时获得高灵敏度。

实验部分

1.1 仪器

三重四极杆气质联用仪：GCMS-TQ8040

1.2 分析条件

GC 条件

色谱柱：Rxi-5 Sil MS(30 m \times 0.25 mm \times 0.25 μm)

进样口温度：250 $^{\circ}\text{C}$

柱温程序：50 $^{\circ}\text{C}$ (1 min)-(25 $^{\circ}\text{C}$ /min)-150 $^{\circ}\text{C}$ - (10 $^{\circ}\text{C}$ /min)-300 $^{\circ}\text{C}$ (15 min)

恒线速度方式：47.2 cm/sec

进样方式：不分流进样

进样量：1 μL

高压进样：250 kpa(1.5 min)

接口温度：250 $^{\circ}\text{C}$

离子源温度：200

检测器电压：调谐电压 +0.8 kv

溶剂延迟时间：4 min

采集方式：MRM，特征离子见表 1

表1 农药组分名称、保留时间及MRM参数

No.	中文名称	英文名称	CAS号	保留时间	定量离子对	CE	定性离子对	CE
1	二丙烯草胺	Allidochlor	93-71-0	6.264	132.10>56.00	8	138.10>96.00	6
2	二氯丙烯胺	Dichtormid	37764-25-3	6.91	172.00>108.10	6	172.00>136.10	6
3	联苯	Biphenyl	92-52-4	7.291	154.10>128.10	22	154.10>115.10	24
4	丁草特	Butylate	2008-41-5	7.747	174.10>146.10	6	174.10>75.00	4
5	依得利(土菌灵)	Etridiazole	2593-15-9	7.938	210.90>182.90	10	210.90>139.90	22
6	苯胺灵	propham	122-42-9	8.029	179.00>137.00	5	120.00>77.00	15
7	虫螨畏	Methacrifos	62610-77-9	8.419	240.00>208.00	4	240.00>180.00	10
8	地茂散	Chloroneb	2675-77-6	8.499	206.00>141.00	20	206.00>113.00	24
9	2-苯基苯酚(邻苯基苯酚)	2-Phenylphenol	90-43-7	8.689	170.10>141.10	24	170.10>115.10	28
10	庚烯磷	heptenophos	23560-59-0	9.26	124.00>89.00	15	215.00>200.00	10
11	四氯硝基苯	Tecnazene	117-18-0	9.451	260.90>202.90	14	260.90>230.90	8
12	梨内二苯胺(二苯胺)	Diphenylamine	122-39-4	9.824	169.10>66.00	24	169.10>77.00	28
13	灭克磷(灭线磷)	Ethoprophos	13194-48-4	9.955	200.00>158.00	6	200.00>114.00	14
14	丁氟消草(乙丁烯氟灵)	Ethalfuralin	55283-68-6	10.025	316.10>276.00	10	316.10>202.00	24
15	氟苯胺灵	Chlorpropham	101-21-3	10.135	213.10>171.10	6	213.10>127.10	14
16	氟乐灵	Trifluralin	1582-09-8	10.195	306.10>264.10	8	306.10>206.10	14
17	氟草胺(乙丁氟灵)	Benfluralin	1861-40-1	10.251	292.10>264.00	8	292.10>206.00	12
18	蔬果磷	Dioxabenzofos (Salithion)	3811-49-2	10.285	216.00>201.00	10	216.00>183.00	10
19	百治磷	Dierotophos	141-66-2	10.288	127.10>95.00	18	127.10>109.00	12
20	硫特普(治螟磷)	Sulfotep	3689-24-5	10.294	322.00>202.00	10	322.00>294.00	4
21	硫线磷	Cadusafos	95465-99-9	10.487	158.90>130.90	8	158.90>97.00	18
22	甲拌磷	Phorate	298-02-2	10.521	260.00>75.00	8	260.00>231.00	4
23	alpha-六六六	alpha-HCH	319-84-6	10.625	218.90>182.90	8	218.90>144.90	20

24	六氯苯	Hexachlorobenzene	118-74-1	10.698	283.80>248.80	24	283.80>213.80	28
25	甲基乙拌磷(二甲基硫吸磷)	Thiometon	640-15-3	10.768	125.00>47.00	14	125.00>62.00	10
26	五氯甲氧基苯(五氯茴香醚)	pentachloroanisole	1825-21-4	10.814	265.00>237.00	15	280.00>265.00	10
27	氯硝胺	Dicloran	99-30-9	10.885	206.00>176.00	10	206.00>160.00	16
28	beta-六六六	beta-HCH	319-85-7	11.123	218.90>182.90	8	218.90>144.90	20
29	绿谷隆	monolinuron	1806-81-2	11.136	214.00>61.00	10	214.00>126.00	25
30	噻节因	Dimethipin	55290-64-7	11.154	118.00>58.00	6	118.00>73.00	2
31	广灭灵(异恶草松)	Clomazone	81777-89-1	11.201	204.10>107.00	20	204.10>78.00	26
32	五氯硝基苯	Quintozone	82-68-8	11.205	294.80>236.80	16	294.80>264.80	12
33	gamma-六六六	gamma-HCH (Lindane)	58-89-9	11.305	218.90>182.90	8	218.90>144.90	20
34	特丁硫磷	Terbufos	13071-79-9	11.384	231.00>174.90	14	231.00>128.90	26
35	杀螟腈	Cyanophos	2636-26-2	11.388	243.00>109.00	14	243.00>116.00	6
36	大福松(地虫磷)(地虫硫磷)	Fonofos	944-22-9	11.467	246.00>109.10	18	246.00>137.10	6
37	快敌稗	Propyzamide	23950-58-5	11.473	172.90>144.90	16	172.90>74.00	28
38	二嗪农(二嗪磷)	Diazinon	333-41-5	11.526	304.10>179.10	10	304.10>162.10	8
39	磷胺-1	Phosphamidon-I	13171-21-6	11.596	264.10>127.10	14	264.10>193.10	8
40	百菌清	Chlorothalonil	1897-45-6	11.644	265.90>230.80	14	265.90>168.00	22
41	乙拌磷	Disulfoton	298-04-4	11.736	186.00>125.00	16	186.00>97.00	6
42	氟唑磷	Isazophos	42509-80-8	11.766	161.00>119.00	15	161.00>146.10	6
43	特草定	Terbacil	5902-51-2	11.776	161.00>118.00	14	161.00>88.00	20
44	七氟菊酯	Tefluthrin	79538-32-2	11.798	177.00>127.10	16	177.00>137.10	16
45	益多松(乙噁硫磷)	Etrifos	38260-54-7	11.849	292.10>181.10	8	292.10>153.10	20
46	delta-六六六	delta-HCH	319-86-8	11.854	218.90>182.90	10	218.90>144.90	20
47	野麦畏	Tri-allate	2303-17-5	11.887	268.10>226.00	14	268.10>184.00	20
48	福木松(安硫磷)	Formothion	2540-82-1	12.183	224.00>125.00	18	224.00>155.00	12
49	除线磷	Dichlofenthion	97-17-6	12.372	279.00>222.90	14	279.00>250.90	8

50	呋草黄(呋草磺)	Benfuresate	68505-69-1	12.375	256.10>163.10	10	256.10>121.10	22
51	汰草灭(二甲吩草胺)	Dimethenamid (Dimethenamid-P)	87674-68-8	12.414	230.00>154.10	10	230.00>137.10	20
52	磷胺-2	Phosphamidon-2	13171-21-6	12.431	264.10>127.10	14	264.10>193.10	8
53	敌稗	Propanil	709-98-8	12.5	160.90>99.00	24	160.90>90.00	22
54	甲基毒死蜱	Chlorpyrifos-methyl	5598-13-0	12.512	285.90>93.00	22	285.90>270.90	14
55	噻草酮	Metribuzin	21087-64-9	12.575	198.10>82.00	14	198.10>110.10	10
56	免克宁(乙烯菌核利)	Vinclozolin	50471-44-8	12.614	285.00>212.00	12	285.00>178.00	14
57	甲基对硫磷	Parathion-methyl	298-00-0	12.659	263.00>109.00	14	263.00>136.00	8
58	甲基立枯磷	Tolclofos-methyl	57018-04-9	12.664	264.90>249.90	14	264.90>93.00	24
59	七氯	Heptachlor	76-44-8	12.789	271.80>236.90	20	271.80>117.00	32
60	皮蝇磷	Fenchlorphos	299-84-3	12.842	284.90>269.90	16	284.90>93.00	24
61	莠灭净	Ametryn	834-12-8	12.85	227.10>170.10	14	227.10>185.10	6
62	氟硫草定	Dithiopyr	97886-45-8	12.893	354.10>306.10	8	354.10>286.10	14
63	扑草净	Prometryn	7287-19-6	12.898	241.20>199.10	6	241.20>58.00	14
64	八氯二丙醚	S421	127-90-2	12.971	130.00>95.00	20	181.00>85.00	10
65	甲基噻啉磷	Pirimiphos-methyl	29232-93-7	13.059	305.10>180.10	8	305.10>290.10	12
66	杀螟硫磷	Fenitrothion	122-14-5	13.117	277.00>260.00	6	277.00>109.10	14
67	乙味草黄	Ethofumesate	26225-79-6	13.159	286.10>207.10	8	286.10>161.10	18
68	甲基五氯苯基硫醚	methyl pentachlorophenyl sulfide	1825-19-0	13.2	296.00>263.00	15	246.00>211.00	20
69	抑菌灵	Dichlofluanid	1085-98-9	13.248	223.90>123.10	8	223.90>77.00	28
70	甲拌磷亚砷	Phorate sulfoxide	2588-03-6	13.299	153.00>97.00	9	125.00>97.00	3
71	毒死蜱	Chlorpyrifos	2921-88-2	13.408	313.90>257.90	14	313.90>285.90	8
72	甲拌磷砷	Phorate sulfone	2588-04-7	13.437	153.00>97.00	15	125.00>97.00	6
73	(E)-甲基毒虫畏	(E)-Dimethylvinphos	2274-67-1	13.474	294.90>109.00	14	294.90>279.90	16
74	(Z)-甲基毒虫畏	(Z)-Dimethylvinphos	2274-67-1	13.474	294.90>109.00	14	294.90>279.90	16
75	艾氏剂	Aldrin	309-00-2	13.474	262.90>193.00	28	262.90>191.00	26

76	信硫磷	Fenthion	55-38-9	13.495	278.00>109.00	20	278.00>125.00	20
77	氟酞酸甲酯	Chlorthal-dimethyl	1861-32-1	13.51	300.90>222.90	26	300.90>272.90	14
78	对硫磷	Parathion	56-38-2	13.561	291.10>109.00	14	291.10>137.00	6
79	三泰芬(三唑酮)	Triadimefon	43121-43-3	13.633	208.10>181.00	10	208.10>127.00	14
80	四克利(四氟醚唑)	Tetraconazole	112281-77-3	13.638	336.00>218.00	14	336.00>204.00	28
81	水胺硫磷	Isocarbophos	24353-61-5	13.658	289.10>136.00	14	289.10>113.00	6
82	三氯杀螨醇分解物(三氯杀螨醇)	Dicofol deg. (DCBP)	0-00-0	13.708	250.00>139.00	14	250.00>215.00	8
83	酞菌酯	Nitrothal-isopropyl	10552-74-6	13.708	254.10>212.00	10	254.10>165.00	22
84	氟咯草酮	Fluorochloridone	61213-25-0	13.724	311.00>174.10	15	311.00>103.10	18
85	乙基虫螨磷/啞啞磷	pirimiphos-ethyl	23505-41-1	13.822	304.00>168.00	10	318.00>166.00	15
86	溴硫磷	Bromophos	2104-96-3	13.829	330.90>315.90	14	330.90>285.90	28
87	牧草啞(双苯酞草胺)	Diphenamid	957-51-7	13.866	239.10>167.10	8	239.10>72.00	16
88	噻啞磷-1(噻啞磷)	Fosthiazate-1	98886-44-3	13.885	283.00>195.00	8	283.00>139.00	18
89	甲基异柳磷	Isofenphos-methyl	99675-03-3	13.946	199.00>121.00	14	241.10>121.10	22
90	异艾氏剂	Isodrin	465-73-6	14.037	193.00>123.00	30	193.00>157.00	21
91	二甲戊乐灵	Pendimethalin	40487-42-1	14.041	252.10>162.10	10	252.10>191.10	8
92	(E)-毒虫畏	(E)-Chlorfenvinphos	470-90-6	14.058	323.00>267.00	16	323.00>295.00	6
93	啞菌环胺	Cyprodinil	121552-61-2	14.088	224.10>208.10	16	224.10>197.10	22
94	氟虫脒	Fipronil	120068-37-3	14.146	366.90>212.90	30	366.90>254.90	22
95	平克座(戊菌唑)	Penconazole	66246-88-6	14.182	248.10>192.10	14	248.10>157.10	26
96	乙菌利(克氯得)	Chlozolinate	84332-86-5	14.192	330.90>258.90	6	330.90>186.00	20
97	亚芬松(异柳磷)	Isofenphos	25311-71-1	14.213	213.10>121.00	14	213.10>185.10	6
98	环氧七氯 (exo)	Heptachlor-exo-epoxide	1024-57-3	14.229	352.80>262.90	14	352.80>281.90	12
99	(Z)-毒虫畏	(Z)-Chlorfenvinphos	470-90-6	14.257	323.00>267.00	16	323.00>295.00	6
100	啞熟酯	Ethychlozate	27512-72-7	14.284	238.10>165.00	12	238.10>138.00	28
101	灭蚜磷	Mecarbam	2595-54-2	14.286	329.00>131.10	18	329.00>159.10	4

102	稻丰散	Phenthoate	2597-03-7	14.341	273.90>125.00	20	273.90>246.00	6
103	喹硫磷	Quinalphos	13593-03-8	14.362	157.10>129.00	14	146.10>118.00	10
104	呋霜灵	furalaxyl	57646-30-7	14.395	242.00>95.00	15	301.00>224.00	20
105	克菌丹	Captan	133-06-2	14.399	149.10>79.10	4	149.10>70.00	14
106	腐霉利	Procymidone	32809-16-8	14.429	283.00>96.00	10	283.00>255.00	12
107	美赐平(烯虫酯)	Methoprene	40596-69-8	14.528	111.10>55.00	18	111.10>83.00	12
108	乙基溴硫磷	Bromophos-ethyl	4824-78-6	14.621	358.90>302.90	16	358.90>330.90	10
109	氯杀螨	Chlorbenside	103-17-3	14.659	125.00>89.00	16	125.00>99.00	18
110	反-氟丹	trans-Chlordane	5103-74-2	14.678	372.80>336.80	10	372.80>263.90	28
111	加护松(丙虫磷)	Propaphos	7292-16-2	14.692	304.10>140.10	26	304.10>220.10	14
112	o,p'-DDE	o,p'-DDE	3424-82-6	14.719	246.00>176.00	30	246.00>211.00	22
113	杀虫威(杀虫畏)	Tetrachlorvinphos	22248-79-9	14.76	328.90>109.00	20	328.90>313.90	18
114	多效唑	Paclbutrazol	76738-62-0	14.802	236.10>125.00	14	236.10>167.00	10
115	丁基拉草(丁草胺)	Butachlor	23184-66-9	14.808	188.10>160.10	12	188.10>132.10	14
116	顺-氟丹	cis-Chlordane	5103-71-9	14.93	372.80>336.80	10	372.80>263.90	28
117	alpha-硫丹	alpha-Endosulfan	959-98-8	14.931	338.90>160.00	18	338.90>266.90	8
118	萘丙酰草胺(敌草胺)	Napropamide	15299-99-7	15.069	128.10>72.00	6	128.10>100.00	12
119	克线磷(苯线磷)	Fenamiphos	22224-92-6	15.079	303.10>195.10	8	303.10>154.10	18
120	福多宁(氟酰胺)	Flutolanil	66332-96-5	15.11	173.00>145.00	14	173.00>95.00	26
121	普硫松(丙硫磷)	Prothiofos	34643-46-4	15.17	309.00>238.90	14	309.00>280.90	10
122	丙溴磷	Profenofos	41198-08-7	15.263	336.90>266.90	14	336.90>308.90	6
123	p,p'-DDE	p,p'-DDE	72-55-9	15.334	246.00>176.00	30	246.00>211.00	22
124	脱叶磷	Tribufos	78-48-8	15.386	258.00>202.00	4	258.00>147.00	10
125	灭克落	Myclobutanil	88671-89-0	15.428	179.10>125.00	14	179.10>152.00	8
126	狄氏剂(地特灵)	Dieldrin	60-57-1	15.451	276.90>241.00	8	276.90>170.00	38
127	o,p'-DDD	o,p'-DDD	53-19-0	15.463	235.00>165.00	24	235.00>199.00	14

128	氟硅唑	Flusilazole	85509-19-9	15.47	233.10>165.10	14	233.10>152.10	14
129	苯氧三唑醇	Diclobutrazol	75736-33-3	15.543	270.00>159.00	14	270.00>201.00	8
130	克凡派(虫螨晴)	Chlorfenapyr	122453-73-0	15.631	247.10>227.00	16	247.10>200.00	24
131	环唑醇-1	Cyproconazole-1	94361-06-5	15.766	222.10>125.10	24	222.10>82.00	12
132	环唑醇-2	Cyproconazole-2	94361-06-5	15.766	222.10>125.10	24	222.10>82.00	12
133	异狄氏剂	Endrin	72-20-8	15.845	262.90>191.00	30	262.90>193.00	28
134	杀螨酯(乙酯杀螨醇)	Chlorobenzilate	510-15-6	15.954	251.00>139.00	14	251.00>111.00	28
135	丰索磷	Fensulfothion	115-90-2	16.009	293.00>153.00	8	293.00>125.00	14
136	beta-硫丹	beta-Endosulfan	33213-65-9	16.046	194.90>160.00	8	194.90>125.00	24
137	爱杀松(乙硫磷)	Ethion	563-12-2	16.113	230.90>174.90	14	230.90>184.90	12
138	p,p'-DDD	p,p'-DDD	72-54-8	16.123	235.00>165.00	24	235.00>199.00	14
139	o,p'-DDT	o,p'-DDT	789-02-6	16.17	235.00>165.00	24	235.00>199.00	16
140	啞螨酯	Fluacrypyrim	229977-93-9	16.252	352.10>188.10	10	352.10>320.10	6
141	灭普宁(灭锈胺)	Mepronil	55814-41-0	16.379	269.10>119.10	14	269.10>227.10	6
142	三唑磷	Triazophos	24017-47-8	16.402	257.00>162.00	8	257.00>134.00	22
143	除虫菊素 I(除虫菊酯I)	Pyrethrin I	121-21-1	16.472	123.10>81.00	8	123.10>95.00	6
144	本达乐(苯霜灵)	Benalaxyl	71626-11-4	16.567	148.10>105.10	16	148.10>79.10	14
145	三硫磷	Carbophenothion	786-19-6	16.616	341.90>157.00	14	341.90>143.00	18
146	克瘟散(敌瘟磷)	Edifenphos	17109-49-8	16.682	310.00>173.00	14	310.00>109.00	26
147	丙环唑-1	Propiconazole-1	60207-90-1	16.698	259.00>69.00	14	259.00>191.00	8
148	(Z)-甲基嘧草醚	(Z)-Pyriminobac-methyl	136191-64-5	16.735	302.10>256.10	18	302.10>230.10	18
149	(E)-甲基嘧草醚	(E)-Pyriminobac-methyl	136191-64-5	16.735	302.10>256.10	18	302.10>230.10	18
150	硫丹硫酸酯	Endosulfan sulfate	1031-07-8	16.762	386.80>288.80	10	386.80>252.90	16
151	丙环唑-2	Propiconazole-2	60207-90-1	16.807	259.00>69.00	14	259.00>191.00	8
152	p,p'-DDT	p,p'-DDT	50-29-3	16.826	235.00>165.00	24	235.00>199.00	16
153	环磷酮	Hexazinone	51235-04-2	16.966	171.10>71.00	16	171.10>85.00	16

154	禾草灵	Diclofop-methyl	51338-27-3	17.094	340.00>253.00	14	340.00>281.00	10
155	胡椒基丁醚(增效醚)	Piperonyl butoxide	51-03-6	17.215	176.10>131.10	12	176.10>117.10	20
156	卡呋菊酯-2	Resmethrin-2 (Bioresmethrin)	10453-86-8	17.265	171.10>128.10	14	171.10>143.10	6
157	胺菊酯-1	Tetramethrin-1	7696-12-0	17.609	164.10>107.10	14	164.10>135.10	8
158	联苯菊酯	Bifenthrin	82657-04-3	17.699	181.10>166.10	12	181.10>153.10	8
159	苯硫磷	EPN	2104-64-5	17.728	169.10>140.90	8	169.10>77.00	22
160	溴螨酯	Bromopropylate	18181-80-1	17.756	340.90>182.90	18	340.90>184.90	20
161	胺菊酯-2	Tetramethrin-2	7696-12-0	17.761	164.10>107.10	14	164.10>135.10	8
162	解毒啉	cloquintocet-1-methylhexyl ester	99607-70-2	17.832	192.00>162.00	25	192.00>126.00	25
163	甲氧滴滴涕(甲氧氯)	Methoxychlor	72-43-5	17.848	227.10>169.10	24	227.10>212.10	14
164	芬普宁(甲氰菊酯)	Fenpropathrin	39515-41-8	17.884	265.10>210.10	12	265.10>172.10	14
165	四氯杀螨砒(三氯杀螨砒)	Tetradifon	116-29-0	18.245	355.90>228.90	12	355.90>159.00	18
166	苯醚菊酯-1	Phenothrin-1	26002-80-2	18.257	123.10>81.00	8	183.10>168.10	14
167	苯醚菊酯-2	Phenothrin-2	26002-80-2	18.257	123.10>81.00	8	183.10>168.10	14
168	戊噁草酮(戊基恶唑酮)	Pentoxazone	110956-75-7	18.32	285.00>70.00	14	285.00>187.00	10
169	氯氟菊酯-1	Cyhalothrin-1	68085-85-8	18.494	197.00>161.00	8	208.00>181.00	12
170	吡丙醚(蚊蝇醚)	Pyriproxyfen	95737-68-1	18.51	136.10>78.00	20	136.10>96.00	14
171	氟氯草酯	Cyhalofop-butyl	122008-85-9	18.545	357.10>256.10	10	357.10>229.10	14
172	氟丙菊酯-1	Acinathrin-1	101007-06-1	18.59	289.10>93.00	14	289.10>77.00	26
173	氯氟菊酯-2	Cyhalothrin-2	68085-85-8	18.677	197.00>161.00	8	208.00>181.00	12
180	灭蚁灵	Mirex	2385-85-5	18.794	272.00>237.00	15	270.00>235.00	5
175	氟丙菊酯-2	Acinathrin-2	101007-06-1	18.837	289.10>93.00	14	289.10>77.00	26
176	定菌磷(吡菌磷)	Pyrazophos	13457-18-6	18.862	221.10>193.10	12	221.10>149.10	14
177	氯苯啶啉醇	Fenarimol	60168-88-9	18.895	251.00>139.00	14	251.00>111.00	26
178	乙基谷硫磷	Azinphos-ethyl	2642-71-9	19.01	132.10>104.00	6	160.10>132.10	4
179	氯菊酯-1	Permethrin-1	52645-53-1	19.476	163.10>127.10	8	183.10>165.10	14

180	氯菊酯-2	Permethrin-2	52645-53-1	19.603	163.10>127.10	8	183.10>165.10	14
181	氟啶唑	Fluquinconazole	136426-54-5	19.625	340.00>298.00	20	340.00>313.00	14
182	敌杀磷	Dioxathion	78-34-2	19.651	271.00>153.00	8	271.00>125.00	14
183	氟氯菊酯-1	Cyfluthrin-1	68359-37-5	20.007	163.10>127.10	6	226.10>206.10	14
184	氟氯菊酯-2	Cyfluthrin-2	68359-37-5	20.123	163.10>127.10	6	226.10>206.10	14
185	氟氯菊酯-3	Cyfluthrin-3	68359-37-5	20.22	163.10>127.10	6	226.10>206.10	14
186	氟氯菊酯-4	Cyfluthrin-4	68359-37-5	20.22	163.10>127.10	6	226.10>206.10	14
187	氯氰菊酯-1	Cypermethrin-1	52315-07-8	20.343	163.10>127.10	6	163.10>109.10	22
188	氯氰菊酯-2	Cypermethrin-2	52315-07-8	20.447	163.10>127.10	6	163.10>109.10	22
189	氟氰菊酯(氟戊菊酯)-1	Flucythrinate-1	70124-77-5	20.502	199.10>157.10	10	199.10>107.10	22
190	氯氰菊酯-3	Cypermethrin-3	52315-07-8	20.512	163.10>127.10	6	163.10>109.10	22
191	氯氰菊酯-4	Cypermethrin-4	52315-07-8	20.512	163.10>127.10	6	163.10>109.10	22
192	依芬宁(醚菊酯)	Etofenprox	80844-07-1	20.658	163.10>135.10	10	163.10>107.10	18
193	氟氰菊酯(氟戊菊酯)-2	Flucythrinate-2	70124-77-5	20.694	199.10>157.10	10	199.10>107.10	22
194	硅醚菊酯	Silafluofen	105024-66-6	20.797	286.10>258.10	14	286.10>207.10	14
195	氟啶草酮	Fluridone	59756-60-4	20.887	328.10>259.00	24	328.10>127.00	22
196	氟戊菊酯-1	Fenvalerate-1	51630-58-1	21.219	419.10>225.10	6	419.10>167.10	12
197	氟胺氰菊酯-1	Fluvalinate-1	102851-06-9	21.33	250.10>55.00	20	250.10>200.00	20
198	氟胺氰菊酯-2	Fluvalinate-2	102851-06-9	21.396	250.10>55.00	20	250.10>200.00	20
199	氟戊菊酯-2(S-氟戊菊酯)	Fenvalerate-2 (Esfenvalerate)	51630-58-1	21.423	419.10>225.10	6	419.10>167.10	12
200	溴氰菊酯-1	Deltamethrin-1 (Tralomethrin deg.-1)	52918-63-5	21.771	252.90>93.00	20	252.90>171.90	8
201	溴氰菊酯-2	Deltamethrin-2 (Tralomethrin deg.-2)	52918-63-5	21.975	252.90>93.00	20	252.90>171.90	8
202	恶唑酮菌(恶唑菌酮)	Famoxadone	131807-57-3	22.371	330.10>224.10	10	330.10>196.10	22

备注:中文名称中部分农药带 () 为同一农药在岛津MRM农残数据库中的名称和在中国常用的农药名称

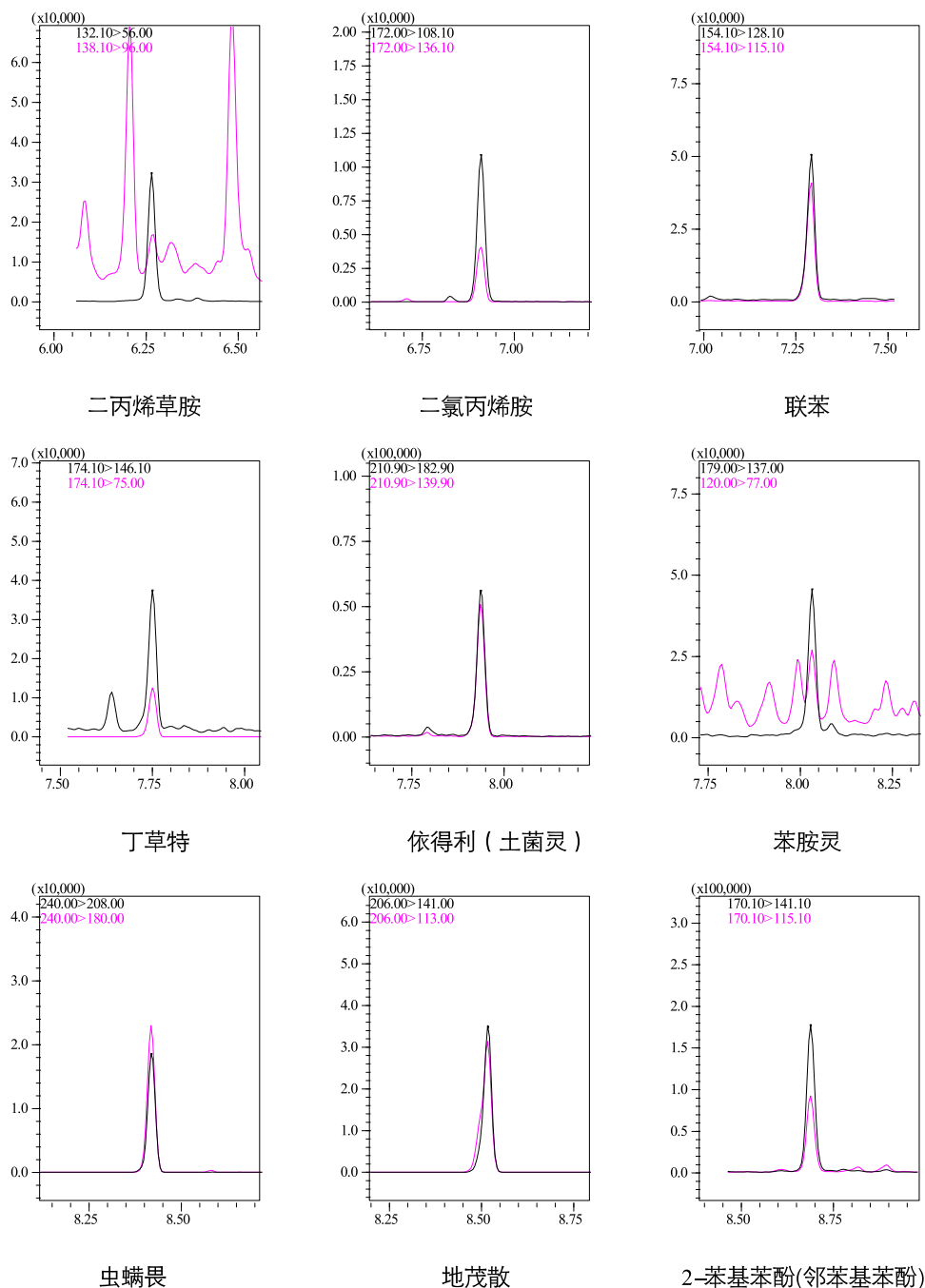
1.3 样品前处理

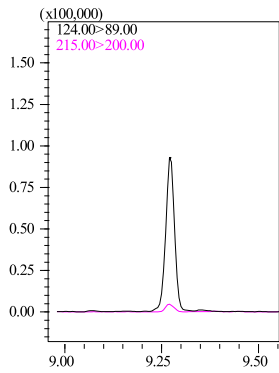
准确称取 10 g 试样，于 50 mL 离心管中，加入 10 mL 乙腈，用均质机高速匀浆 1 min。加入 8-12 g 氯化钠，漩涡混合后，静置 2 h，待分层。取 1 mL 上清液，QuEChERS 净化，过膜，氮吹至干，丙酮定容至 1 mL，加 179 种农药混标（加标浓度为 10 μg/L）。

■ 结果讨论

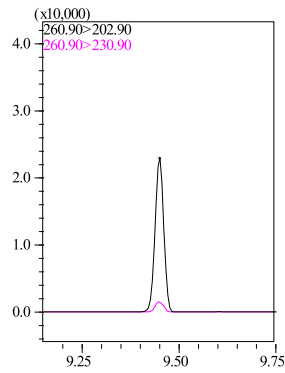
2.1 茶叶基质中 179 种农药残留（浓度为 10 μg/L）灵敏度考察

茶叶基质中 179 种农药残留（浓度为 10 μg/L）的质量色谱图见图 1。

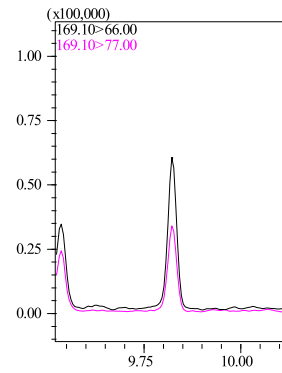




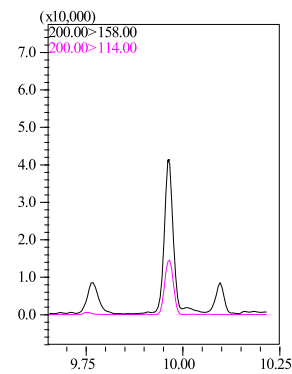
庚烯磷



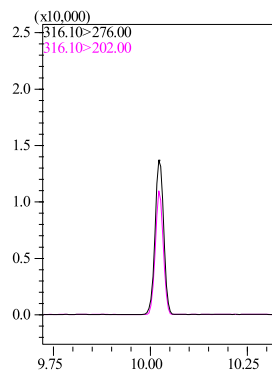
四氯硝基苯



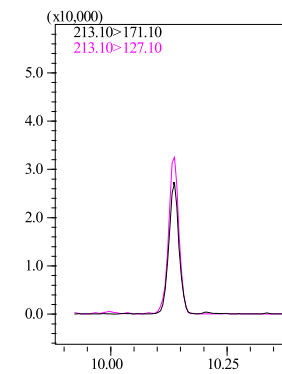
梨内二苯胺(二苯胺)



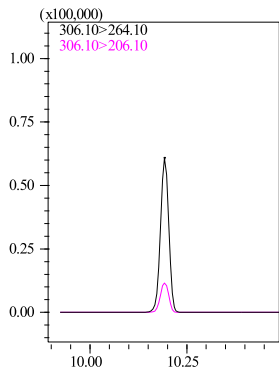
灭克磷(灭线磷)



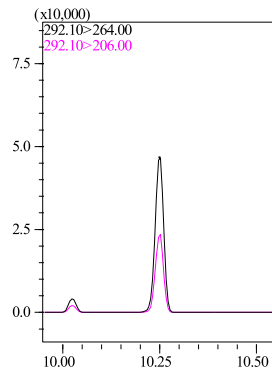
丁氟消草(乙丁烯氟灵)



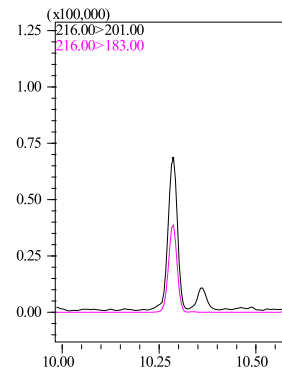
氯苯胺灵



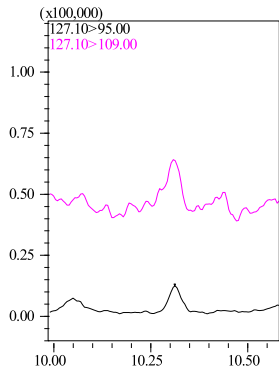
氟乐灵



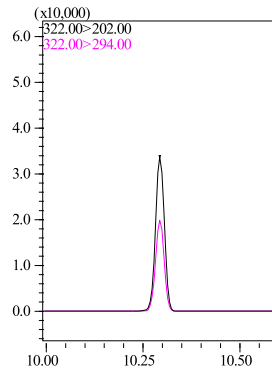
氟草胺(乙丁氟灵)



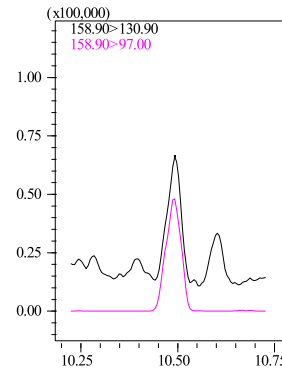
蔬果磷



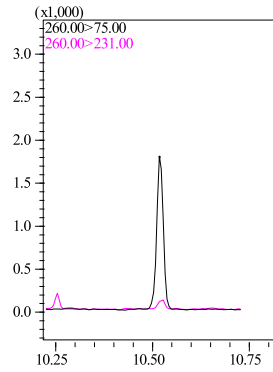
百治磷



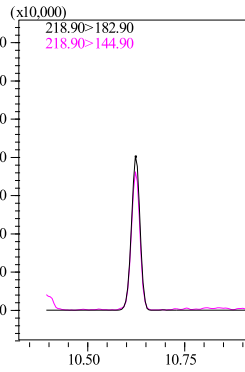
硫特普(治螟磷)



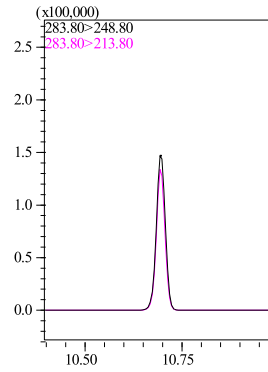
硫线磷



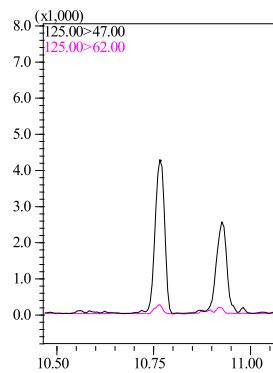
甲拌磷



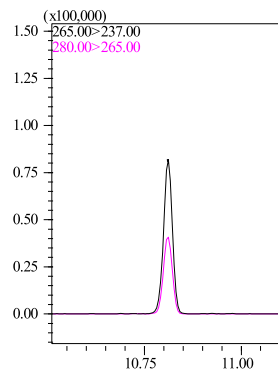
alpha-六六六



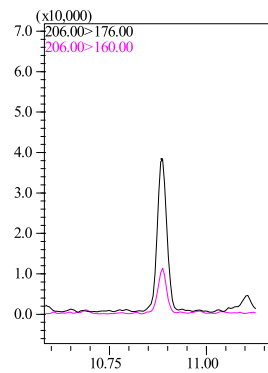
六氯苯



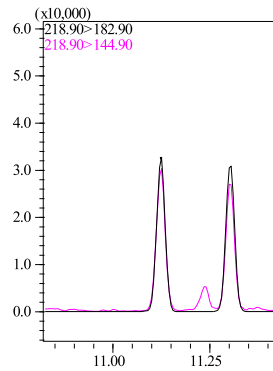
甲基乙拌磷(二甲基硫吸磷)



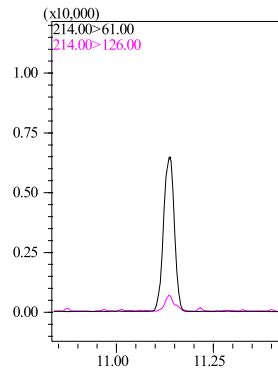
五氯甲氧基苯(五氯茴香醚)



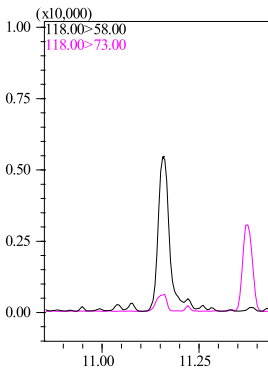
氯硝胺



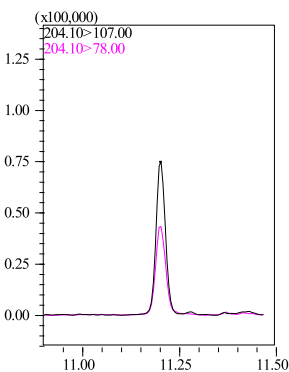
beta-六六六



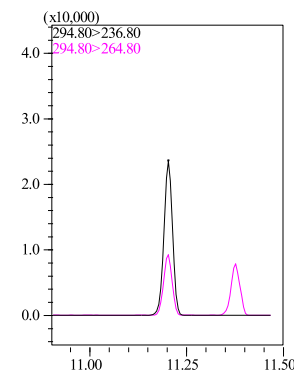
绿谷隆



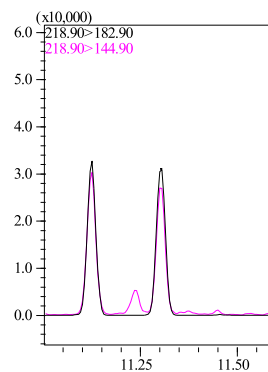
噻节因



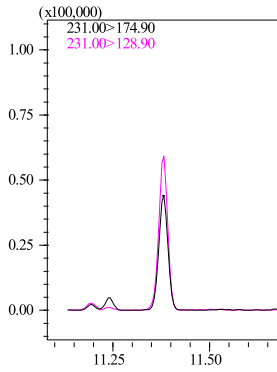
广灭灵(异恶草松)



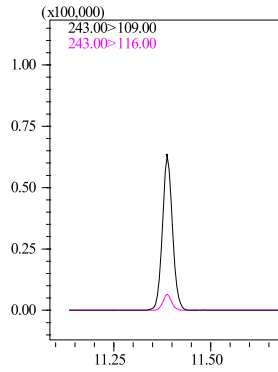
五氯硝基苯



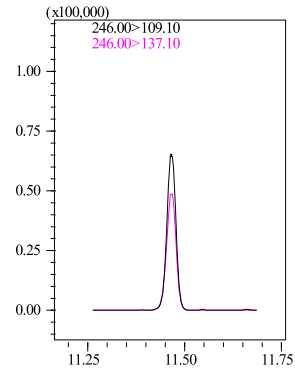
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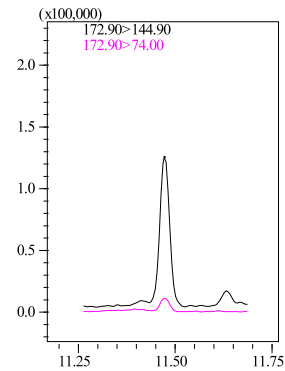
特丁硫磷



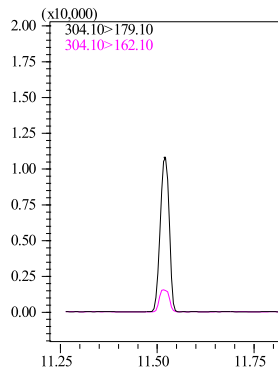
杀螟腈



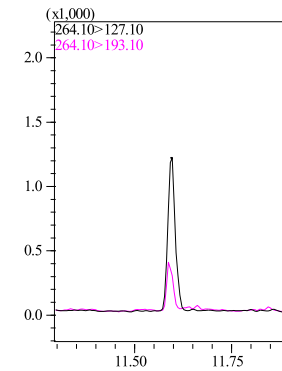
大福松(地虫磷)(地虫硫磷)



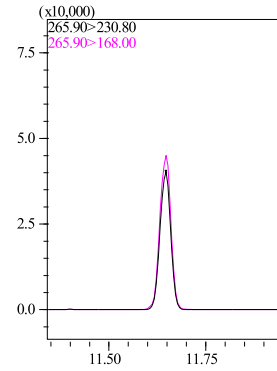
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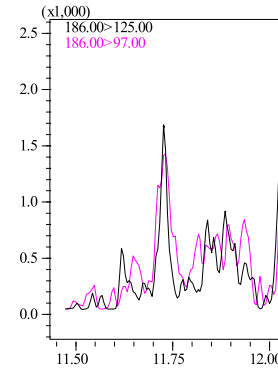
二嗪农(二嗪磷)



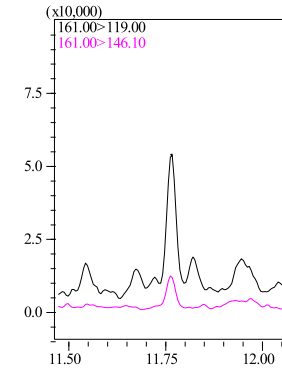
磷胺-1



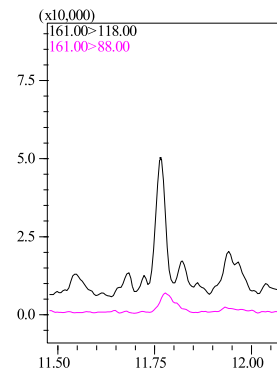
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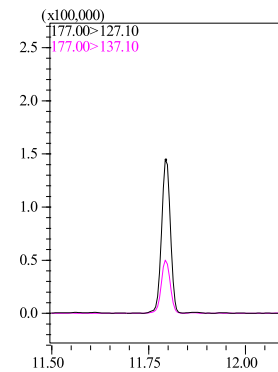
乙拌磷



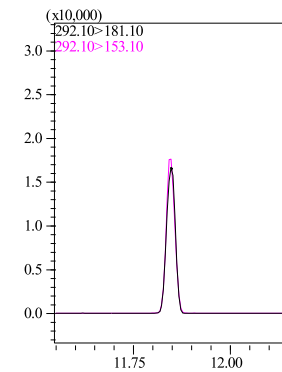
氯唑磷



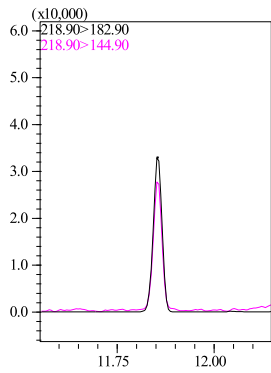
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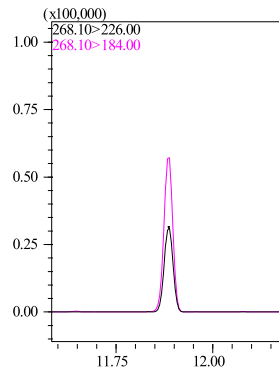
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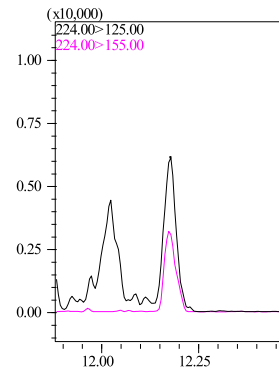
益多松(乙嘧硫磷)



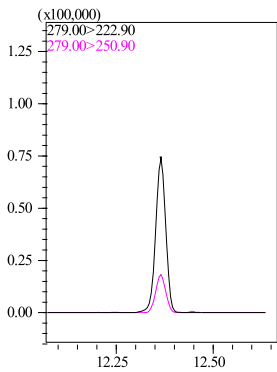
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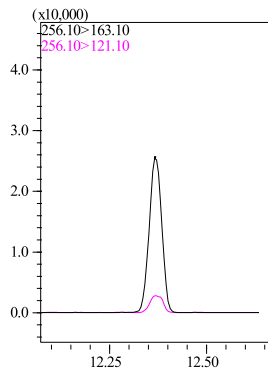
野麦畏



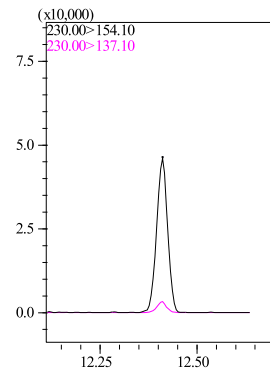
福木松(安硫磷)



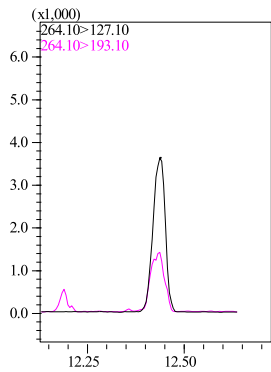
除线磷



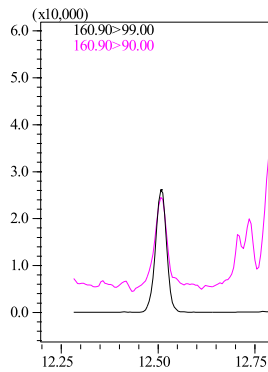
呋草黄(呋草磺)



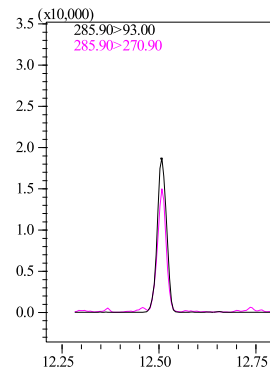
汰草灭(二甲吩草胺)



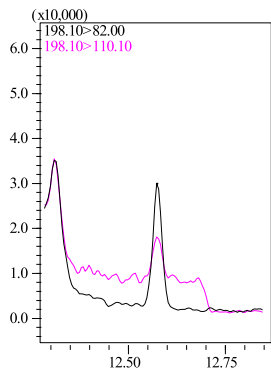
磷胺-2



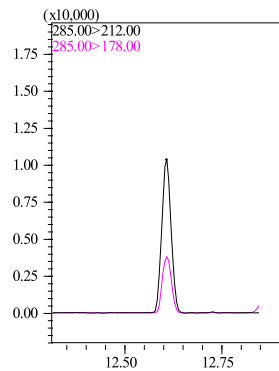
敌稗



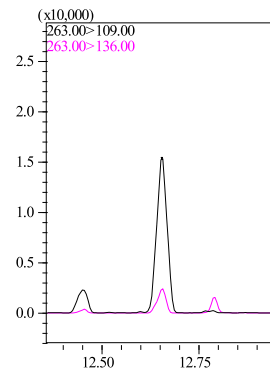
甲基毒死蜱



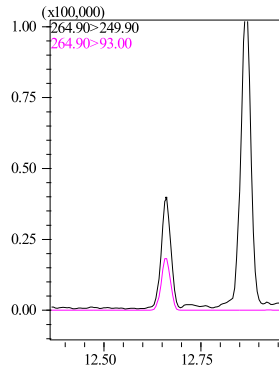
噻草酮



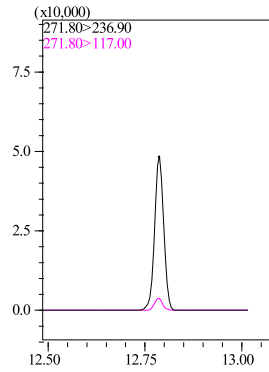
免克宁(乙烯菌核利)



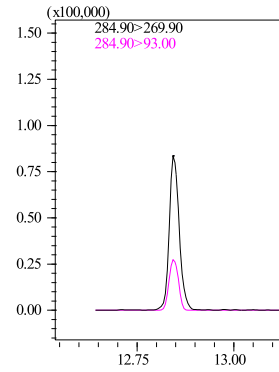
甲基对硫磷



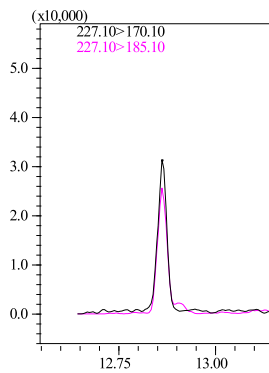
甲基立枯磷



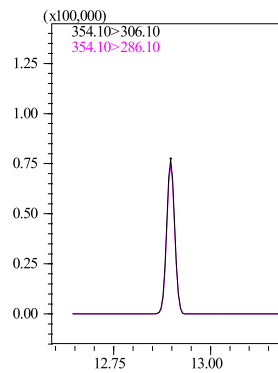
七氯



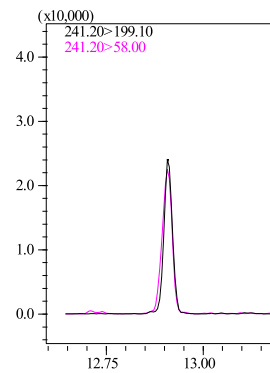
皮蝇磷



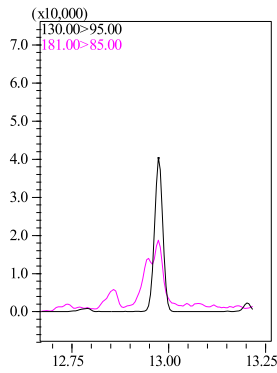
莠灭净



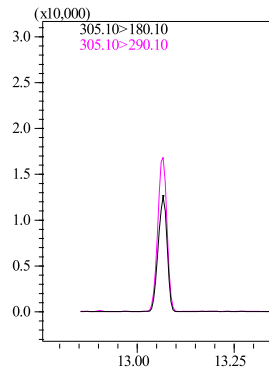
氟硫草定



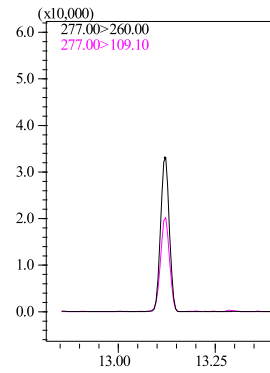
扑草净



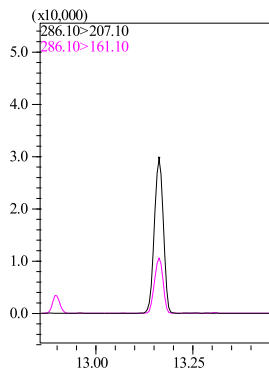
八氯二丙醚



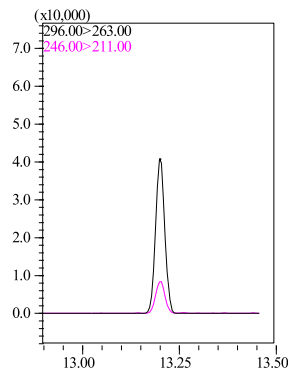
甲基嘧啶磷



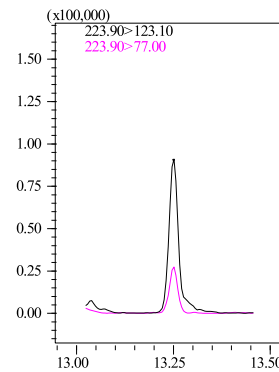
杀螟硫磷



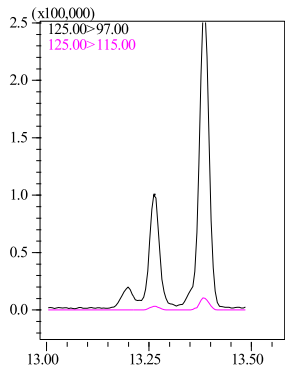
乙味草黄



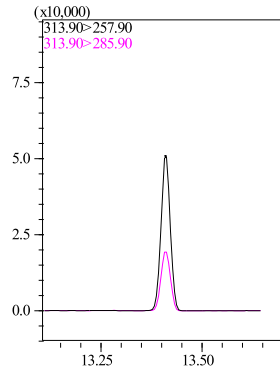
甲基五氯苯基硫醚



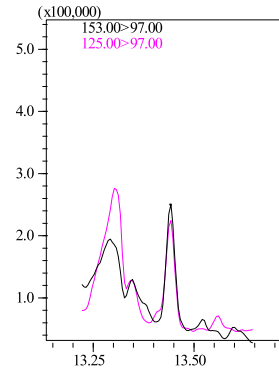
抑菌灵



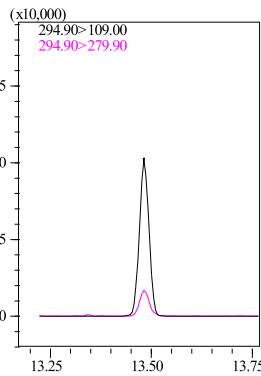
甲拌磷亚砷



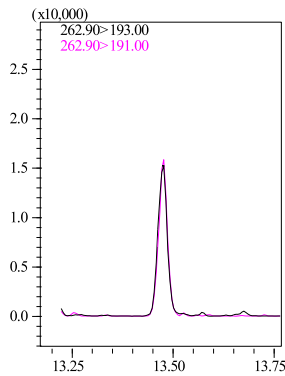
毒死蜱



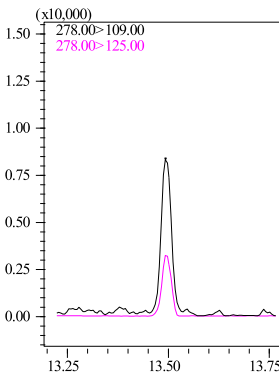
甲拌磷砷



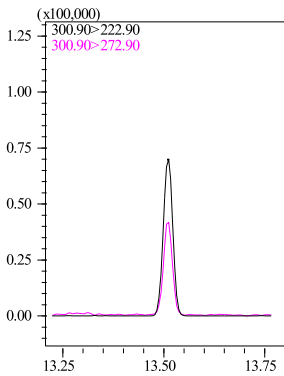
(E,Z)-甲基毒虫畏



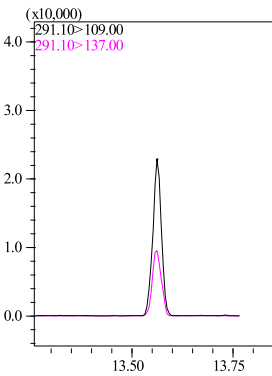
艾氏剂



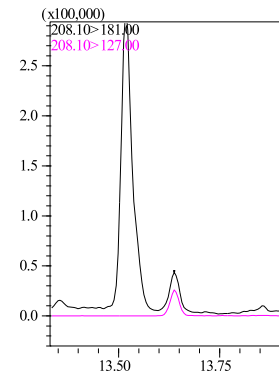
倍硫磷



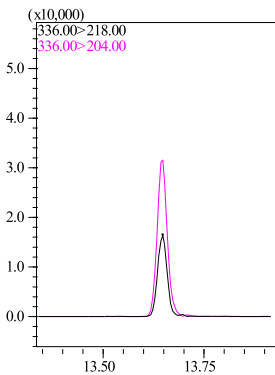
氯酞酸甲酯



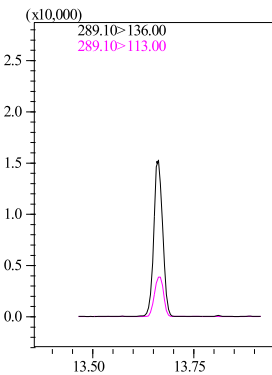
对硫磷



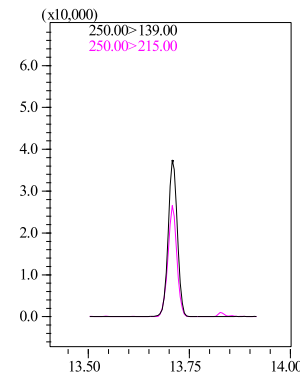
三泰芬(三唑酮)



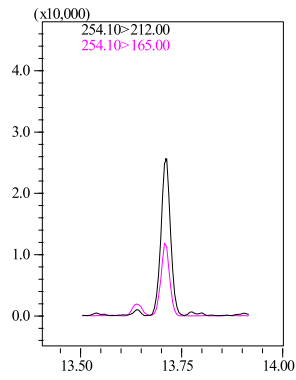
四克利(四氟醚唑)



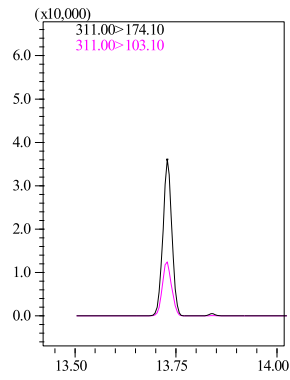
水胺硫磷



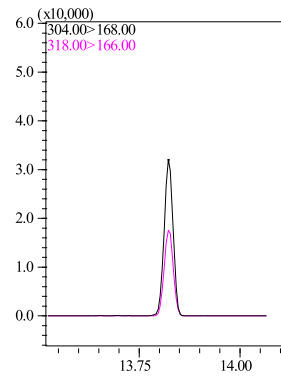
三氯杀螨醇分解物(三氯杀螨醇)



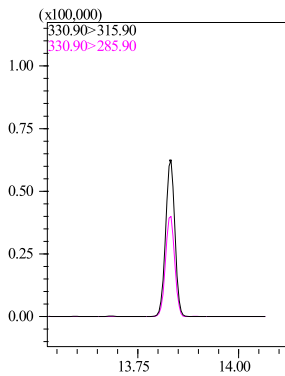
酞菌酯



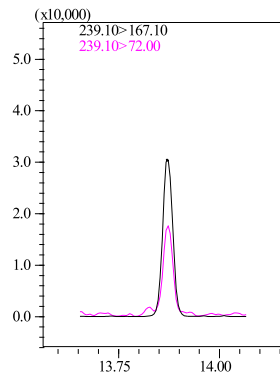
氟咯草酮



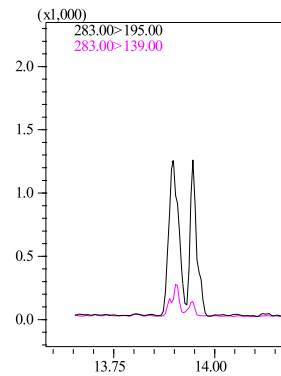
乙基虫螨磷/啉啉磷



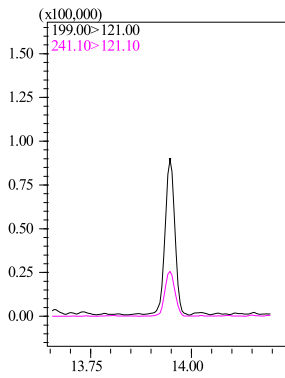
溴硫磷



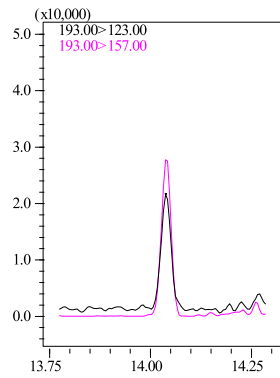
牧草谢(双苯酰草胺)



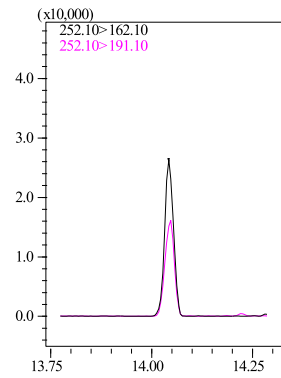
噻唑磷-1(噻唑磷)



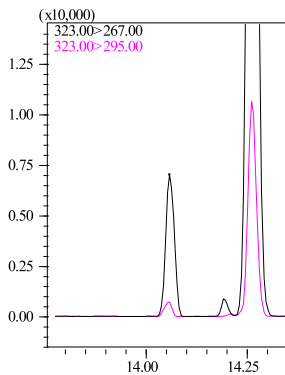
甲基异柳磷



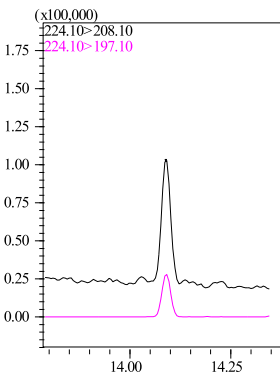
异艾氏剂



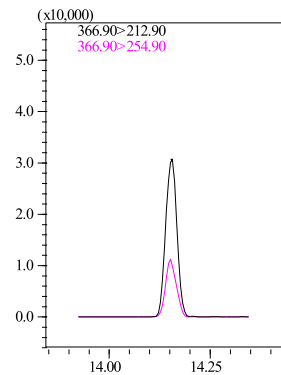
二甲戊乐灵



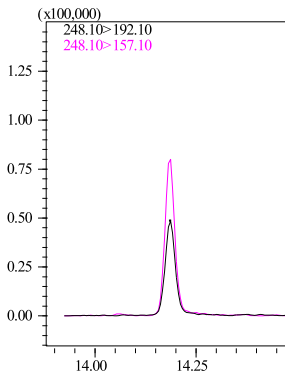
(E,Z)-毒虫畏



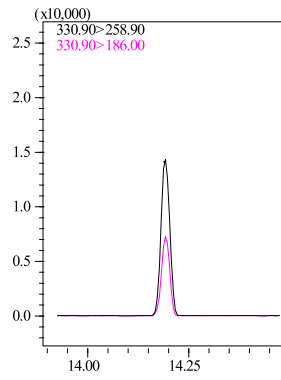
啉菌环胺



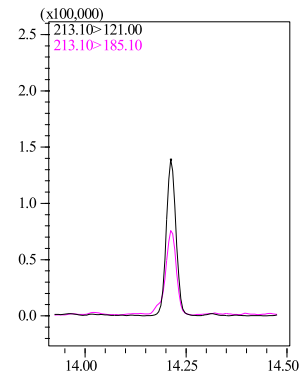
氟虫腈



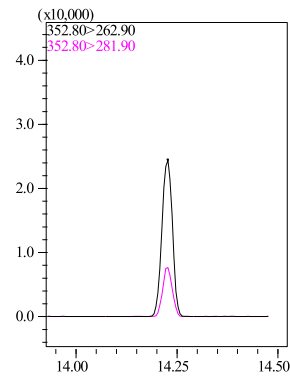
平克座 (戊菌唑)



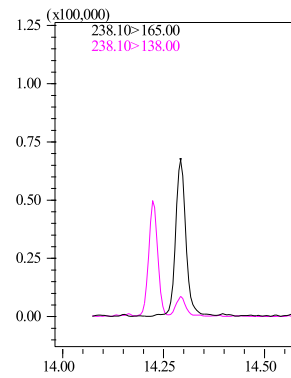
乙菌利 (克氯得)



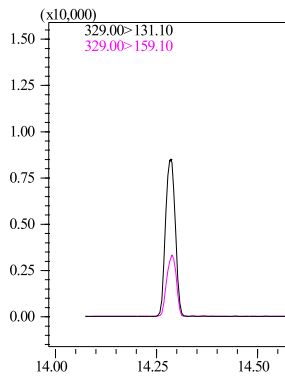
亚芬松 (异柳磷)



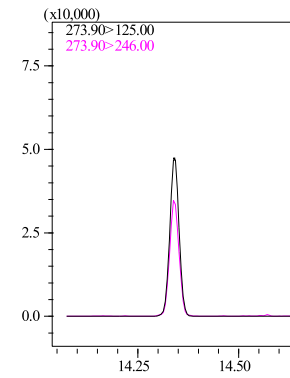
环氧七氯



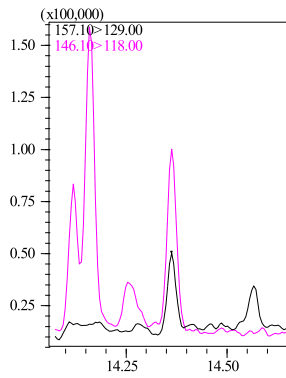
吗熟酯



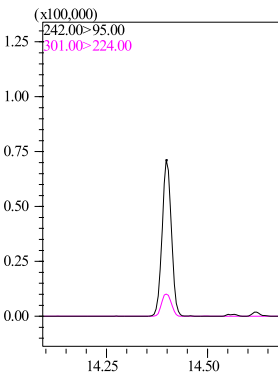
灭蚜磷



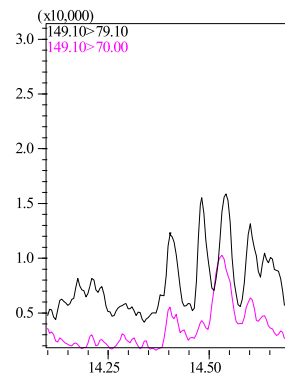
稻丰散



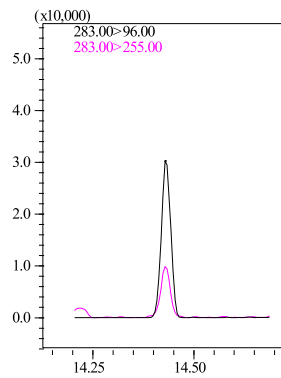
啶硫磷



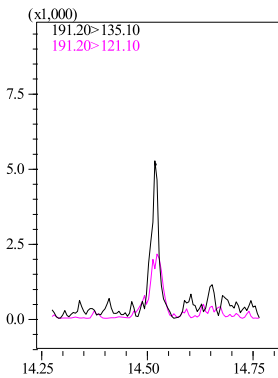
呋霜灵



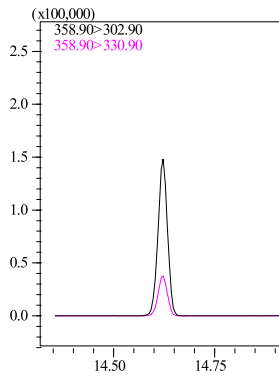
克菌丹



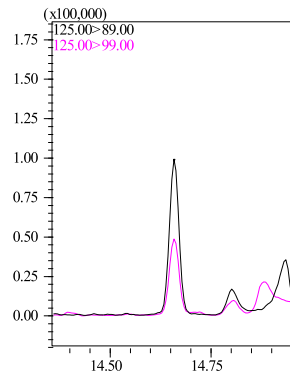
腐霉利



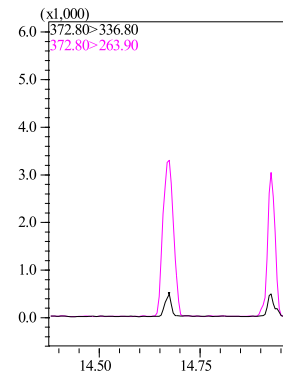
美赐平(烯虫酯)



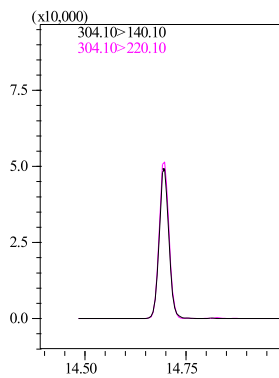
乙基溴硫磷



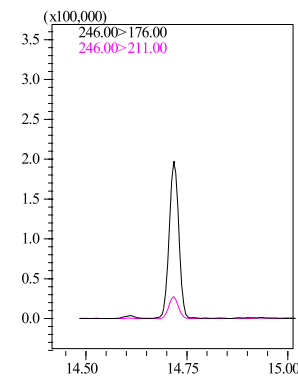
氯杀螨



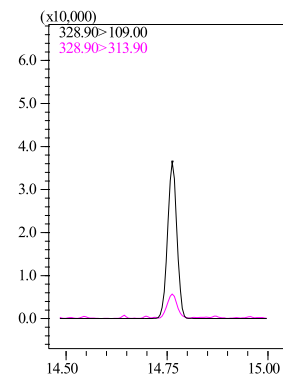
反,顺-氯丹



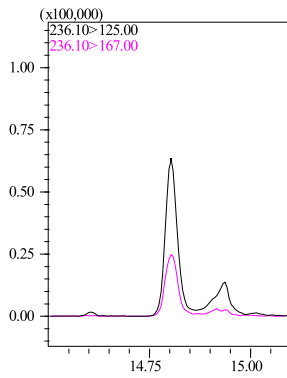
加护松(丙虫磷)



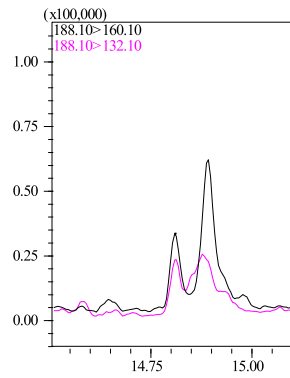
o,p'-DDE



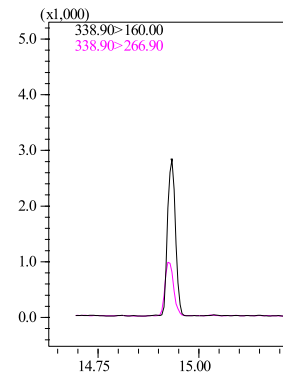
杀虫威(杀虫畏)



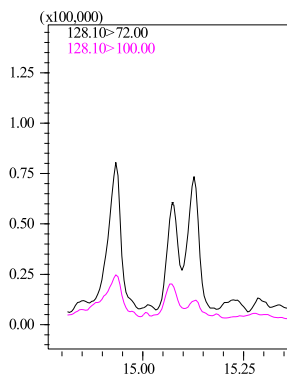
多效唑



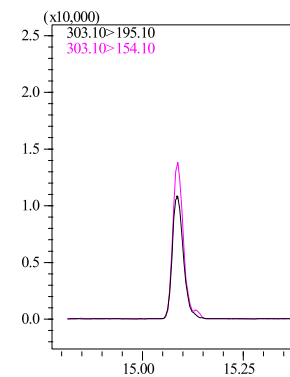
丁基拉草(丁草胺)



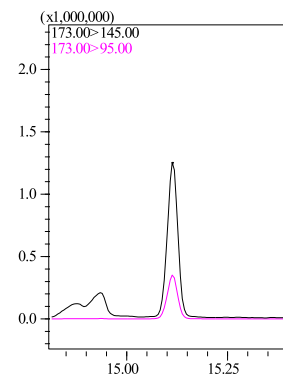
alpha-硫丹



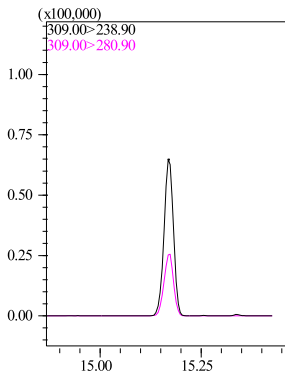
萘丙酰草胺(敌草胺)



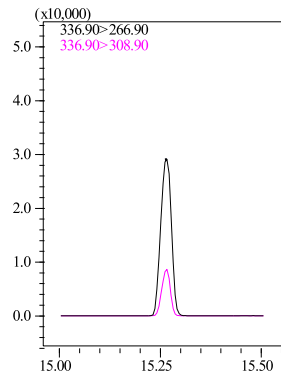
克线磷(苯线磷)



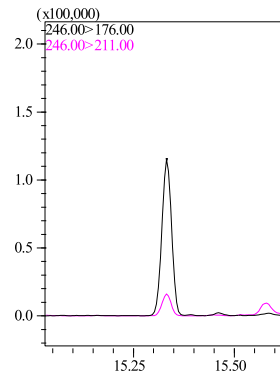
福多宁(氟酰胺)



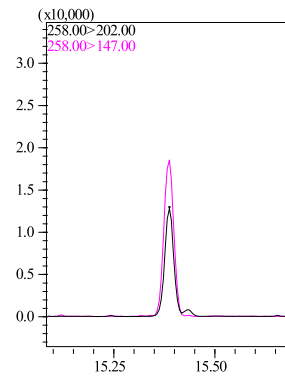
普硫松 (丙硫磷)



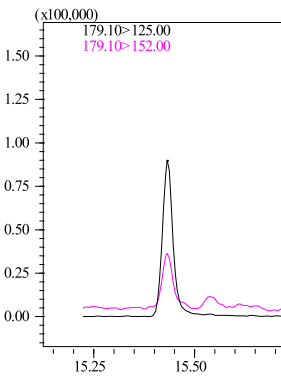
丙溴磷



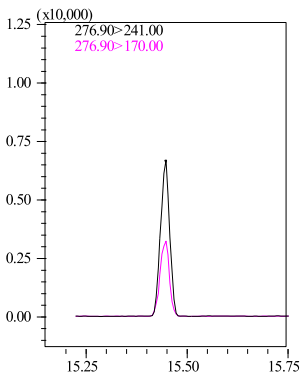
p,p'-DDE



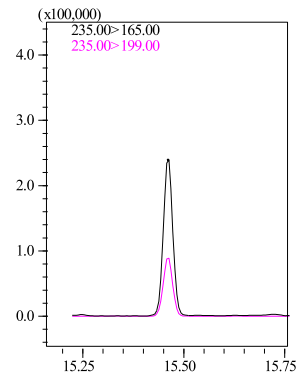
脱叶磷



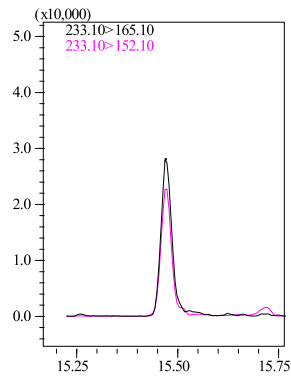
灭克落



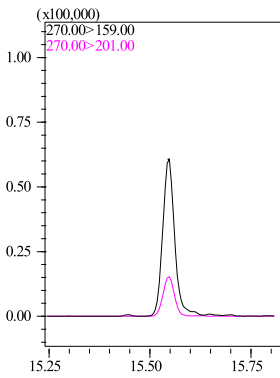
狄氏剂(地特灵)



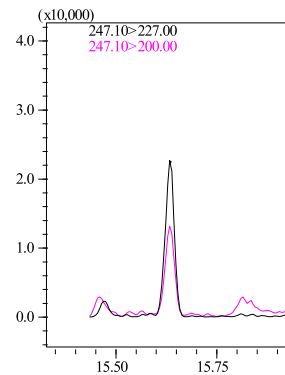
o,p'-DDD



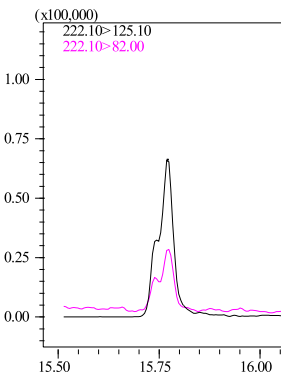
氟硅唑



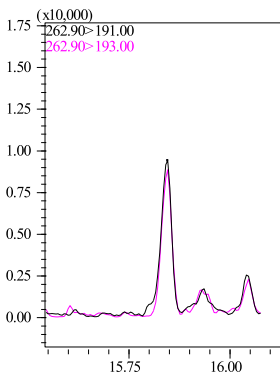
苯氯三唑醇



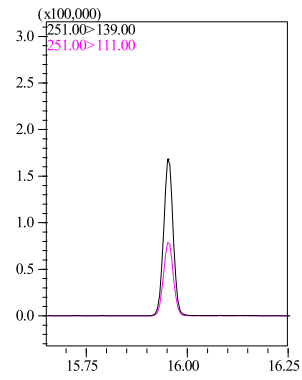
克凡派(虫螨腈)



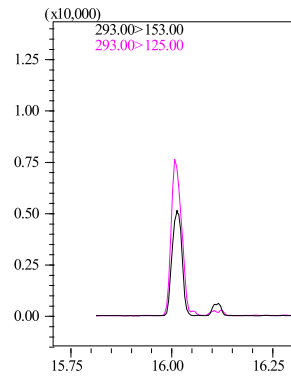
环唑醇-1,2



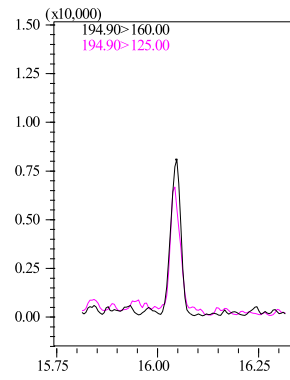
异狄氏剂



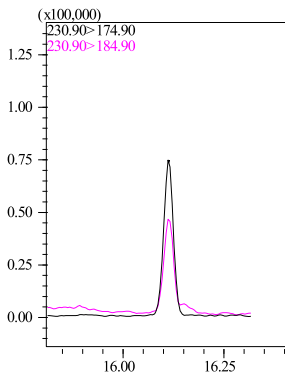
杀螨酯(乙酯杀螨醇)



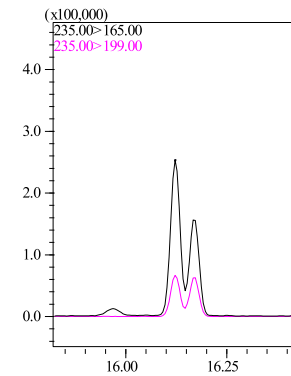
丰索磷



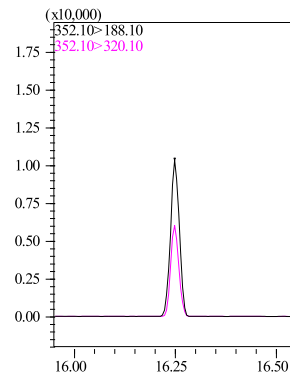
beta-硫丹



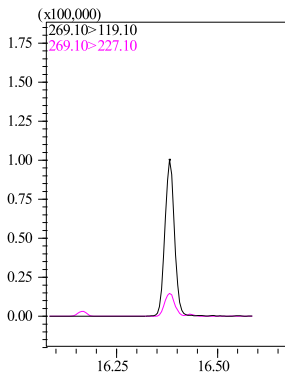
爱杀松(乙硫磷)



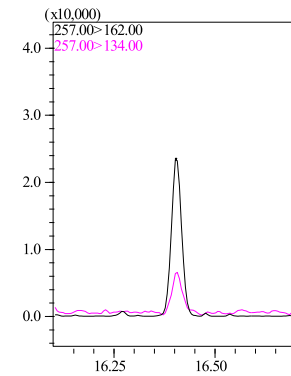
p,p'-DDD o,p'-DDT



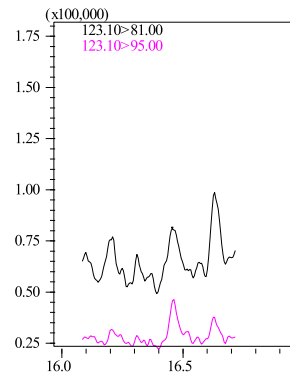
啞螨酯



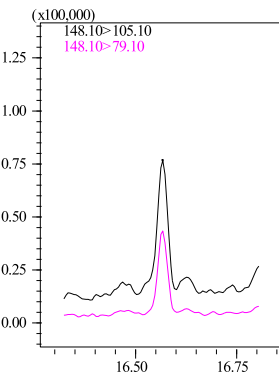
灭普宁(灭锈胺)



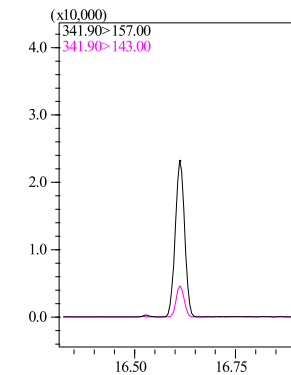
三唑磷



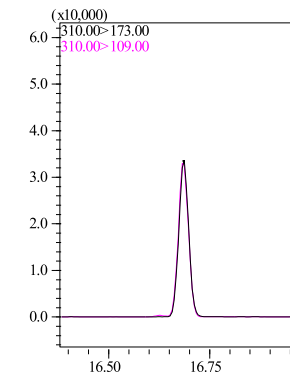
除虫菊酯 I



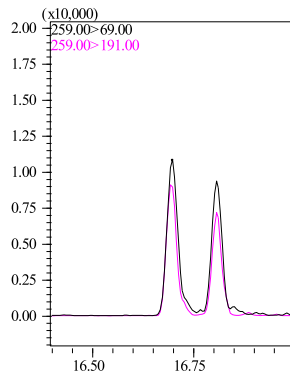
本达乐(苯霜灵)



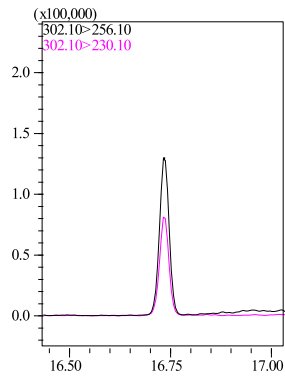
三硫磷



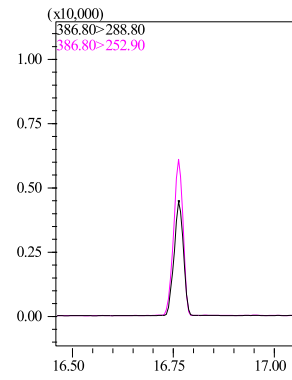
克温散(敌瘟磷)



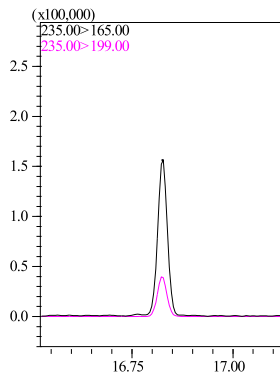
丙环唑-1,2



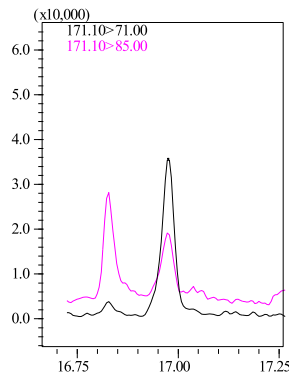
(Z,E)-甲基嘧草醚



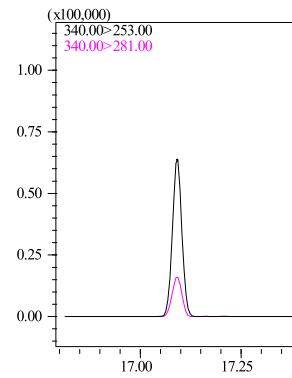
硫丹硫酸酯



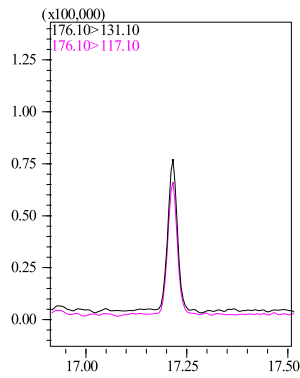
p,p'-DDT



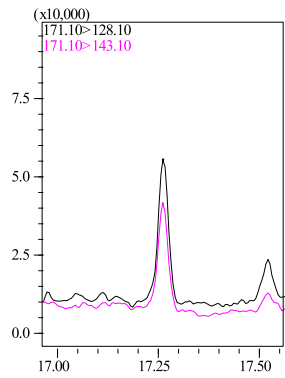
环嗪酮



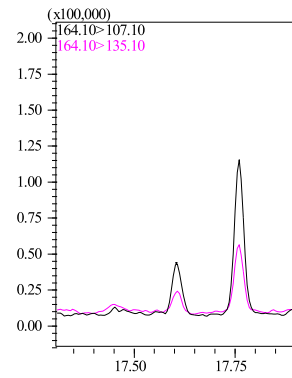
禾草灵



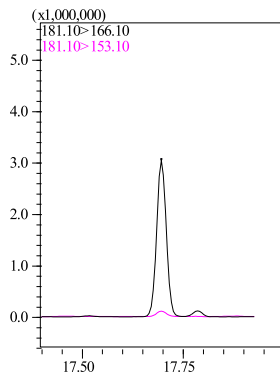
胡椒基丁醚(增效醚)



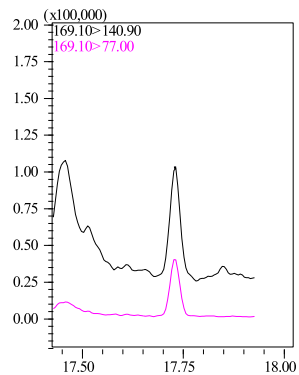
苜呋菊酯



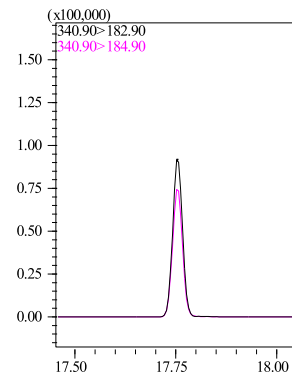
胺菊酯-1,2



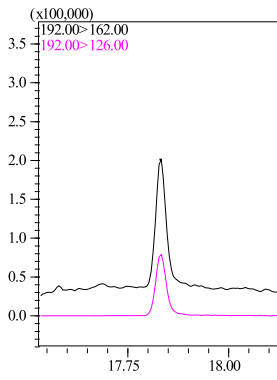
联苯菊酯



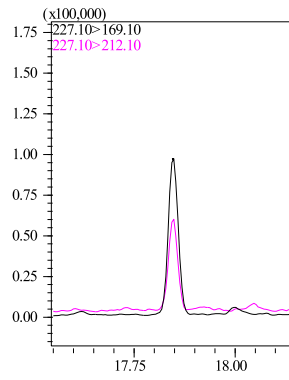
苯硫磷



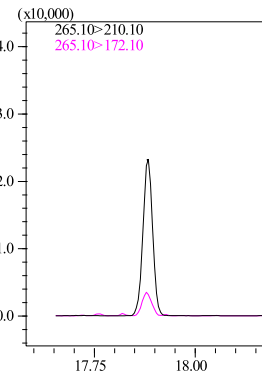
溴螨酯



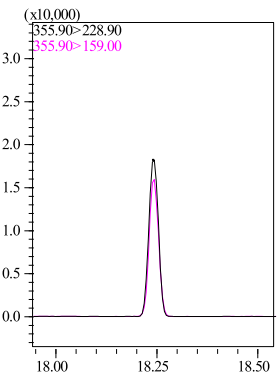
解毒啉



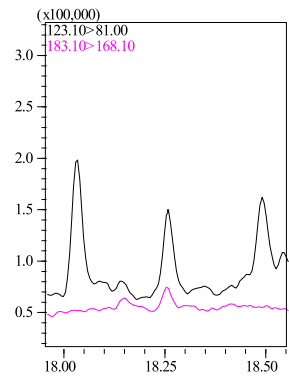
甲氧滴滴涕(甲氧氯)



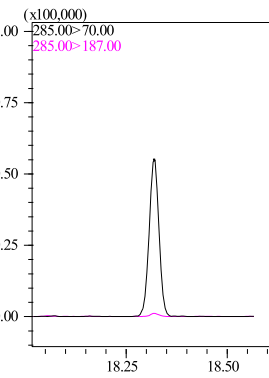
芬普宁(甲氰菊酯)



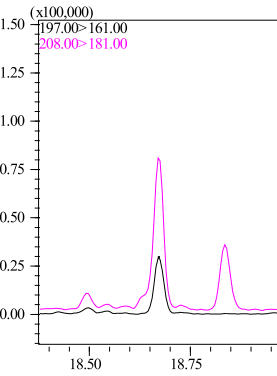
四氯杀螨砒(三氯杀螨砒)



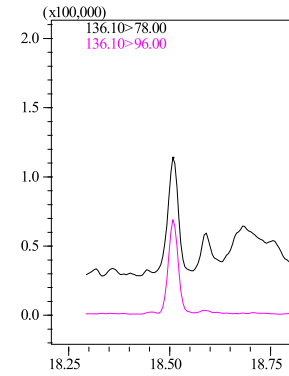
苯醚菊酯-1,2



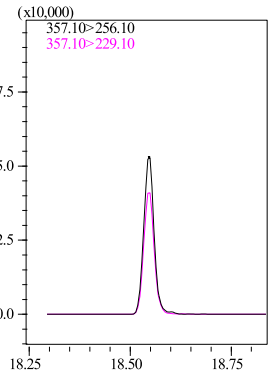
戊噁草酮(戊基恶唑酮)



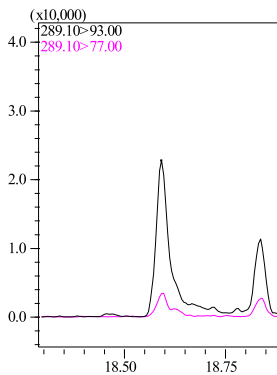
氯氟菊酯-1,2



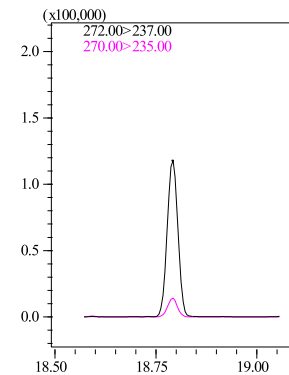
吡丙醚(蚊蝇醚)



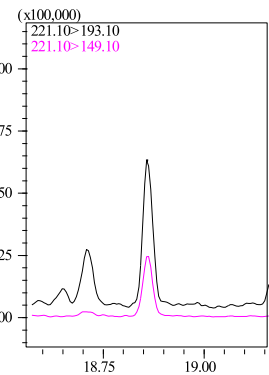
氟氟草酯



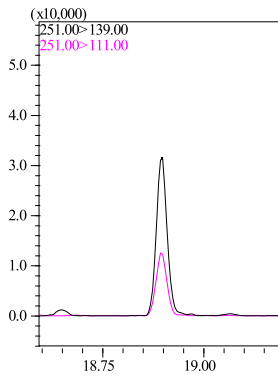
氟丙菊酯



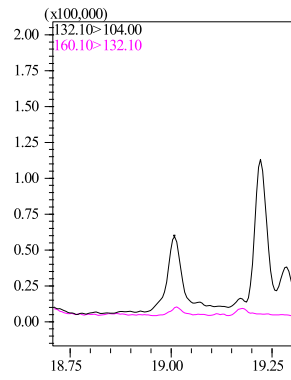
灭蚊灵



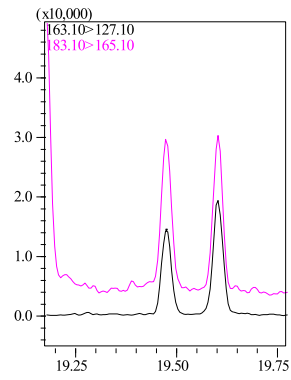
定菌磷(吡菌磷)



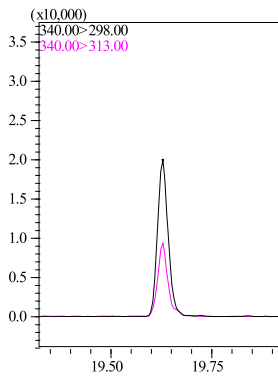
氯苯咪唑醇



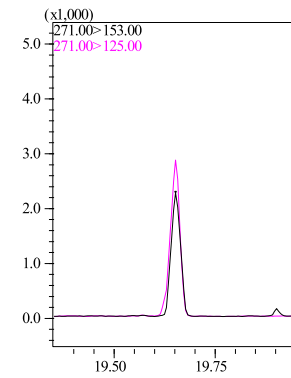
乙基谷硫磷



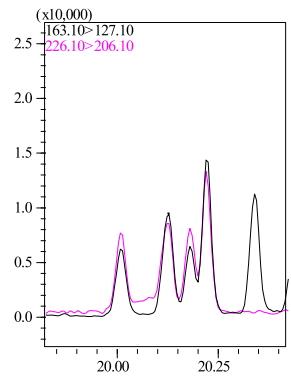
氯菊酯-1,2



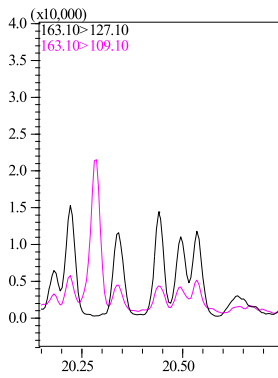
氟啶唑



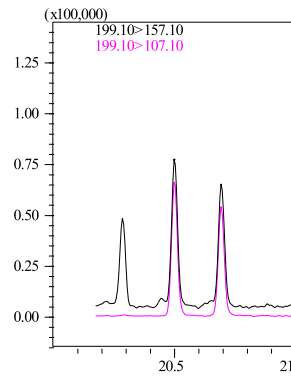
敌杀磷



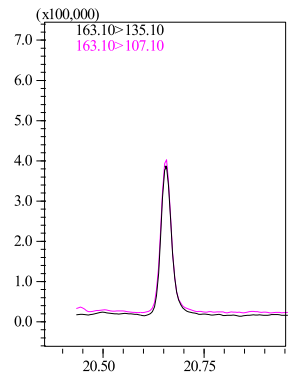
氟氯菊酯-1,2,3,4



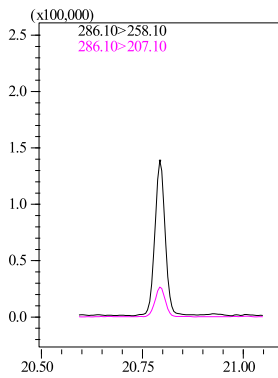
氯氟菊酯-1,2,3,4



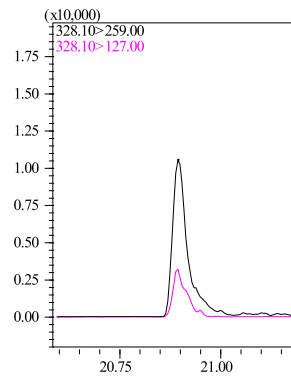
氟氯菊酯(氟氯戊菊酯)-1,2



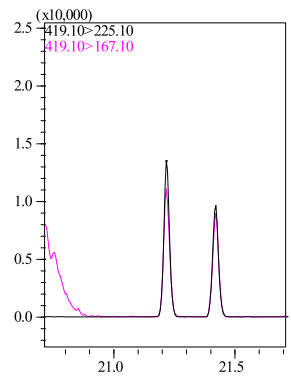
依芬宁(醚菊酯)



硅醚菊酯



氟啶草酮



氟戊菊酯-1,2

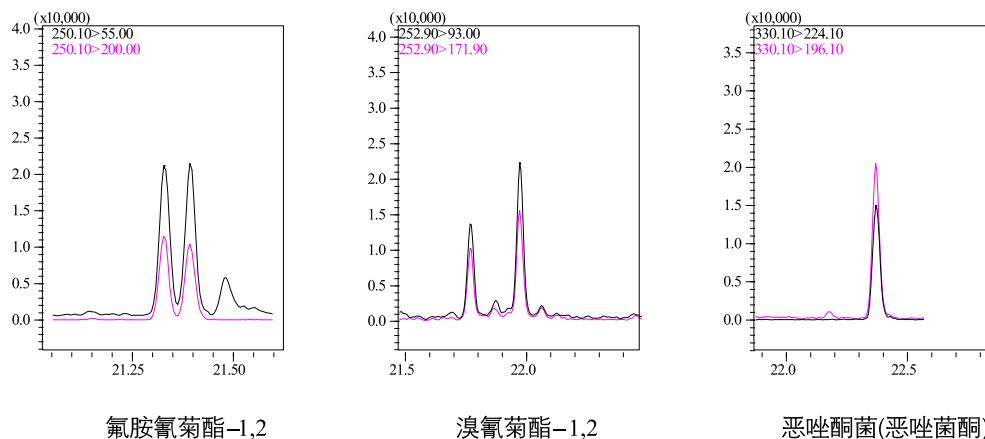


图1 茶叶中179种农药混标(加标10 μg/L)的质量色谱图

2.2 重复性测试

取茶叶空白基质配制的 10 μg/L 的混合标品，重复进样 6 次，重复性结果见表 2。

表2 茶叶中179种农药残留(加标10 μg/L)连接进样6针的峰面积

No	中文名称	峰面积 1	峰面积 2	峰面积 3	峰面积 4	峰面积 5	峰面积 6	RSD %
1	二丙烯草胺	12614	10850	11484	11966	12401	11819	5.38
2	二氯丙烯胺	14014	13656	13684	14172	13839	13969	1.44
3	联苯	81933	83098	82645	81304	81537	84168	1.31
4	丁草特	49528	47875	51292	51650	49002	51637	3.17
5	依得利(土菌灵)	74699	75229	74012	74625	74858	72366	1.38
6	苯胺灵	65869	59395	61021	58739	59858	58570	4.52
7	虫螨畏	23648	23316	24121	23580	24087	23107	1.72
8	地茂散	48643	47768	47798	47906	47126	47721	1.02
9	2-苯基苯酚(邻苯基苯酚)	246619	245397	238845	237877	235291	238927	1.87
10	庚烯磷	131954	129400	132954	131188	130444	128378	1.28
11	四氯硝基苯	31768	33042	31996	29053	31263	32976	4.62
12	梨内二苯胺(二苯胺)	84752	85426	84411	84640	85632	84965	0.56
13	灭克磷(灭线磷)	56989	53668	55765	55097	53813	53845	2.44
14	丁氟消草(乙丁烯氟灵)	18184	18478	19496	18650	17539	18792	3.52
15	氯苯胺灵	39463	37699	36560	37094	38463	37845	2.70
16	氟乐灵	75767	75114	73047	75542	74779	77172	1.80
17	氟草胺(乙丁氟灵)	57228	60178	61450	57045	60862	59568	3.13
18	蔬果磷	101478	101103	99814	99842	97728	100761	1.35
19	百治磷	23129	24735	23964	24181	26665	24391	4.84
20	硫特普(治螟磷)	46982	46546	47616	46785	47328	50377	2.96
21	硫线磷	123960	116241	115236	119992	116097	117733	2.77
22	甲拌磷	2108	2042	2288	1731	2114	1869	9.75
23	alpha-六六六	52408	54182	54219	51090	51084	53370	2.71
24	六氯苯	213656	208115	209426	210682	206464	205353	1.44
25	甲基乙拌磷(二甲基硫吸磷)	6077	6075	6719	6621	6636	6135	4.88

26	五氯甲氧基苯(五氯茴香醚)	116782	115696	115536	112297	115392	116014	1.34
27	氯硝胺	59404	59172	57079	60670	58075	59066	2.08
28	beta-六六六	41620	41347	42065	41218	41331	42920	1.55
29	绿谷隆	12335	13750	12880	13453	12585	12203	4.82
30	噻节因	8534	9241	8807	9797	8932	9837	5.82
31	广灭灵(异恶草松)	103054	104380	108948	108375	102620	109376	2.93
32	五氯硝基苯	30207	32203	30871	30560	30988	29428	3.00
33	gamma-六六六	40526	44595	43227	41992	39536	40175	4.70
34	特丁硫磷	63531	63045	61080	61148	62516	58663	2.88
35	杀螟腈	103939	99886	97993	100458	102784	101373	2.10
36	大福松(地虫磷)(地虫硫磷)	92600	91197	87476	88559	94801	96425	3.79
37	炔敌稗	196769	194163	195353	196148	194372	197962	0.75
38	二嗪农(二嗪磷)	16468	15301	16370	15150	14649	15935	4.65
39	磷胺	8890	9486	9467	9776	10637	8722	7.22
40	百菌清	78426	78666	75294	77712	76457	75641	1.87
41	乙拌磷	4911	4363	3926	4356	4381	4228	7.32
42	氯唑磷	80745	76460	70931	74634	71116	78186	5.19
43	特草定	61492	83139	75258	79220	72698	71494	10.07
44	七氟菊酯	191138	191805	188333	193374	192096	196876	1.46
45	益多松(乙啉硫磷)	21352	23909	22978	23172	21687	24704	5.57
46	delta-六六六	44361	47364	47566	43727	42630	43149	4.79
47	野麦畏	43331	39708	41483	41543	40315	41695	3.03
48	福木松(安硫磷)	10429	11462	11121	10510	12047	11674	5.77
49	除线磷	119698	107824	112269	113609	114432	115575	3.43
50	呋草黄(呋草磺)	50920	47541	47633	46634	50500	50744	3.93
51	汰草灭(二甲吩草胺)	79269	77428	77703	80766	79645	80346	1.73
52	敌稗	43412	45024	43674	47988	43167	46202	4.22
53	甲基毒死蜱	25775	25221	24701	26689	24278	24639	3.53
54	噻草酮	44151	41384	38952	43479	40679	41293	4.56
55	免克宁(乙烯菌核利)	15390	14654	14029	13149	13734	13332	6.03
56	甲基对硫磷	43531	46861	47825	41921	40086	42556	6.81
57	甲基立枯磷	124269	123226	117958	112002	116110	112447	4.44
58	七氯	71174	69350	73689	71104	70815	71531	1.97
59	皮蝇磷	125729	127084	123643	124554	124339	125940	1.01
60	莠灭净	41864	42742	41343	41809	41001	42131	1.45
61	氟硫草定	93735	94549	94308	94250	89655	97844	2.78
62	扑草净	33149	30975	32065	30879	32302	31375	2.76
63	八氯二丙醚	52077	52226	50382	52256	55389	53722	3.23
64	甲基嘧啶磷	16690	17437	17327	17797	15751	16942	4.24
65	杀螟硫磷	50246	46269	46632	48325	46760	46779	3.20

66	乙炔草黄	41774	41994	40419	39740	41901	41471	2.24
67	甲基五氯苯基硫酸酯	57473	53750	55565	54820	53257	53327	2.98
68	抑菌灵	144368	142296	141874	141614	144211	143730	0.86
69	甲拌磷亚砷	135751	137294	131747	132563	130684	135098	1.92
70	毒死蜱	70962	66609	71136	64292	70251	71806	4.36
71	甲拌磷砷	256446	233089	238174	250018	238437	249522	3.68
72	(E、Z)-甲基毒虫畏	77236	77847	75799	74129	75937	74163	2.02
73	艾氏剂	19797	19854	20215	19455	21773	20133	4.03
74	倍硫磷	13544	13619	13281	14968	14527	13833	4.65
75	氯酞酸甲酯	94211	100191	90624	94811	90876	93168	3.71
76	对硫磷	31030	28661	29969	30100	31597	30935	3.42
77	三泰芬(三唑酮)	58710	64894	65326	72172	57534	59802	8.73
78	四克利(四氟醚唑)	24488	22832	24647	21122	24725	24449	6.12
79	水胺硫磷	20696	21350	19709	21341	20295	20718	3.04
80	三氯杀螨醇分解物	52467	48490	48942	48623	50309	50034	3.01
81	酞菌酯	37749	34291	34791	33674	31412	34305	5.94
82	氟咯草酮	50040	51923	49824	45310	52212	48716	5.06
83	乙基虫螨磷/噁啉磷	41494	41348	40310	39769	40360	39594	1.95
84	溴硫磷	88128	86563	88403	86748	82331	83454	2.90
85	牧草谢(双苯酰草胺)	47372	47262	47122	45901	47952	45913	1.78
86	噻唑膦-1(噻唑膦)	3381	3685	3404	3600	3517	3399	3.57
87	甲基异柳磷	128948	130340	128072	131626	128386	134817	1.96
88	异艾氏剂	32261	36280	35077	32137	33531	32976	4.90
89	二甲戊乐灵	32322	31870	33284	34971	36270	30615	6.28
90	噻菌环胺	122334	118512	109670	117614	117714	115470	3.58
91	氟虫腈	51446	50137	53285	50832	51691	48935	2.89
92	平克座(戊菌唑)	79830	77064	78377	75404	80190	74607	2.96
93	乙菌利(克氯得)	17101	18377	18993	18220	18511	18413	3.45
94	亚芬松(异柳磷)	195205	197653	200941	193820	185077	189892	2.91
95	环氧七氯 (exo)	38417	37644	33812	37875	33247	39409	6.97
96	(E、Z)-毒虫畏	88055	90995	91430	92057	89025	91017	1.71
97	吲熟酯	109226	108639	110839	104978	103435	97803	4.54
98	灭蚜磷	11002	10733	12213	10694	10130	11407	6.48
99	稻丰散	68360	66202	68195	66321	65608	64518	2.25
100	啶硫磷	62392	56437	56754	57136	53628	56820	4.99
101	呋霜灵	97944	99534	98058	96212	102077	95840	2.34
102	克菌丹	6040	6201	5766	6047	5398	5295	6.45
103	腐霉利	44218	38295	39663	41596	37259	39776	6.19
104	美赐平(烯虫酯)	83934	97612	91332	87126	93787	88264	5.45

105	乙基溴硫磷	214793	204261	208554	205056	203967	207994	1.97
106	氯杀螨	140940	138146	138218	144451	143127	138079	2.00
107	氯丹	8808	9070	9953	9489	8641	9841	5.86
108	加护松(丙虫磷)	76486	74139	71692	76658	69700	69554	4.39
109	o,p'-DDE	279541	272710	265879	266356	264123	272165	2.14
110	杀虫威(杀虫畏)	55342	53382	58304	53211	55812	52478	3.96
111	多效唑	117083	118589	110759	106901	113193	117550	4.01
112	丁基拉草(丁草胺)	49987	50980	53657	47264	47133	48647	5.02
113	硫丹	15018	15942	14645	16936	16040	16702	5.69
114	萘丙酰草胺(敌草胺)	82305	85525	87484	83643	88408	77151	4.87
115	克线磷(苯线磷)	18060	18354	16967	20871	19069	18722	6.93
116	福多宁(氟酰胺)	193175 9	190770 7	192307 9	192929 9	192027 6	194002 7	0.58
117	普硫松(丙硫磷)	83311	88133	84156	89828	85726	86076	2.83
118	丙溴磷	48493	47315	50192	48343	46707	48446	2.48
119	p,p'-DDE	173333	165778	161829	163440	157355	168631	3.36
120	脱叶磷	20889	20199	20263	18412	17632	17642	7.55
121	灭克落	153338	149572	151912	148794	151234	148394	1.29
122	狄氏剂(地特灵)	8081	7853	7916	7365	8814	8456	6.24
123	o,p'-DDD	336801	329629	327961	328798	329765	328298	1.00
124	氟硅唑	45754	43393	44529	44849	43665	42689	2.51
125	苄氯三唑醇	115726	115893	113998	114855	109282	115911	2.24
126	克凡派(虫螨腈)	30181	30127	26738	29624	30910	32152	6.02
127	环唑醇	164306	164199	158449	159558	157144	161435	1.86
128	异狄氏剂	13518	16570	14395	16292	13793	14852	8.55
129	杀螨酯(乙酯杀螨醇)	240390	233978	238429	232966	229985	232458	1.67
130	丰索磷	6405	6795	7352	6535	6324	6954	5.76
131	爱杀松(乙硫磷)	110959	99580	105902	108875	111793	102525	4.55
132	p,p'-DDD	365643	355652	363692	366822	349142	355560	1.95
133	o,p'-DDT	225174	222936	230265	216854	228495	223937	2.10
134	噁螨酯	11819	10541	12329	11885	10800	10954	6.30
135	灭普宁(灭锈胺)	140611	134916	145534	145473	139270	144206	2.97
136	三唑磷	36986	34883	34731	36944	34858	36369	3.04
137	除虫菊素 I(除虫菊酯I)	82253	85400	89339	84673	82845	87417	3.17

138	本达乐(苯霜灵)	112481	110688	108678	112719	107603	109598	1.87
139	三硫磷	29588	30396	30594	33014	32046	31948	4.08
140	克温散(敌瘟磷)	53009	49809	53469	51646	53687	54897	3.38
141	丙环唑	32996	31093	34836	34371	32971	33349	3.94
142	(E、Z)-甲基嘧草醚	188761	195565	191167	191996	189630	190827	1.24
142	硫丹硫酸酯	6026	6474	5407	6343	5358	6832	9.79
143	p,p'-DDT	210782	214557	219391	222159	211891	222114	2.34
144	环嗪酮	70282	70630	68577	68039	65848	67281	2.65
145	禾草灵	94373	89106	89117	91738	92544	92820	2.31
146	胡椒基丁醚(增效醚)	115814	110446	109825	110613	113742	111188	2.09
147	苄呋菊酯	92053	87868	81801	90347	82398	89006	4.85
148	胺菊酯	208913	216424	217984	207701	209929	210010	2.02
149	联苯菊酯	433404 2	424766 6	424913 2	435366 7	4282811	435838 5	1.18
150	苯硫磷	135072	131713	125188	126420	118495	129746	4.53
151	溴螨酯	142206	134341	141124	140697	138359	135938	2.25
152	解毒啞	285937	279971	283187	333486	314914	274230	7.95
153	甲氧滴滴涕(甲氧氯)	149108	148844	144446	148438	149249	147216	1.24
154	芬普宁(甲氧菊酯)	34429	31440	32799	32273	34384	33174	3.56
155	四氯杀螨砒(三氯杀螨砒)	23385	23686	23035	22869	20966	23015	4.20
156	苯醚菊酯	125702	141881	120022	135047	125667	126715	6.10
157	戊噁草酮(戊基恶唑酮)	81738	81641	82042	82420	78831	80531	1.63
158	氯氟氰菊酯	45222	44306	46483	48779	45415	44255	3.71
159	吡丙醚(蚊蝇醚)	138026	135618	132045	132269	131695	133518	1.86
160	氰氟草酯	80266	76348	76267	78492	78954	80166	2.26
161	氟丙菊酯	67148	58140	62207	55446	67095	67558	8.29
162	灭蚁灵	181195	180179	182508	179789	175908	177616	1.34
163	定菌磷(吡菌磷)	92655	87123	92316	93160	94318	93635	2.81
164	氯苯嘧啶醇	47044	47724	48108	47919	47846	47261	0.86
165	乙基谷硫磷	101593	98067	106031	111902	116857	99816	6.99
166	氯菊酯	50196	50262	49776	50086	47916	49275	1.80
167	氟啶啞	30170	30426	31880	29440	32741	32180	4.20
168	敌杀磷	3646	4146	3673	3951	4742	4174	9.98
169	氟氯氰菊酯	65201	65369	64887	61424	62350	65696	2.81

171	氯氰菊酯	65129	62407	64873	62884	61895	62965	2.10
172	氟氰菊酯(氟氰戊菊酯)	204522	192481	198484	200240	192964	208814	3.21
173	依芬宁(醚菊酯)	595198	606972	615105	624568	610816	631938	2.12
174	硅醚菊酯	218006	217904	215557	209953	217630	214441	1.44
175	氟啶草酮	27733	25274	28727	28813	27448	25712	5.48
176	氰戊菊酯	30589	30845	31113	30941	31233	32452	2.10
177	氟胺氰菊酯	62546	62967	63650	64043	63054	66265	2.10
178	溴氰菊酯	60245	60390	60804	58850	59077	59350	1.33
179	恶唑酮菌(恶唑菌酮)	29445	28245	30237	29555	30410	29865	2.61

■ 结论

采用岛津公司三重四极杆气质联用仪 GCMS-TQ8040 对茶叶基质中 179 种农药的灵敏度和重现性进行考察。结果表明，茶叶基质中 179 种农药峰形良好，重复性实验相对标准偏差 (RSD%) 均在 10% 以下，岛津 GCMS-TQ8040 在分析茶叶中多农药残留时灵敏度高，稳定性良好，结合岛津 Smart MRM 农残数据库，能够快速、准确地建立多农药残留检测方法，能够有效排除基质对检测结果的影响。