

A photograph of a laboratory rack containing several small glass vials with blue caps. Some vials contain a yellow liquid, while others are empty. The rack is white and the background is slightly blurred.

Dual layer injection

A way to improve the sensitivity of GC-amenable compounds



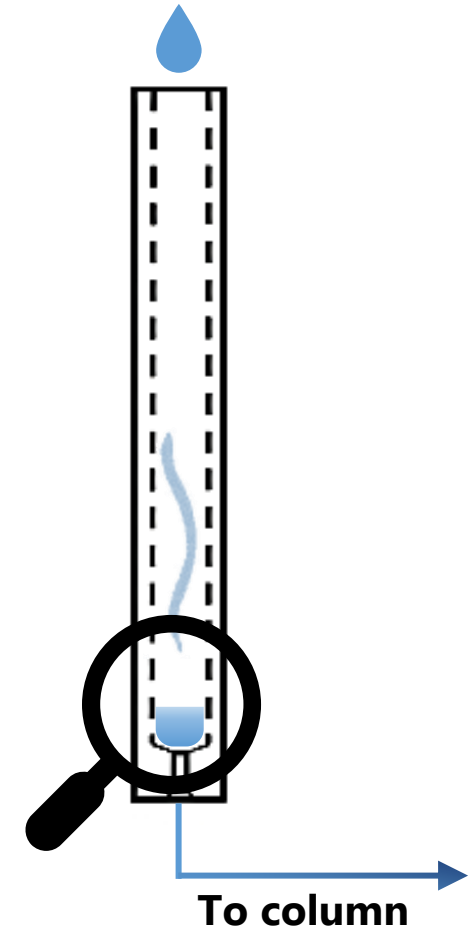
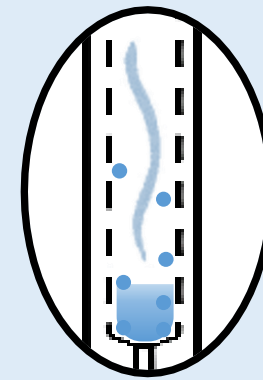
In gas chromatography, samples are typically injected in liquid state and turned into **gas state** in the injector

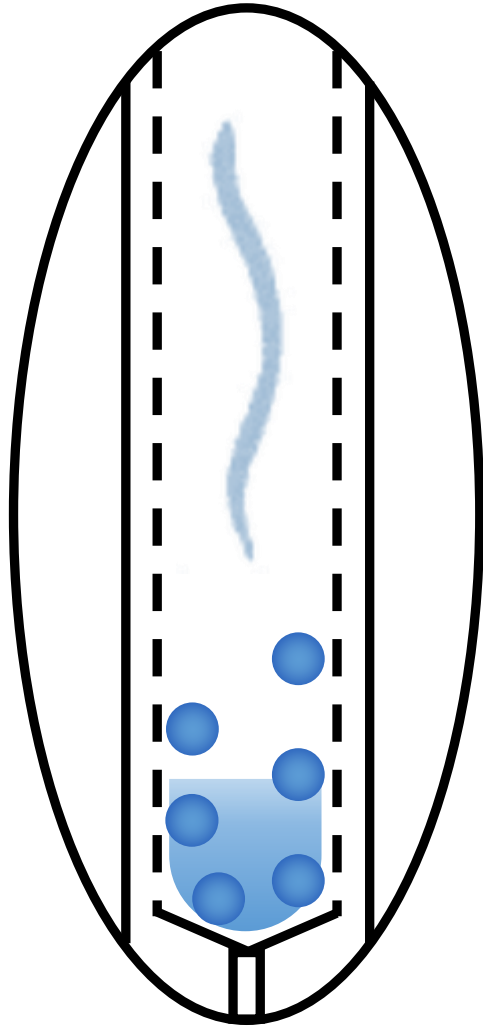
Liner



Over **30 different liner references** offered by companies specialized in chromatography

Even the inert liners possess **active sites** in which the sample components can be retained





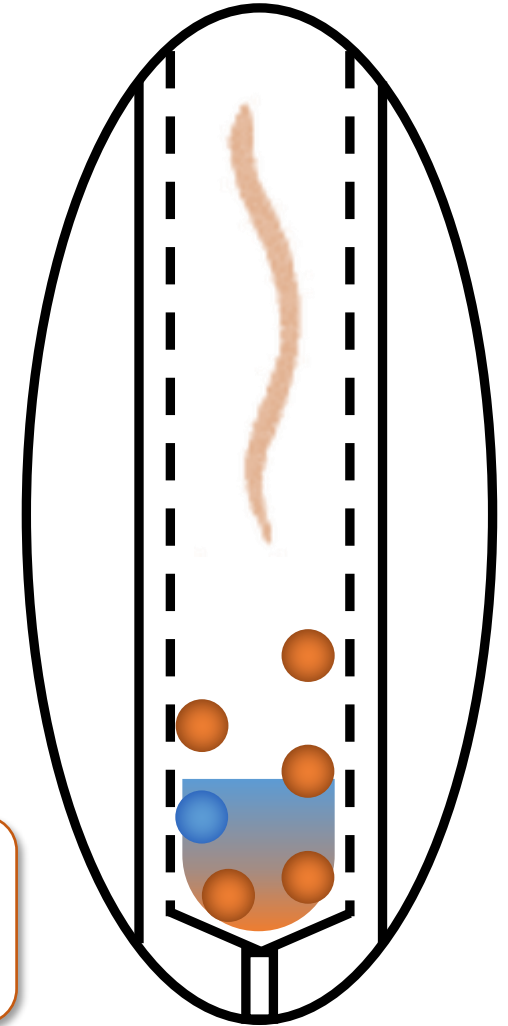
Few matrix components:
analytes retained in liner

Loss of sensitivity
Poor peak shapes



Abundant **matrix components** that can be **retained** in liner

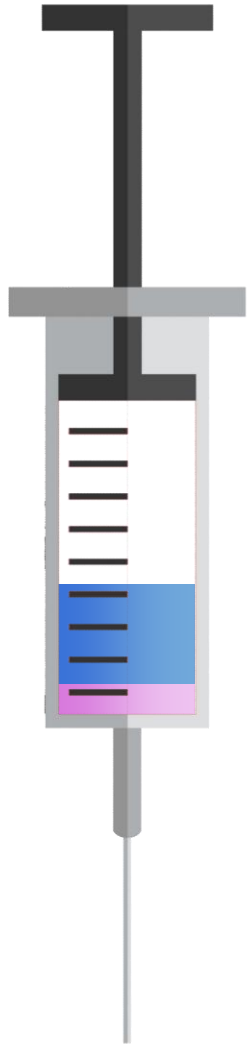
Higher sensitivity
Narrower peaks



Matrix effect: enhancement of the signals

REGULAR INJECTION

209 GC-amenable compounds in
tomato matrix



1 μL injection volume (sample)
0.2 μL gap (air)

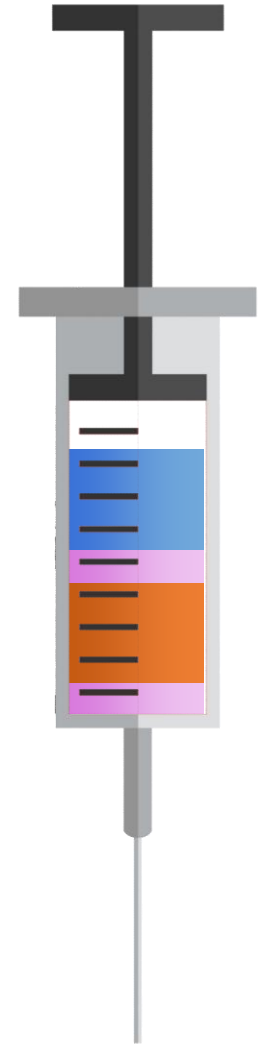
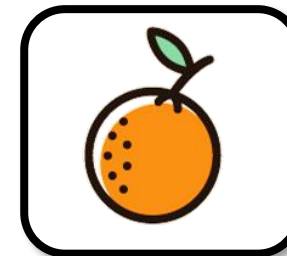


DUAL LAYER INJECTION

1 μL injection volume (sample)
0.2 μL gap (air)
1 μL blank extract (orange in EtAc)
0.2 μL gap (air)



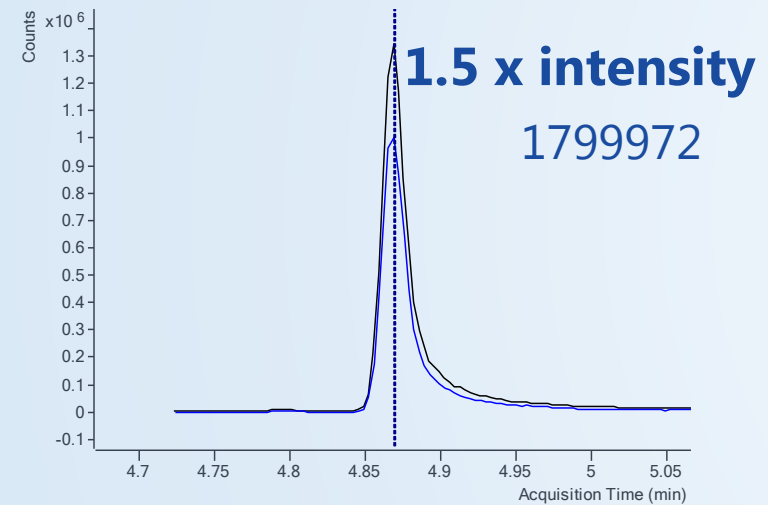
+



Chlorpropham (100 µg/L)

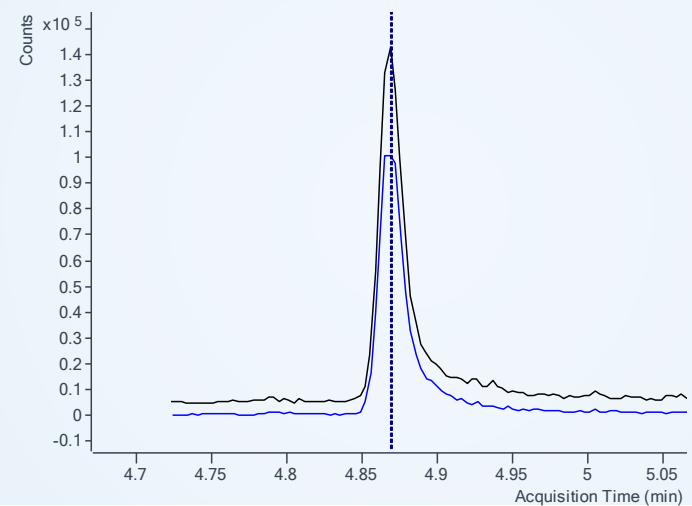


Dual layer injection



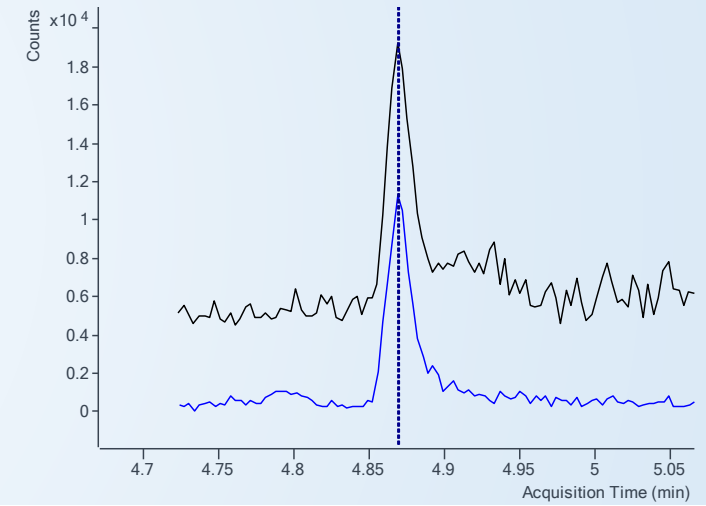
Chlorpropham (10 µg/L)

Dual layer injection

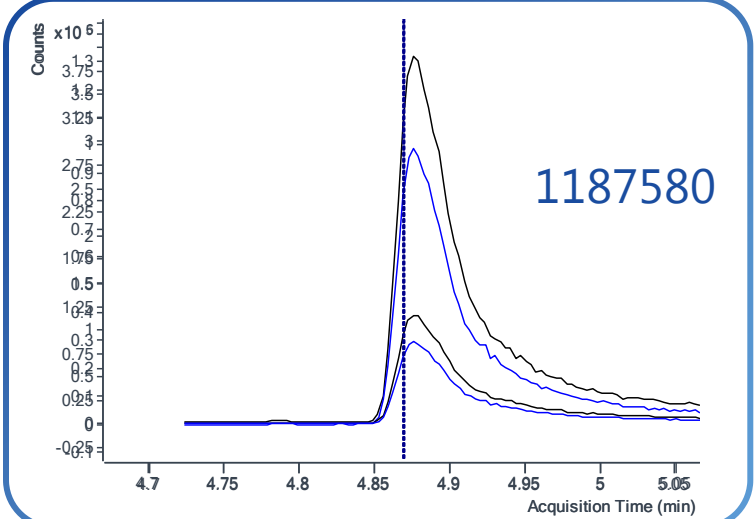


Chlorpropham (1 µg/L)

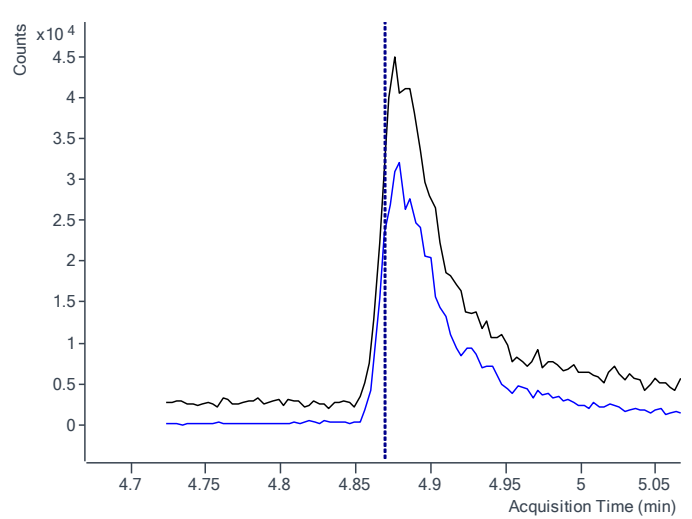
Dual layer injection



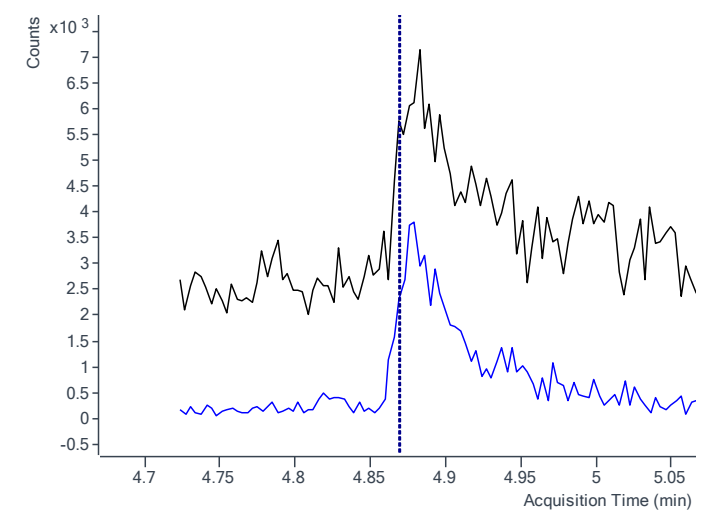
Regular injection



Regular injection



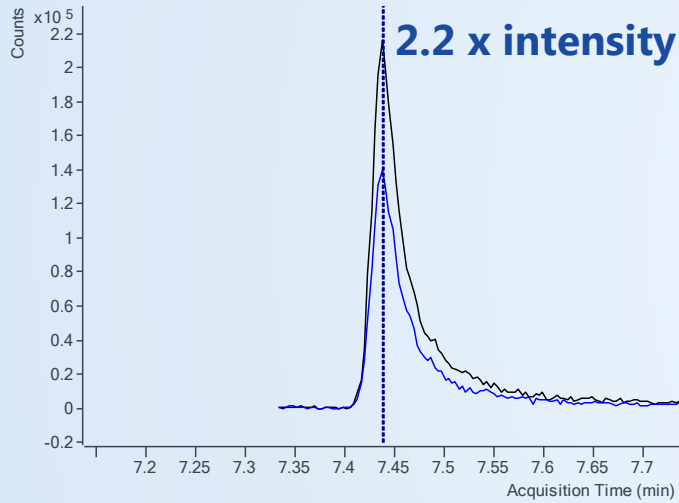
Regular injection



Fludioxonil (10 µg/L)

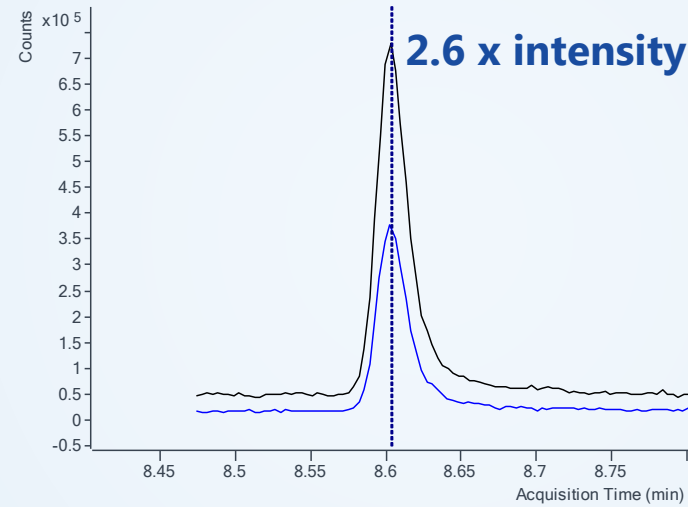


Dual layer injection



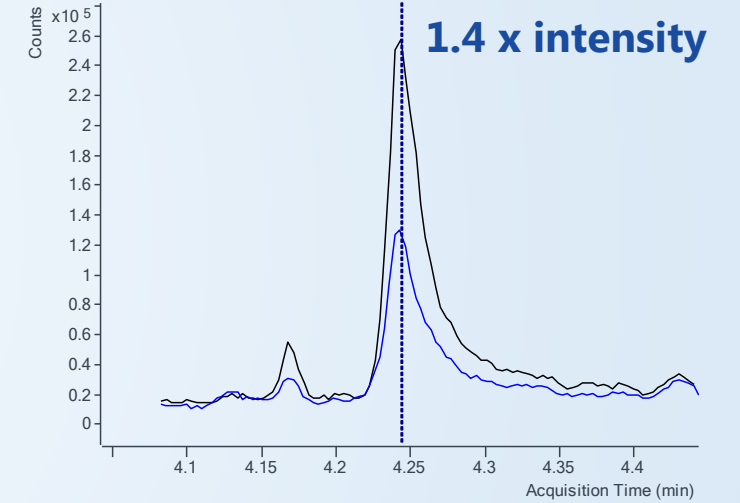
Phosmet (10 µg/L)

Dual layer injection

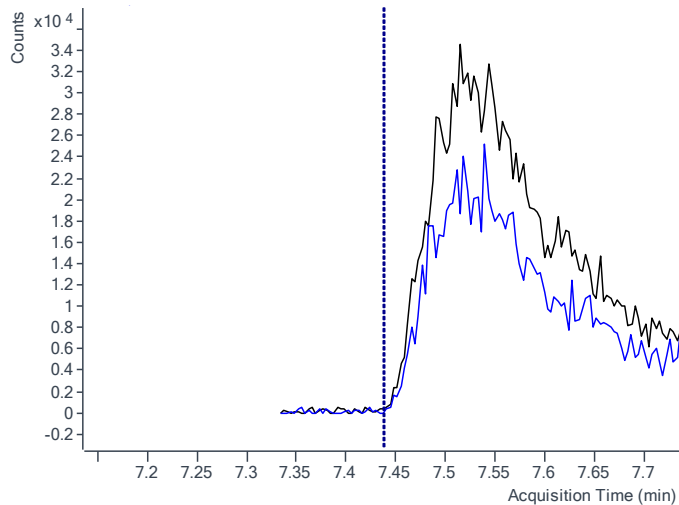


Tetrahydrophthalimide (10 µg/L)

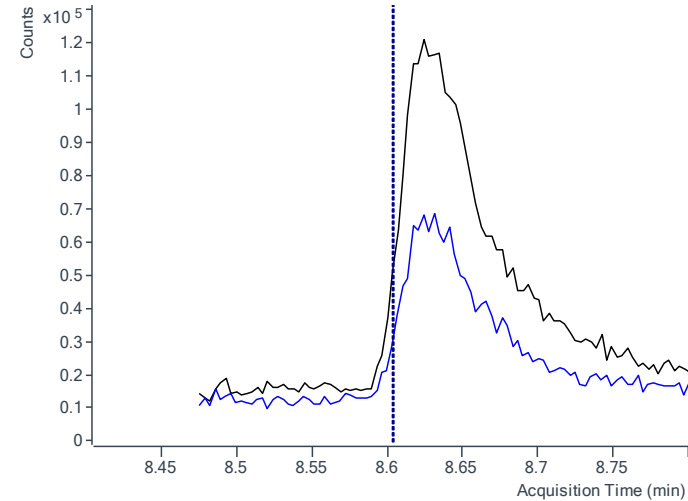
Dual layer injection



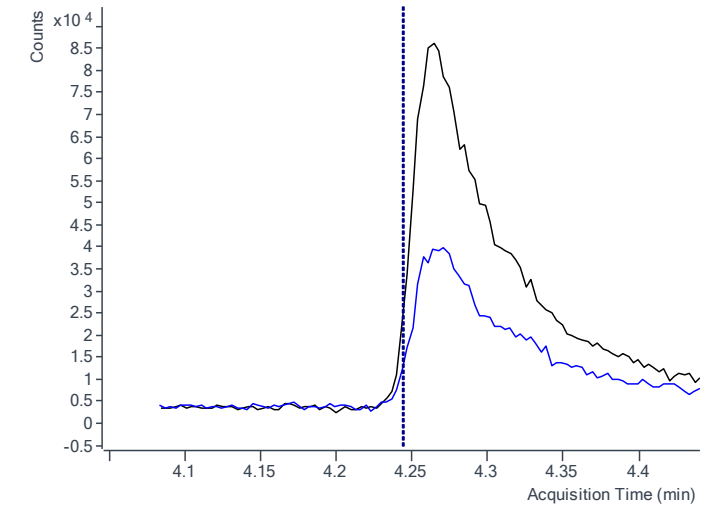
Regular injection



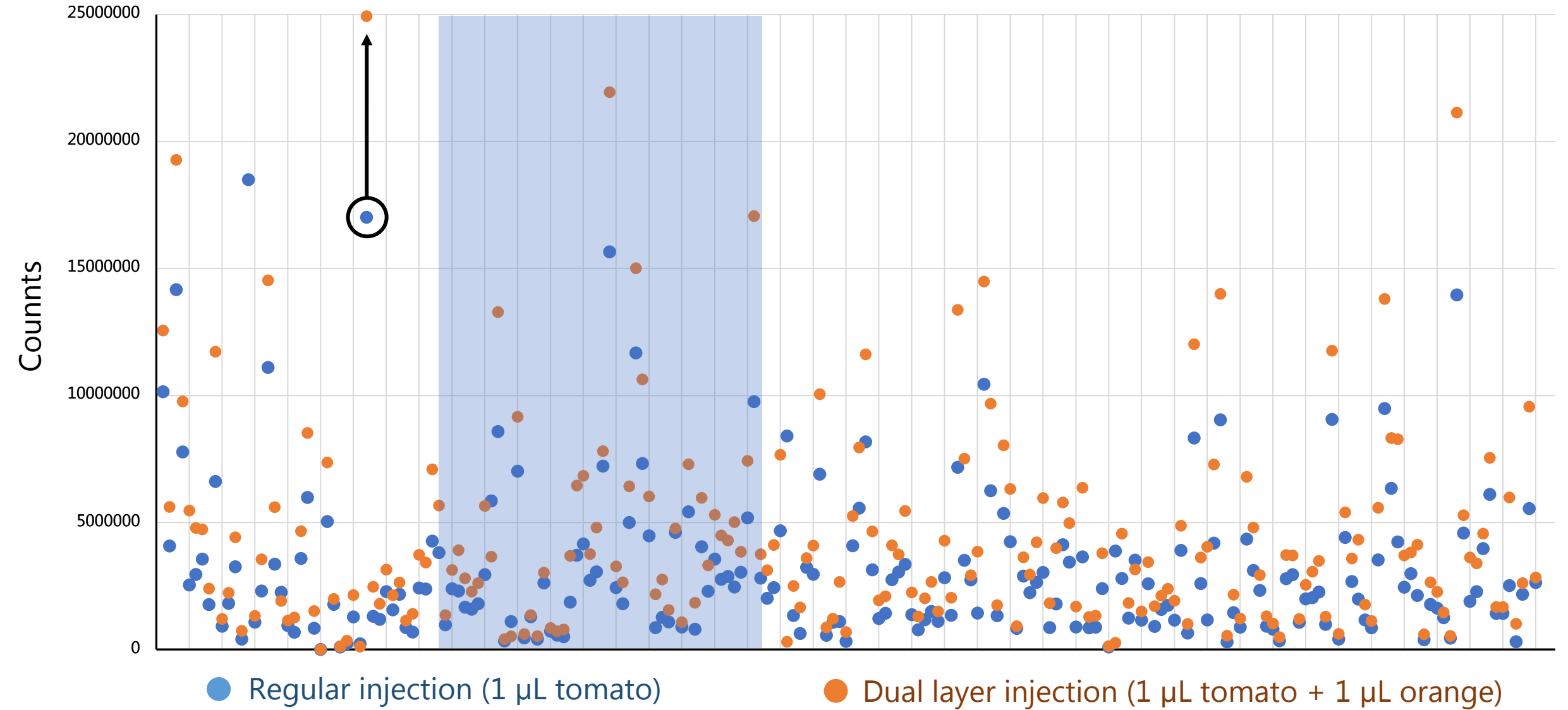
Regular injection



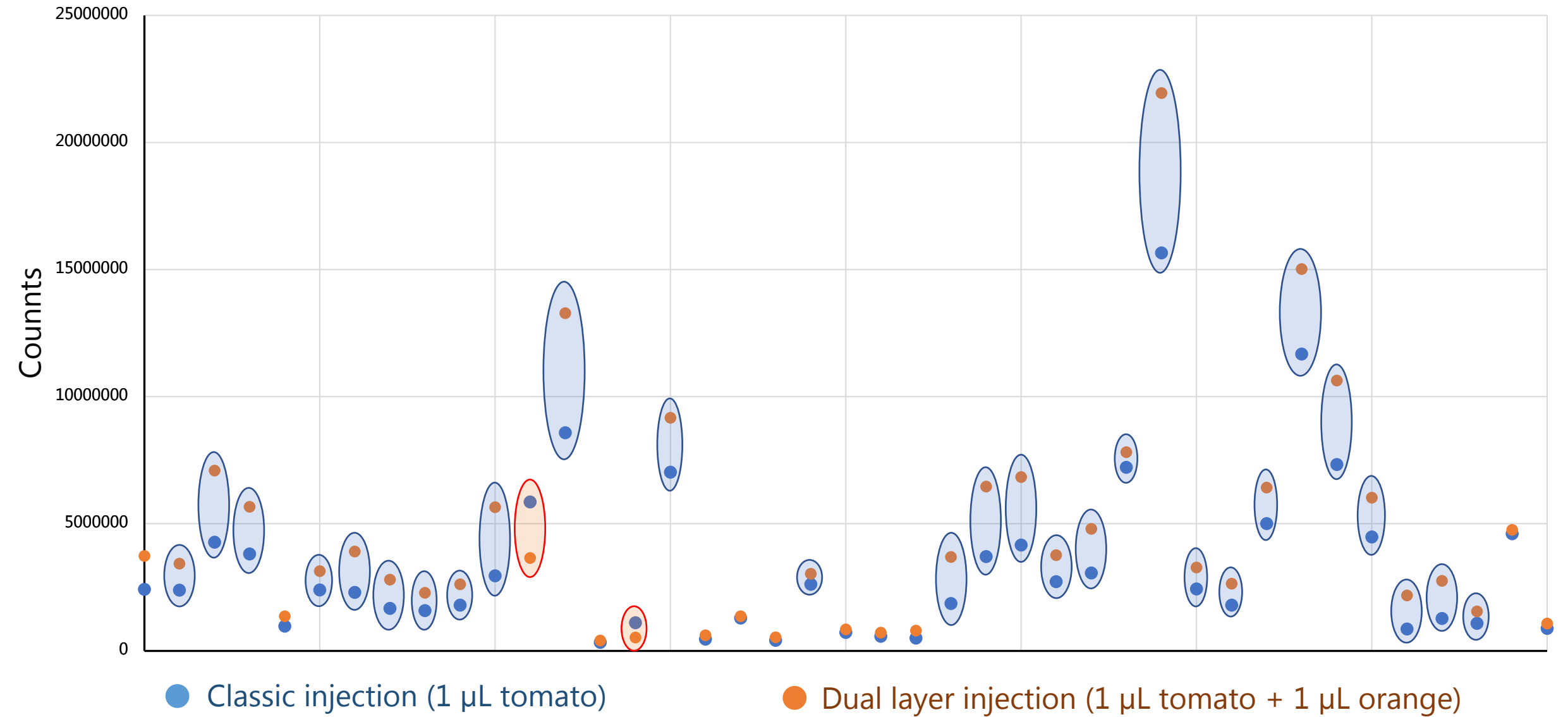
Regular injection



209 compounds (100 µg/L) in tomato matrix

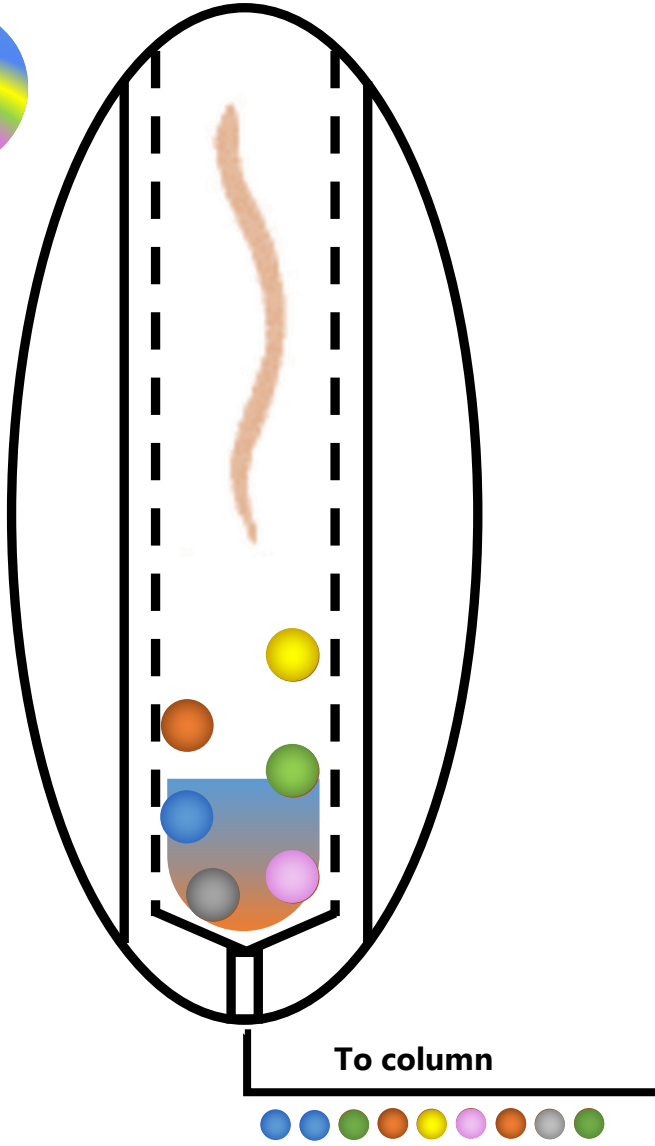
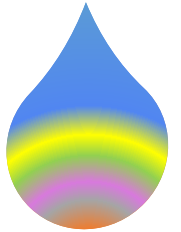


40 compounds (100 µg/L) in tomato matrix



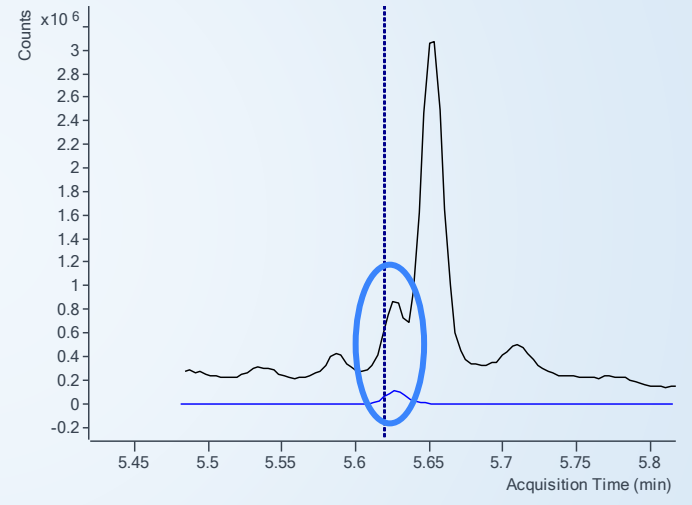
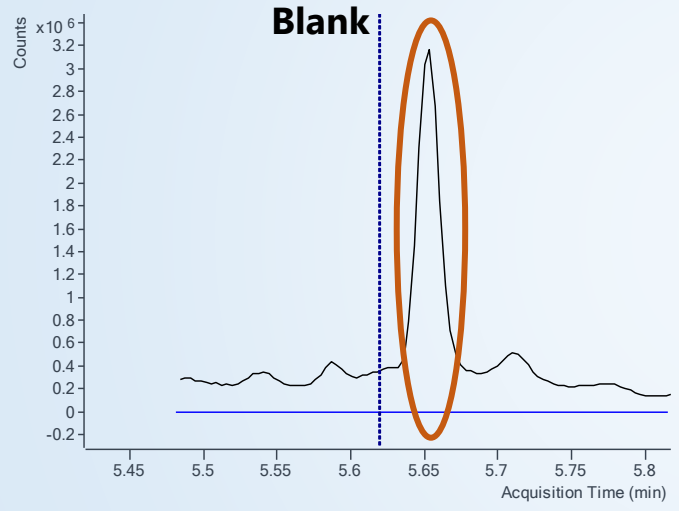
Increased sensitivity of 209 compounds in dual layer injection over regular injection at 100 ppb (%)

2,4'-DDE	124	Chlorthal-dimethyl	121	Fenarimol	128	Isofenphos	143	Permethrin	150	Tebufenpyrad	154
2-Phenylphenol	138	Chlozolate	132	Fenazaquin	129	Isofenphos-methyl	142	Phenothrin	152	Tecnazene	131
4,4'-DDD	136	Coumaphos	204	Fenbuconazole	145	Isoprothiolane	148	Phenthoate	158	Tefluthrin	130
4,4'-DDE	126	Cyfluthrin	154	Fenchlorphos	135	Isopyrazam	159	Phorate	134	Terbufos	151
4,4'-DDT	215	Cypermethrin	144	Fenhexamid	254	Kresoxim-methyl	147	Phosmet	274	Terbumeton	122
Acrinathrin	162	Cyproconazole	166	Fenitrothion	217	Lambda-Cyhalothrin	149	Picolinafen	163	Terbutryn	134
Alachlor	133	Cyprodinil	149	Fenpropathrin	144	Lindane	123	Picoxystrobin	149	Tetrachlorvinphos	218
Ametryn	136	Deltamethrin	140	Fenpropimorph	103	Malathion	163	Pirimicarb	90	Tetraconazole	151
Antraquinone	177	Diazinon	131	Fenthion	122	Malathion-d10	164	Pirimiphos-methyl	130	Tetradifon	132
Atrazine	131	Dichlofluanid	170	Fenvalerate	134	Mecarbam	169	Procymidone	133	Tetramethrin	158
Azoxystrobin	123	Dichloran	168	Fipronil	232	Mepanipyrim	172	Profenofos	187	Thiobencarb	145
Benalaxyl	136	Dichlorvos	144	Flamprop-isopropyl	148	Merphos	178	Prometon	134	Tolclofos-methyl	131
Bifenox	179	Dichlorvos-d6	145	Flamprop-methyl	145	Metalaxyl	136	Prometryn	137	Tolyfluanid	195
Bifenthrin	142	Diclobutrazol	192	Fluacrypyrim	149	Metazachlor	152	Propaphos	165	Triadimefon	151
Biphenyl	123	Dicofol, o, p'-	170	Fluazifop-p-butyl	163	Metconazole	152	Propazine	125	Triallate	128
Bixafen	155	Dicofol, p, p'-	155	Flucythrinate	149	Methidathion	187	Propiconazole	156	Triazophos	194
Boscalid	131	Dieldrin	121	Fludioxonil	204	Methiocarb	214	Propyzamide	144	Trifloxystrobin	157
Bromopropylate	167	Diethofencarb	47	Fluensulfone	126	Methoxychlor, o,p'-	106	Prothiofos	139	Trifluralin	148
Bupirimate	84	Dimethenamid	131	Fluopicolide	143	Methoxychlor, p,p'-	269	Pyraclostrobin	348	Triphenyl phosphate	140
Buprofezin	121	Dimethipin	133	Fluopyram	175	Metolachlor	139	Pyrazophos	174	Vinclozolin	117
Butralin	186	Diphenylamine	105	Fluquinconazole	133	Mevinphos	155	Pyridaben	155	Aldrin	119
Butylate	130	Dodemorph	129	Flusilazole	155	Molinate	131	PyrifenoX II	184	Dichlorobenzophenone, 4,4'-	151
Cadusafos	142	Endosulfan sulfate	116	Flutolanil	169	Myclobutanil	150	Pyrimethanil	149	Disulfoton-sulfoxide	115
Carbophenothion	180	Endosulfan-alpha	117	Flutriafol	164	Napropamide	149	Pyriofenone	139	Fipronil sulfone	191
Chinomethionate	146	Endosulfan-beta	126	Fonofos	127	Novaluron	111	Pyriproxyfen	156	Fipronil-desulfinil	149
Chlorbromuron	112	Endrin	158	Formothion	186	Nuarimol	126	Quinalphos	154	HCH-alpha	115
Chlordane	116	EPN	198	Fosthiazate	263	Ofurace	132	Quinoxifen	126	HCH-beta	124
Chlorfenapyr	148	Epoxiconazole	174	HCB	111	Oxadixyl	160	Quintozene	143	Heptachlor endo-epoxide	118
Chlorfenvinphos	168	Ethion	164	Heptachlor	138	Paclbutrazol	197	Secbumeton	128	Heptachlor exo-epoxide	118
Chlorfluazuron	50	Ethofumesate	138	Heptenophos	146	Parathion	212	Spirodiclofen	140	Malaoxon	238
Chlorobenzilate	147	Ethoprophos	157	Hexaconazole	154	Parathion-methyl	223	Spiromesifen	134	Paraoxon-methyl	338
Chlorothalonil	190	Ethoxyquin	108	Indoxacarb	113	Pebulate	140	Sulfotep	126	Pentachloroaniline	120
Chlorpropham	152	Etofenprox	140	Iprodione	242	Penconazole	145	Sulprofos	113	Phorate sulfone	172
Chlorpyrifos	138	Etrimfos	134	Iprovalicarb	214	Pendimethalin	191	Tau-fluvalinate	128	Tetrahydrophthalimide	108
Chlorpyrifos-methyl	137	Fenamidone	147	Isazofos	129	Penthiopyrad	175	Tebuconazole	150		

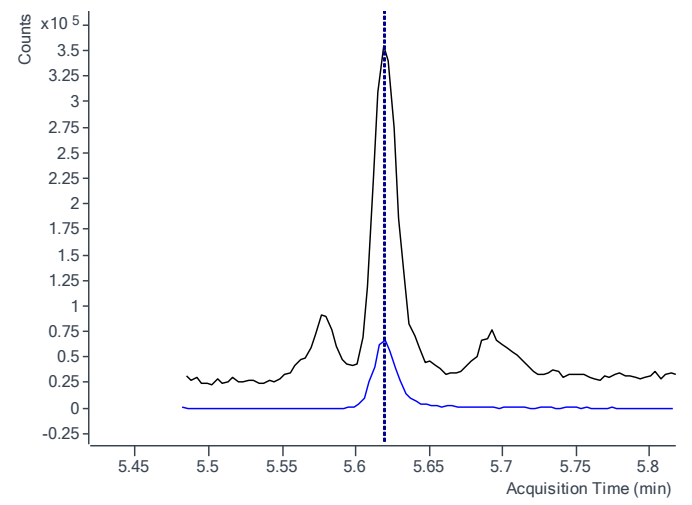
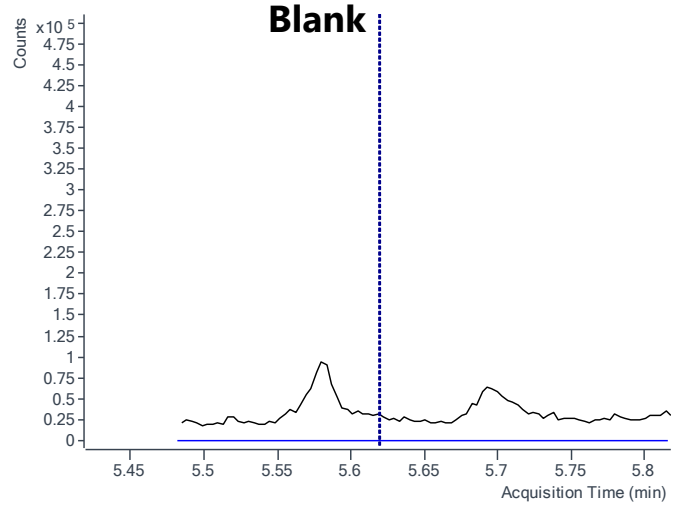


Isazofos (10 µg/L)

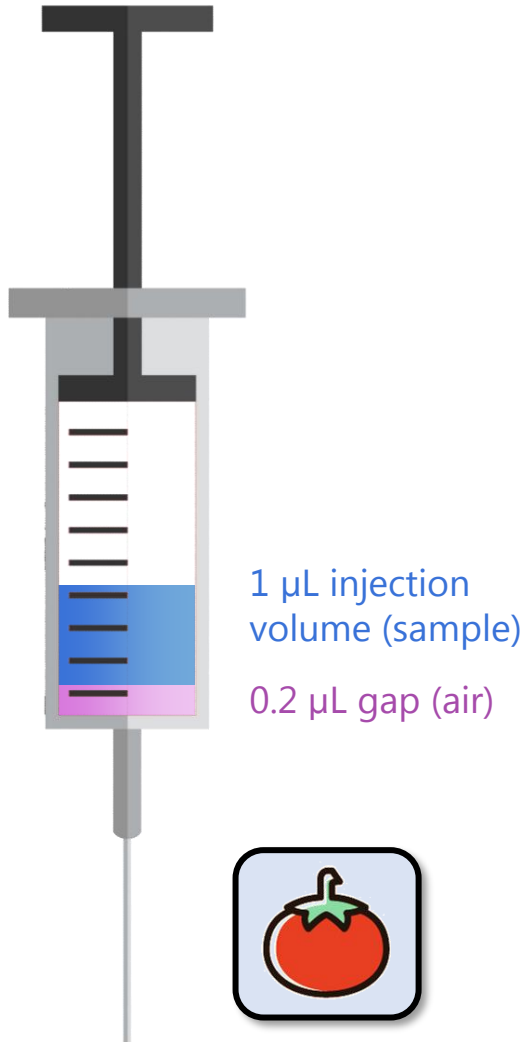
Dual layer injection



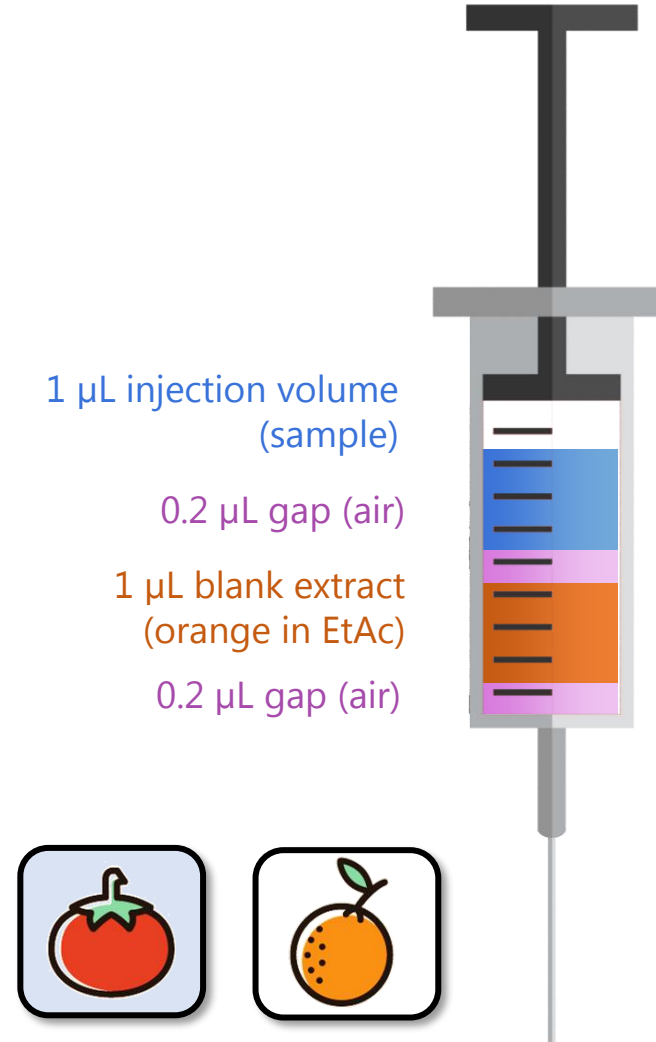
Regular injection



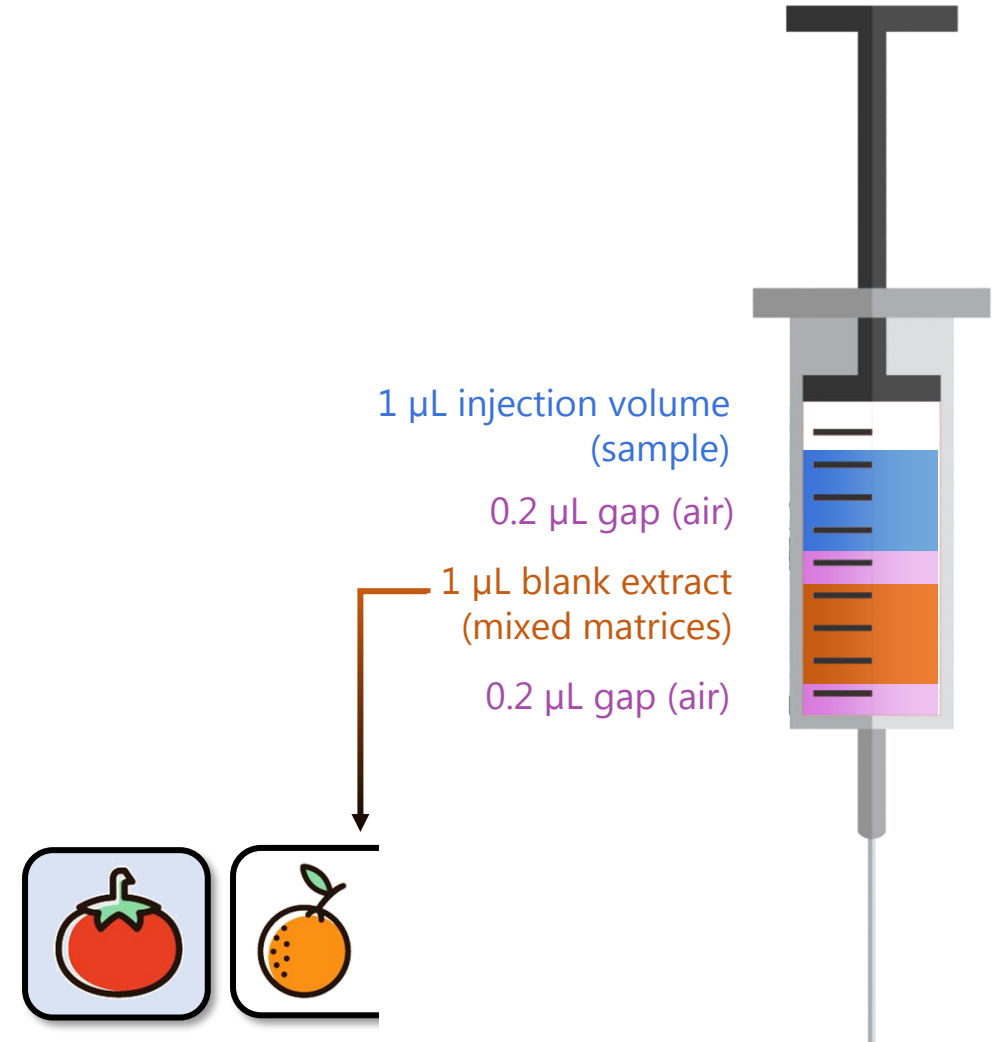
REGULAR INJECTION



DUAL LAYER INJECTION (ONE MATRIX)

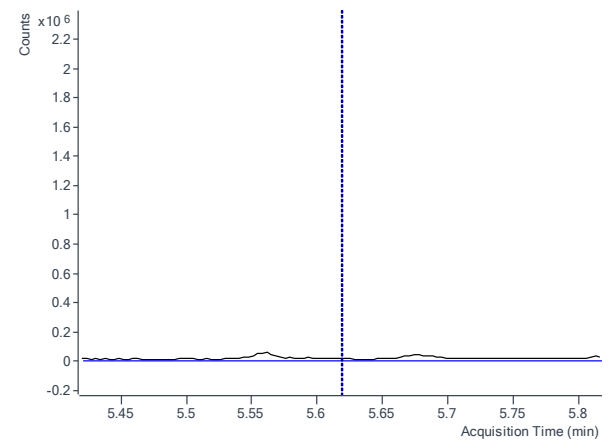


DUAL LAYER INJECTION (MIXED MATRICES)

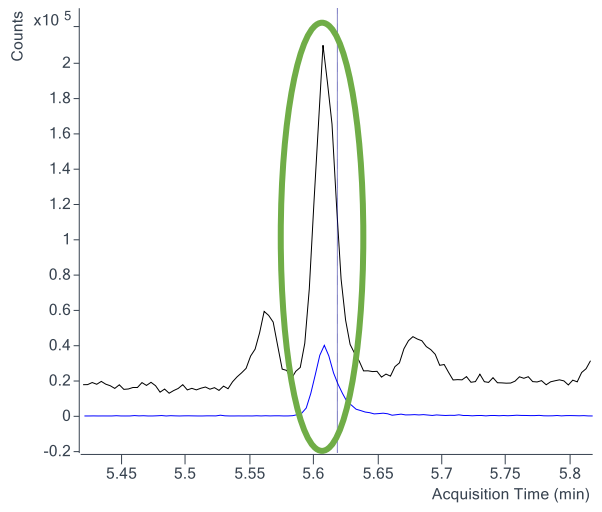


REGULAR INJECTION

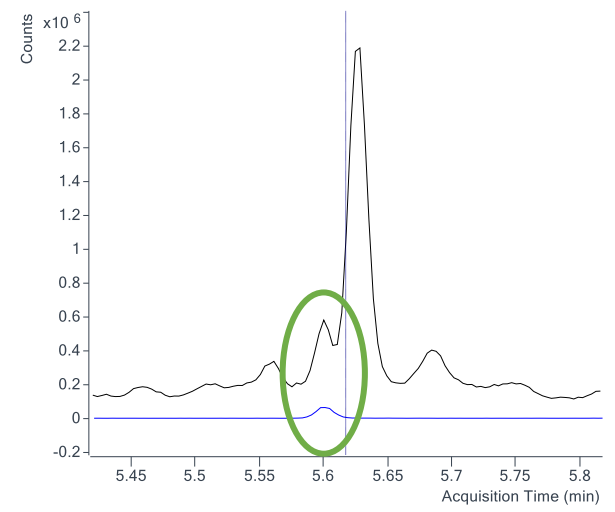
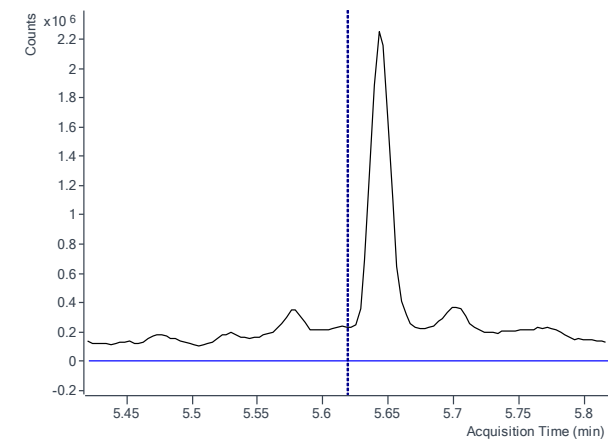
Isazofos (blank)



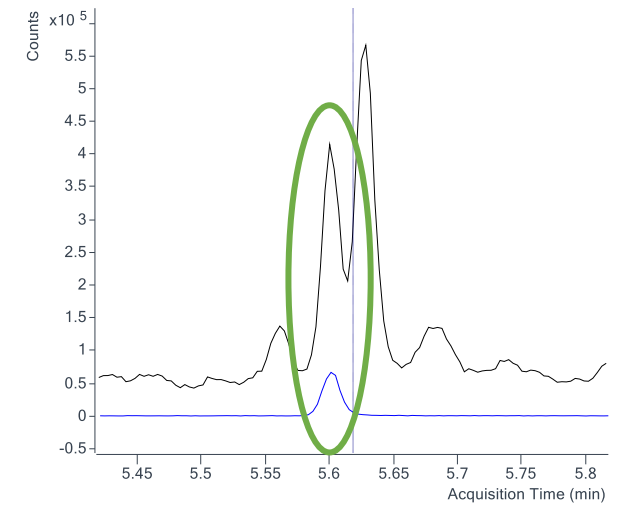
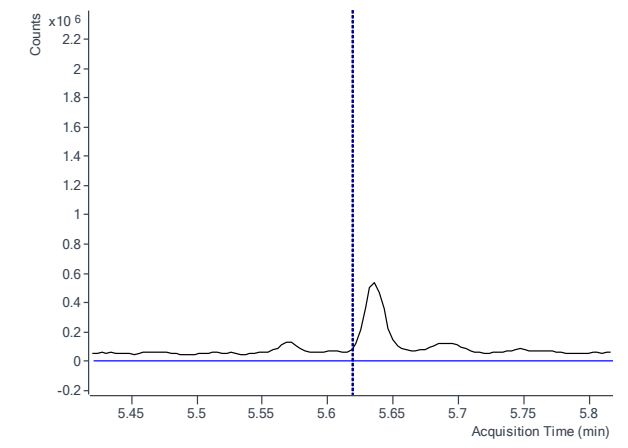
Isazofos (10 µg/L)



DUAL LAYER INJECTION (ONE MATRIX)

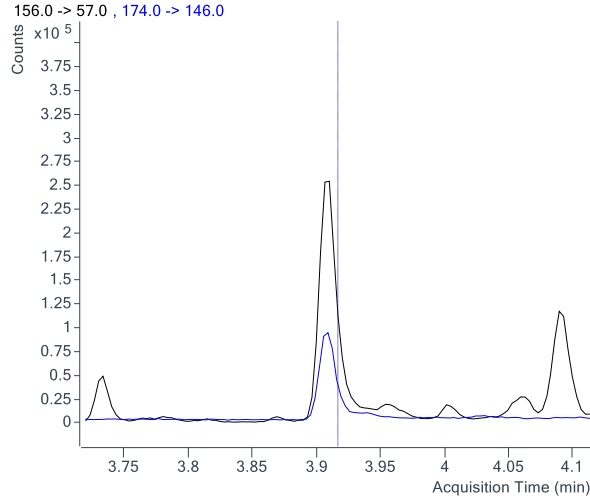


DUAL LAYER INJECTION (MIXED MATRICES)

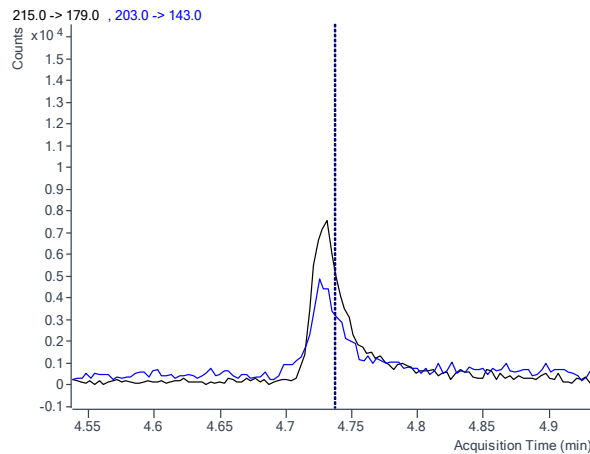


Butylate (10 ppb)

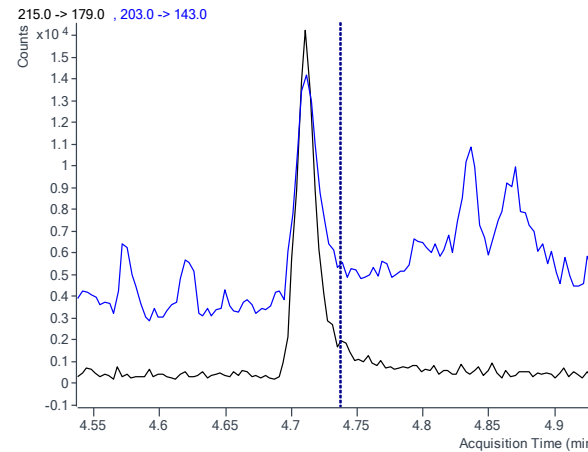
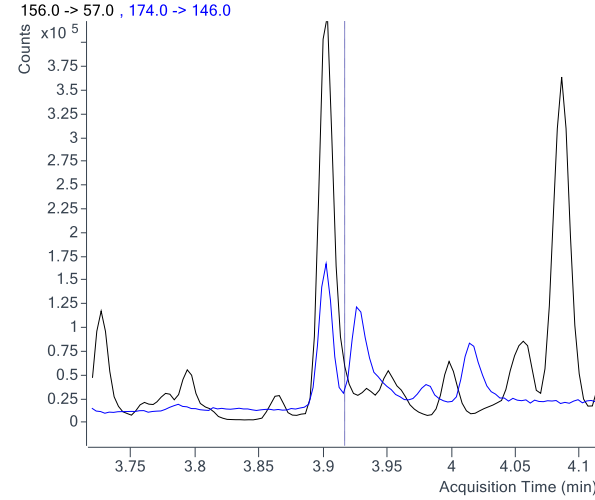
REGULAR INJECTION



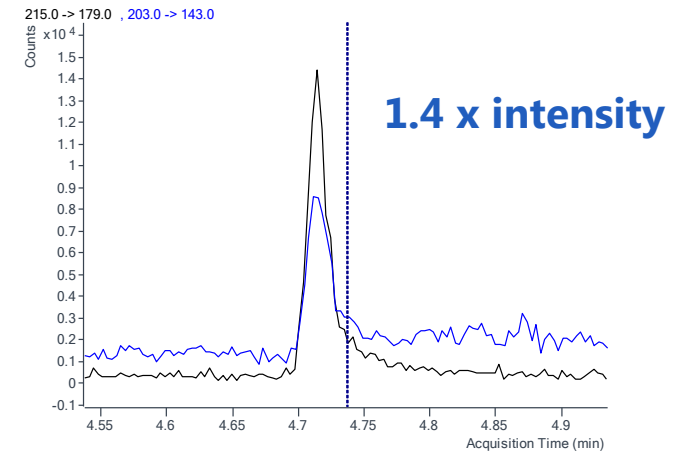
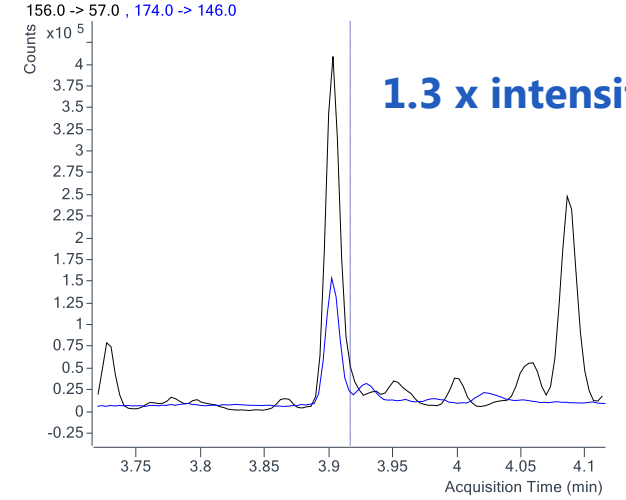
Tecnazene (2 ppb)



DUAL LAYER INJECTION (ONE MATRIX)



DUAL LAYER INJECTION (MIXED MATRICES)




- ▶▶▶▶ The dual layer injection allows to enhance the **sensitivity** of the vast majority of GC-amenable compounds in the analysis of **clean matrices**.

- ▶▶▶▶ **Narrower peaks** obtained with some typically troublesome compounds in these matrices.

- ▶▶▶▶ **Interferences** can appear in chromatograms, especially at low concentration levels.
 - More selective transitions.
 - Lower proportion of blank matrix (1 : 0.5).
 - **Mixed blank matrix extracts** (orange,onion, leak...).





**Thank you
for your attention**

