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Pesticidal Properties and Chemical Composition of Tomato Plant Bio-oil

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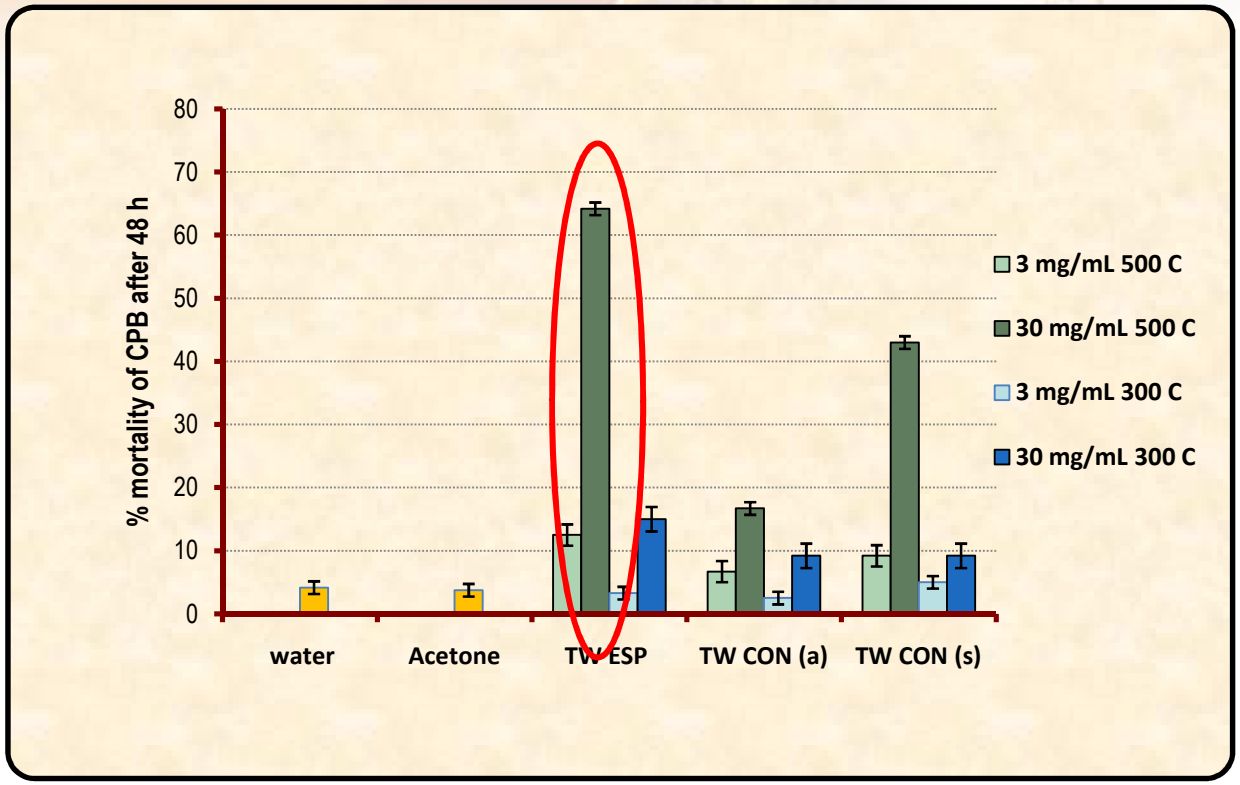
Results
CPB Bioassay (Bio-oil at 300 and 500° C)



Percent mortality after 48 h for CPB exposed to bio-oil solutions

CPB 2nd Instar larvae on potato leaf

Results

Bacteria and Fungi Bioassay (Bio-oil at 300 and 500º C)

X indicates mild activity and XX indicates strong activity

	Control	Tomato waste ESP				Tomato waste Condenser (a)				Tomato waste Condenser (s)			
		3 mg/ml 300 ºC	30 mg/ml 300 ºC	3 mg/ml 500 ºC	30 mg/ml 500 ºC	3 mg/ml 300 ºC	30 mg/ml 300 ºC	3 mg/ml 500 ºC	30 mg/ml 500 ºC	3 mg/ml 300 ºC	30 mg/ml 300 ºC	3 mg/ml 500 ºC	30 mg/ml 500 ºC
BACTERIA													
Acidovorax avenae			X		X								
Clavibacter michiganensis sub. sp. M.										X	XX		
Erwinia carotovora pv. atroseptica													
Pseudomonas syringae pv. tomato					X								
Streptomyces scabies		X		XX	XX		X				XX	X	
Xanthomonas campestris pv. Vesi													
Xanthomonas gardneri Group D													
FUNGI													
Alternaria alternata					XX								xx
Botrytis cinerea (isolate 2)					X				X				x
Fusarium oxysporum (isolate 1)					X								
Fusarium solani (isolate 1)					XX								
Monilinia fructicola					X						X		xx
Pythium aphanidermatum (isolate 1)					X						X		
Phytophthora sojae Race 2					XX						X		xx
Pythium ultimum					X						XX	X	x
Rhizoctonia solani		X	XX	X	XX						X		xx
Sclerotinia sclerotiorum (isolate 1)			X		XX						X		xx

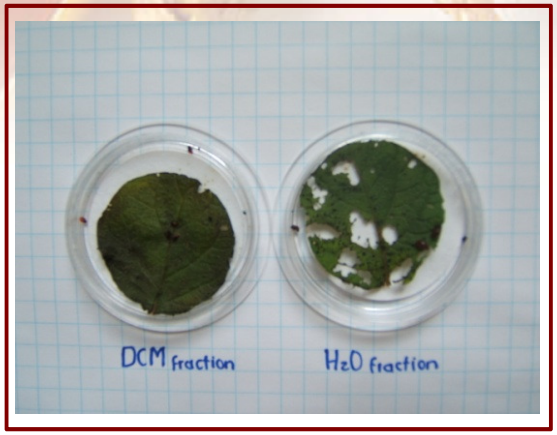
CHEMICAL COMPOUND	RT(min)	ESP 500	ESP 300	CON 500	CON 300	DCM	MeOH
phenol	10.80	++++		++++			
(2E)-but-2-ene-1,4-diol	11.49				+		
hydroxyacetic acid	12.31				+		
hydroxyacetic acid	12.70			++			
pyridin-3-ol	14.85	++	++	++	++		
3-methylphenol	15.16	++					
2-aminopropanoic acid	15.33			+			
9-methyl-9H-fluorene	15.64	++					
2-methylphenol	15.73	++					
pyrrolidin-2-one	15.81			+			
2-oxopentanoic acid	15.96		+		++		
pentane-1,2,4-triol	17.97				+		
ethanimidic acid	18.64				+		
(formylamino)acetic acid	18.94			+	+		
2-methoxyphenol	19.01			+	+		
6-methylpyridin-3-ol	20.15	+		+			
phosphoric acid	20.95					+	+++
3-ethylphenol	21.09	+++					
2-aminoethanol	21.13					+	
4-hydroxybutanoic acid	21.52			++++	++		
1,3,5,7-tetramethyltricyclo[3.3.1.13,7]decane	23.48	+					
4-aminophenol	23.49	+					
ethane-1,2-diol	24.50					+	
propane-1,2,3-triol	24.55	+	+++	++	+++	+	+
benzene-1,2-diol	26.21	+++	++		++		
2-ethoxy-4H-3,1-benzoxazin-4-one	26.43					+	
2,2,2-trifluoro-N-methylacetamide	27.60					++++	
5-hydroxypentanoic acid	27.75				+		
5-chloro-4-hydroxy-1-[4-hydroxy-5-(hyd)	27.97	+					
2-oxooctanoic acid	28.11			+			
4-methylbenzene-1,2-diol	30.89	++					
2,6-dimethoxyphenol	31.66	++	+		+		
benzene-1,4-diol	31.78	++					
2,5-dihydroxy-4H-imidazol-4-one	32.20			++			
tetrahydro-2H-pyran-2,3,4,5-tetrol	32.45				+		
2,4-dihydroxybutanoic acid	33.51		++		+++		
4-methoxy-1,3-diazabiphenylen	33.56			++			
2-methylbenzene-1,4-diol	35.38	+++					
butan-1-ol	35.46				+		
dihydropyrimidine-2,4(1H,3H)-dione	36.02			+			

CHEMICAL COMPOUND	RT(min)	ESP 500	ESP 300	CON 500	CON 300	DCM	MeOH
2-hydroxybutanedioic acid	38.39						++
2-aminobutanedioic acid	39.49						+
5-oxopyrrolidine-2-carboxylic acid	39.50						++
pentane-1,2,5-triol	39.68	+	+++	+	++++		
butane-1,2,3,4-tetrol	40.05						+
ethyl 3,5-di-tert-butyl-4-hydroxybenzoate	40.41					+	
dodecan-1-ol	41.93					+	
2,5-diaminopentanoic acid	42.51		+				
2,3-bis(hydroxymethyl)butane-1,4-diol	42.70		++				
tetrahydrofuran-2,3,4-triol	43.48				+		
4-[(1E)-3-hydroxyprop-1-en-1-yl]phenol	45.89	+					
3,4,5-trihydroxypentanal	46.29				+		
2-amino-4-methylpentanoic acid	47.50			++			
3-BUTEN-2-ONE, 4-(4-CHLOROPHENYL)-,	48.13			++++			
dodecyl prop-2-enoate	48.83					++	
(2Z)-2-(methoxyimino)hexanedioic acid	49.15			+			
(3Z,5Z)-4,6-dihydroxyhepta-3,5-dienoic acid	49.66			++			
6,8-dioxabicyclo[3.2.1]octane-2,3,4-triol	51.00	+++	++	++	+		
pentane-1,2,3,4,5-pentol	52.76						++++
2,3,4,5-tetrahydroxypentanoic acid	54.71						+
2-hydroxypropane-1,2,3-tricarboxylic acid	57.67						+++.
(5E)-5-(methoxyimino)hexane-1,2,3,4,6-pentol	61.56						+++
(6E)-6-(methoxyimino)hexane-1,2,3,4,5-pentol	62.13						++++
(6Z)-6-(methoxyimino)hexane-1,2,3,4,5-pentol	62.91						+
hexane-1,2,3,4,5,6-hexol	63.86						++++
2,3,4,5,6-pentahydroxyhexanoic acid	67.17						+++
hexadecanoic acid	67.41	++	+				
hexadecanoic acid	67.53					++++	
CIS-5-METHYL-11H-4B,10B-DIHYDRO[1]BEN	69.13					+	
2,3,4,5-tetrahydroxyhexanedioic acid	69.15						++
cyclohexane-1,2,3,4,5,6-hexol	71.03						++++
9,12-Octadecadienoic acid (Z,Z)	74.90					+++	
trans-9-Octadecenoic acid	75.23					+++	
Octadecanoic acid	76.25					+++	
(3Z)-4-hydroxypent-3-enoic acid	78.22		++				
Eicosanoic acid	84.59					+	
10'-Apo-β,.psi.-carotenoic acid, 5,6-dihydro-6-h	90.30					+++	
Docosanoic acid	92.37					+	
monostearin	98.20					+	
9,12-Octadecadiynoic acid	105.09					+	

Results

Liquid-liquid (H2O-DCM) extraction (Bio-oil at 500° C)

CPB mortality evaluation after liquid-liquid extraction of the most active bio-oil

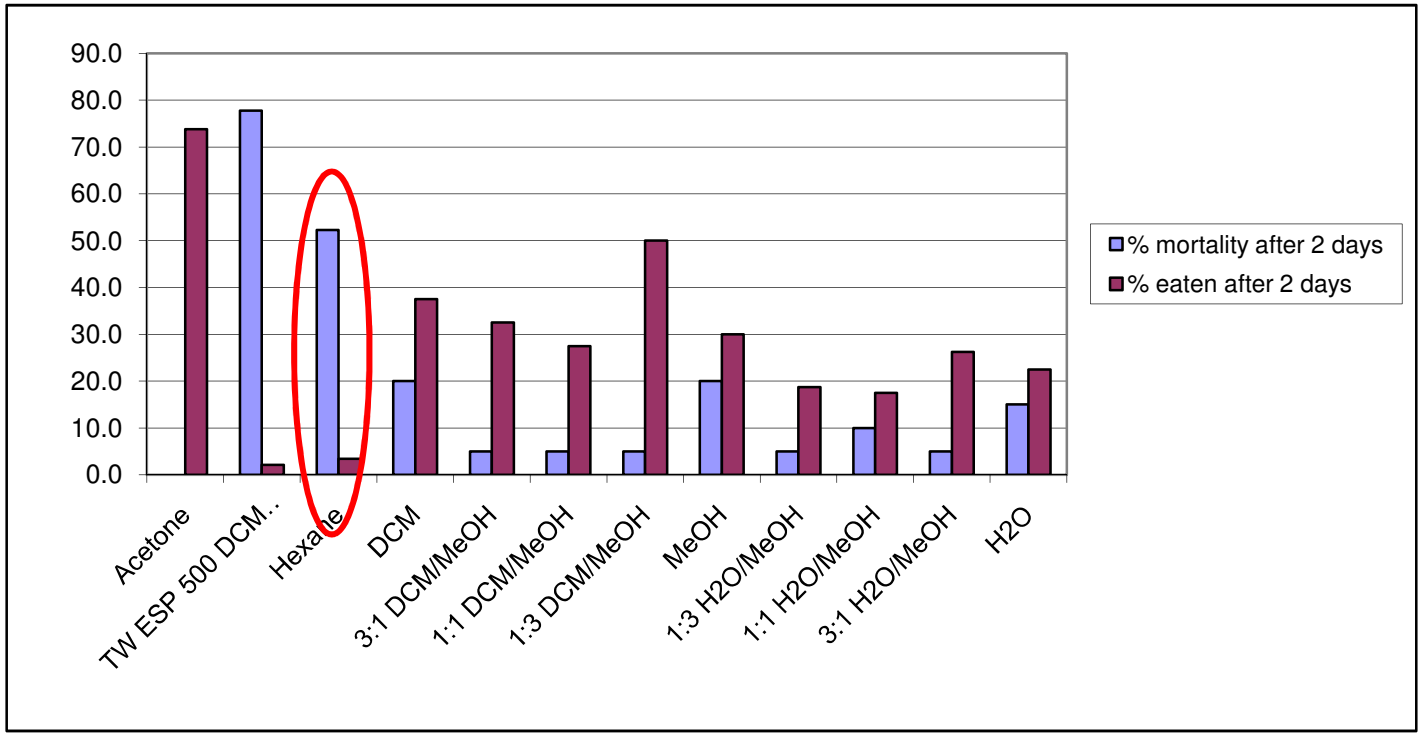


Mortality in Colorado potato beetle using DCM and H_2O fractions of the ESP tomato waste bio-oil at 500°C

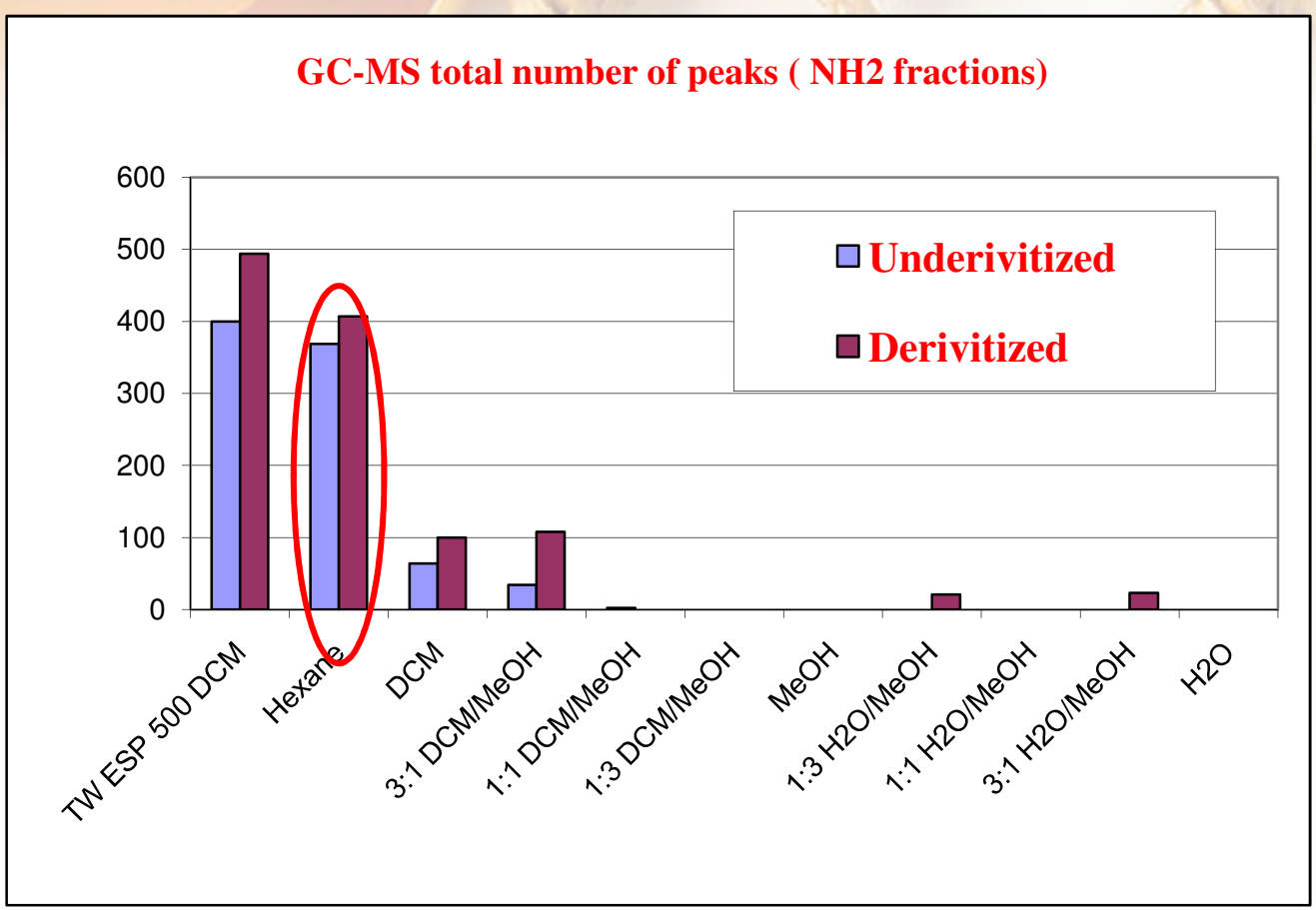
Fraction of the 500°C ESP Bio-oil	Total CPB	Total dead	48h mortality(%dead)
DCM fraction/acetone	45	28	62.2
Water fraction/ water	45	6	13.3
Acetone control	45	2	4.4
Water control	45	1	2.2

Results

SPE NH2 (Bio-oil 500º C)



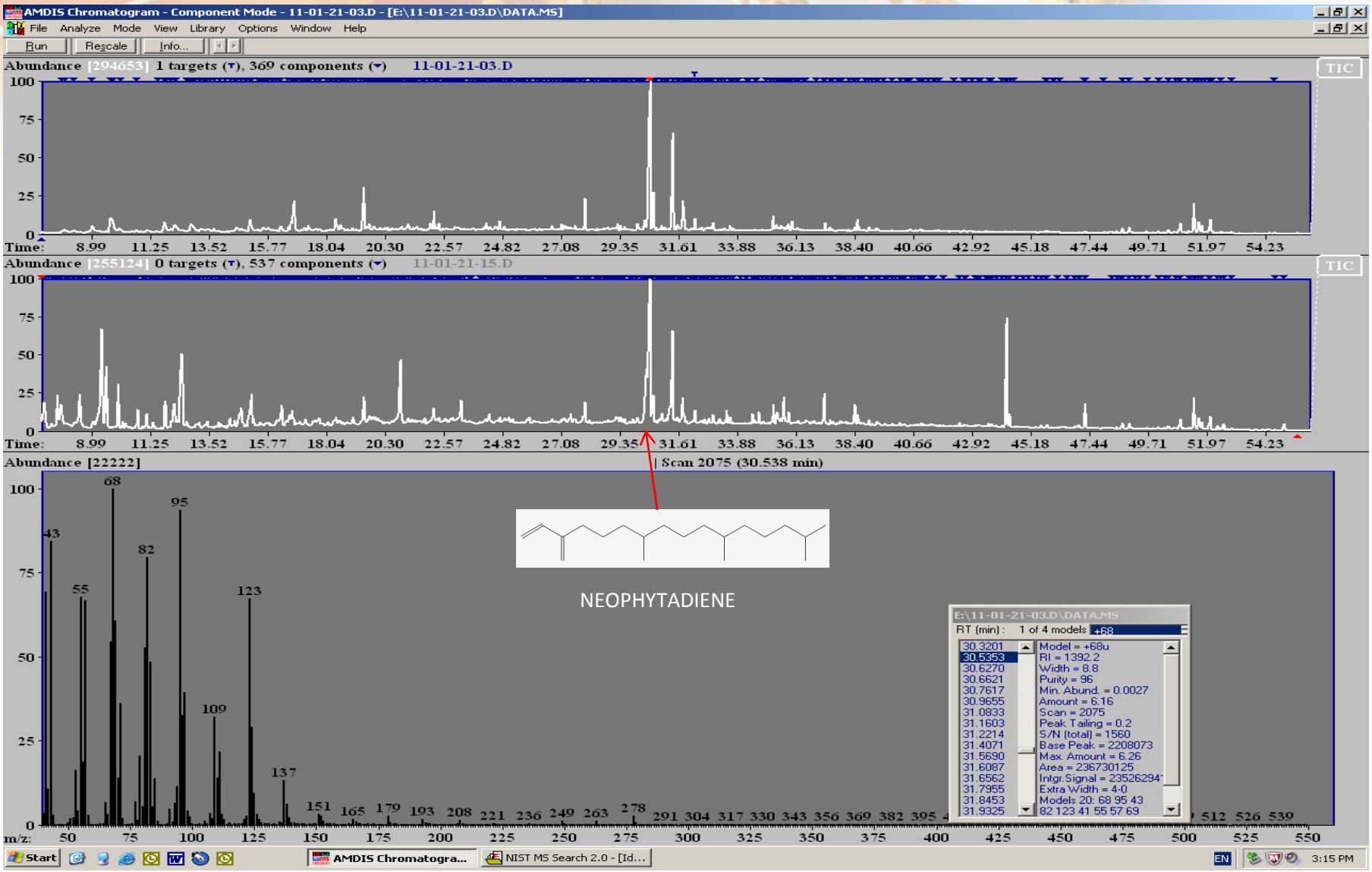
Results



GC-MS detected more components when the bio-oil is derivatized compared to the underivatized one

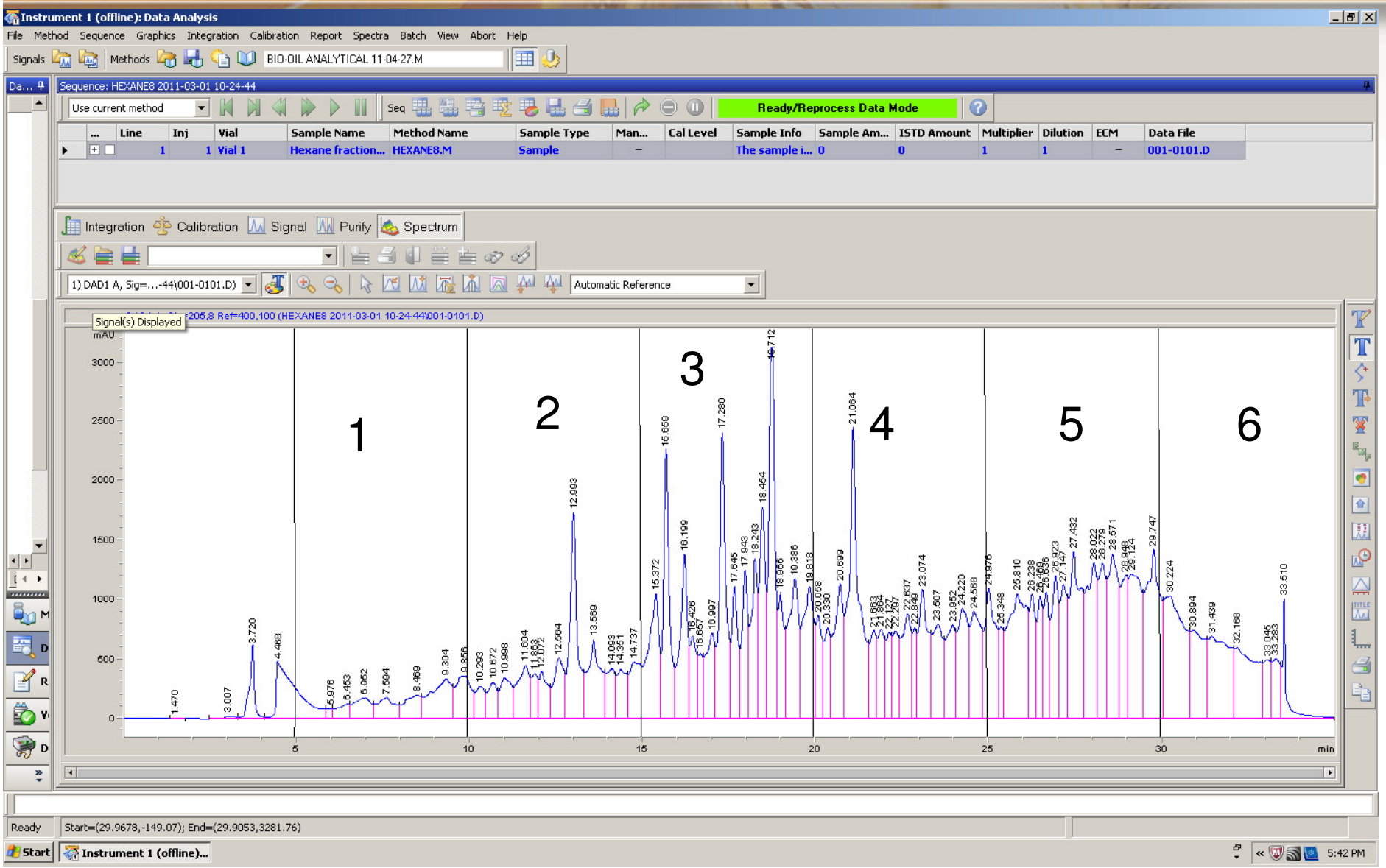
Results

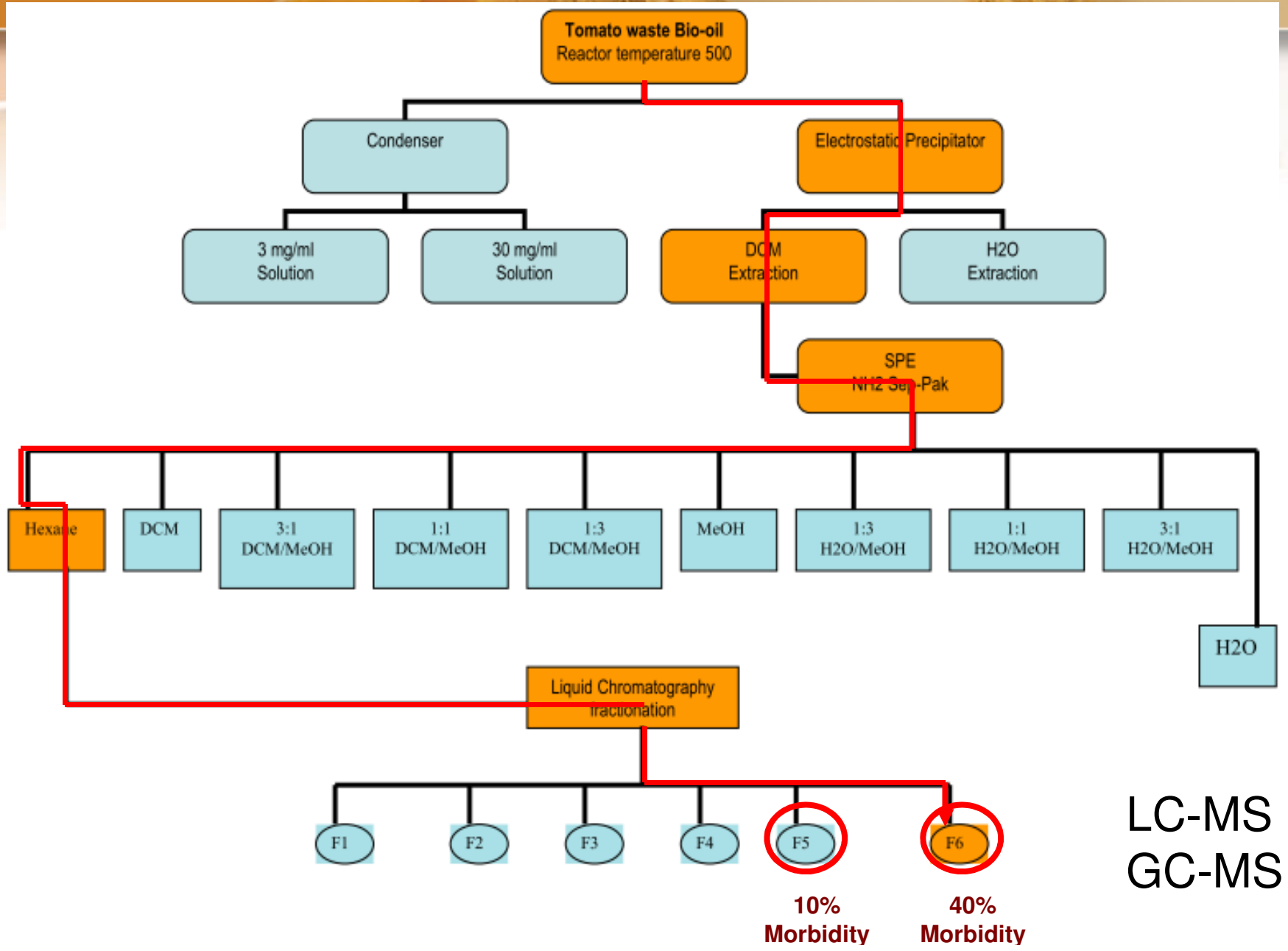
Hexane Fraction



Results

LC fractionation of Hexane fraction from NH2 SPE




Tomato waste Bio-oil
Reactor temperature 500
Condenser
Electrostatic Precipitator
3 mg/ml Solution
30 mg/ml Solution
DCM Extraction
H2O Extraction
SPE
Hexane
DCM
3:1 DCM/MeOH
1:1 DCM/MeOH
1:3 DCM/MeOH
MeOH
1:3 H2O/MeOH
1:1 H2O/MeOH
3:1 H2O/MeOH
H2O
Liquid Chromatography
F1
F2
F3
F4
F5
F6
10% Morbidity
40% Morbidity

LC-MS
GC-MS

SPE C-18

Bio-oil at 500º C

DCM fraction

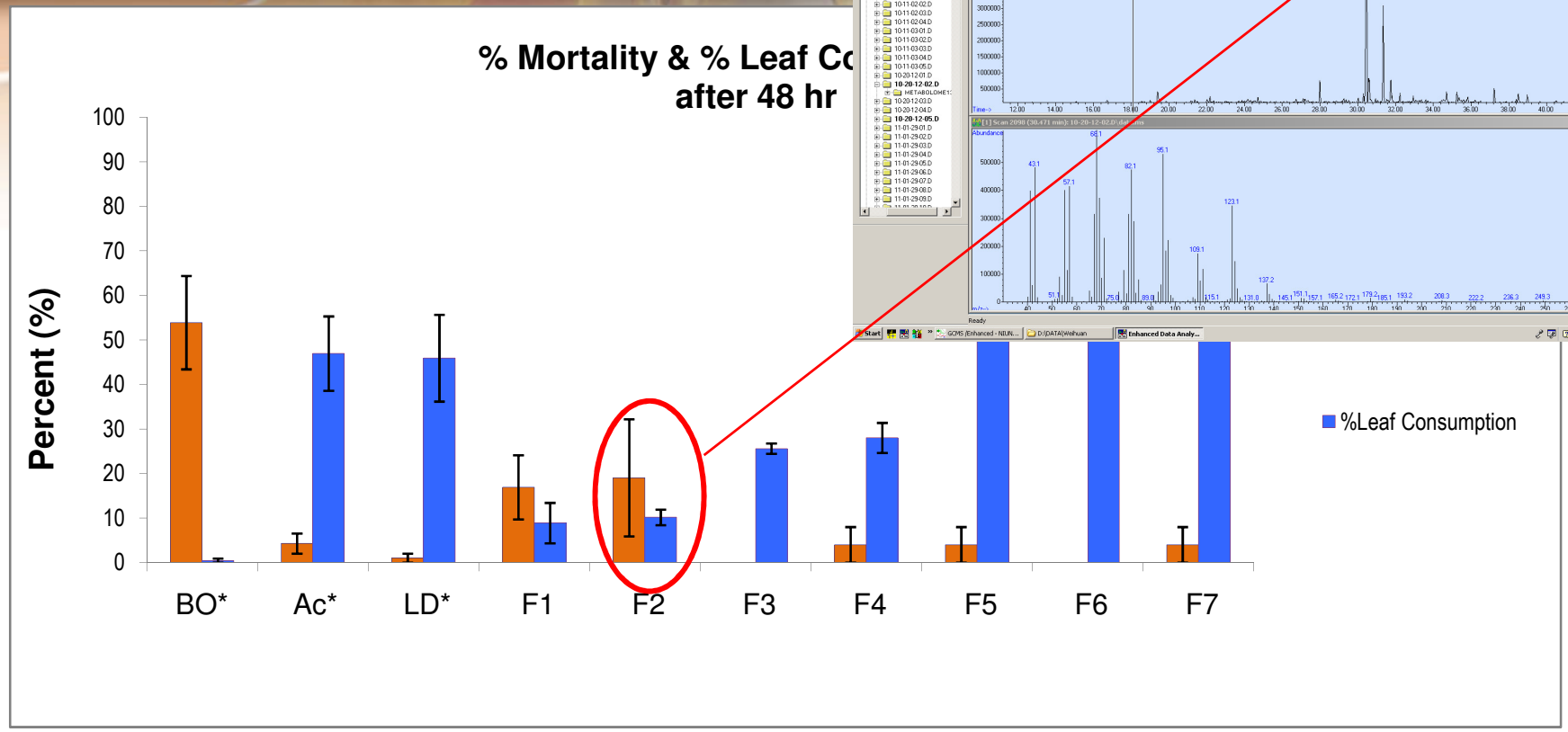
↓

C-18

↓

F1	AcN/H_2O 1:4
F2	AcN
F3	MeOH
F4	Acetone
F5	Isopropanol
F6	DCM
F7	Hexane

Colorado Beetle Assays



Fraction F1- ACN/H_2O (1:4)

Fraction F2 -ACN

} Exhibited highest activity
Most polar fractions

Anti-pest activity: mortality & anti-feeding

COMMENTS AND FUTURE WORK

- The ESP-DCM fraction from the bio-oil collected at 500^{o} C from ESP is active
- Hexane fraction of ESP-DCM bio-oil showed higher activity compared to others when NH2 SEP cartridge was rinsed with different mobile phases
- AcN fraction of ESP-DCM bio-oil showed higher activity compared to others when C-18 SEP cartridge was rinsed with different mobile phases
- Active fractions from the NH2 SPE were further fractionated into 6 fractions with LC. F5 and F6 showed morbidity against CPB
- Fractions collected from LC are currently evaluated by LC-MS and GC-MS

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