

# **Uptake of Weathered p, p'-DDE in Soil by Grafted Plant Species**

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# Why look at Persistent Organic Pollutants?

- They persist for decades
- Likely mutagenic and carcinogenic effects
- Bioaccumulation potential
- Other remediation strategies are ineffective due to high degree of sequestration

# DIRTY DOZEN

Elimination by International  
Treaty Underway

Aldrin

Chlordane

DDT/DDE

Dieldrin

Dioxins

Eldrin

Furans

Heptachlor

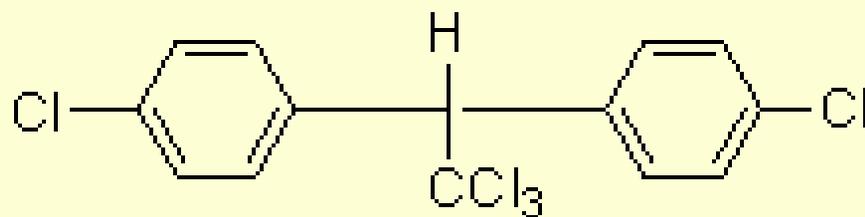
Lindane

Mirex

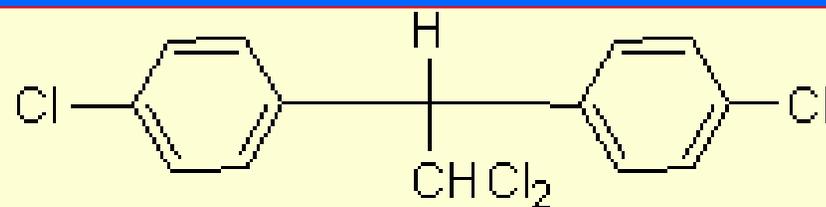
PCBs

Toxaphene

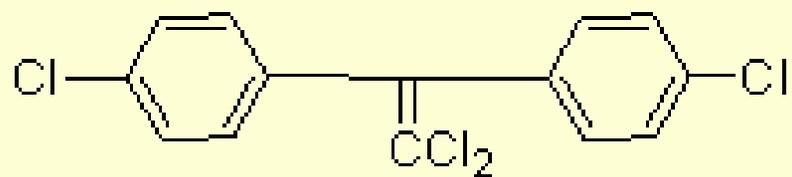
# DDT/DDD/DDE



DDT



DDD



DDE

# **Main Reason for this research**

**I like watermelon a lot**

**Watermelon selling in Market is grafted (99%)**



# “Black Beauty” is an accumulator

Two species of plants were used:  
*Cucurbita pepo* L. subsp. *pepo* (“Black Beauty”) and *Water melon*

“Black Beauty” is considered an accumulator, while “Watermelon” is termed non-accumulators (White, 2003-2009)

# Objective of This Research

- Tracking of movement of p,p-DDE from bulk soil
- ⇒ rhizosphere
- ⇒ whole root tissue
- ⇒ xylem sap
- ⇒ aerial plant tissue of grafted *Cucurbitaceae* and comparison with intact plants

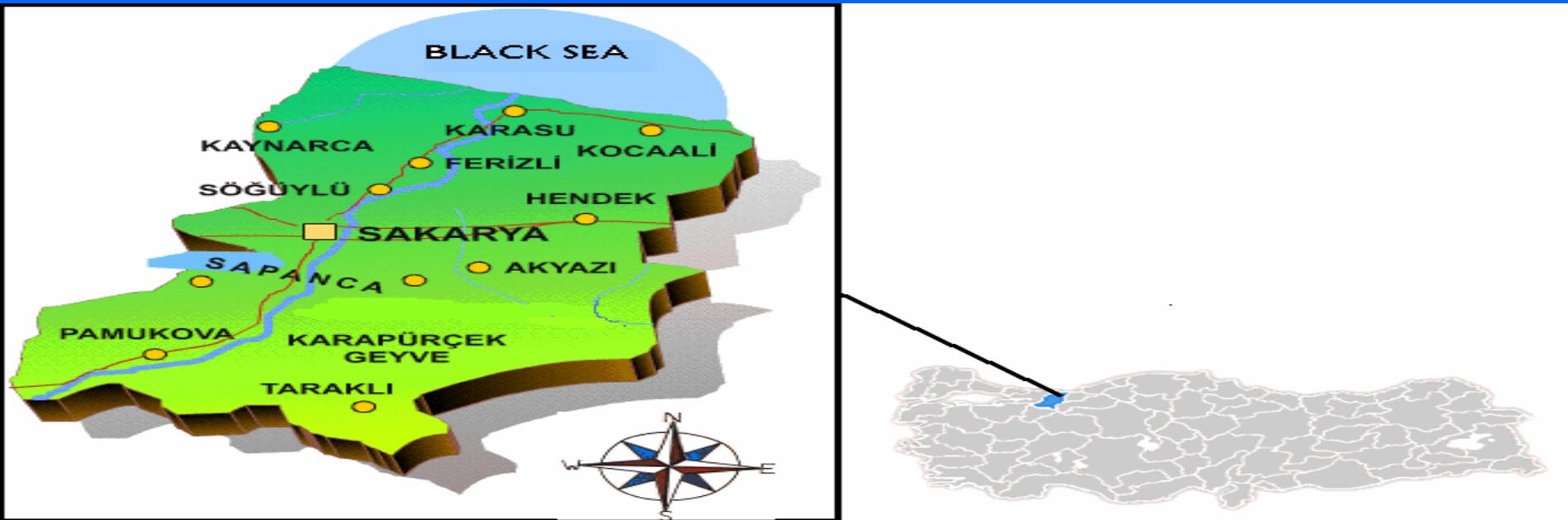


## Contaminated sites are needed to do research

- Where can we get the soil samples?
  - More than 400 farmowners were interviewed in this survey to decide where to collect soil samples from agricultural sites in Sakarya, Turkey.
  - One component of the investigation of the interview was a survey of application of pesticides to the agricultural sites where have been actively used for 40 years by farmers.
- How many soil samples should we get?
  - Based upon the survey, thirty-three agricultural sites given in (Figure 1) were sampled during May and June 2007.



**Figure 1:** Soil Samples collected areas in Sakarya, Turkey



			Amount (ng/g)							
			DDE	DDD	DDT	Toplam(DDTs)	Flou	Pyrene	Naph	Phenanthrene
<b>FERIZLI:</b>	Degirmencik Koyu	broken								
	Seyifler Koyu	1A	7.38	1.95	6.75	16.08	5.46	3.99	3.36	5.34
	Damlık Koyu	1B	16.64	6.15	8.31	31.11	9.16	7.06	4.71	8.93
<b>KOCAALI</b>	Merkez	2A	84.26	19.40	6.13	109.80	90.21	73.71	20.42	41.25
	Yayla Mah. Mevki	2B	5.42	2.16	5.46	13.04	5.75	4.16	8.62	6.77
	Merkez	2C	69.04	13.43	40.05	122.52	6.87	5.09	3.57	9.53
<b>SOGUTLU</b>	Hasanfaki Koyu	3A	3.18	4.27	2.87	10.32	7.44	7.70	2.87	9.60
	Findikli Koyu	3B	17.37	7.96	7.54	32.86	20.71	19.47	4.66	9.59
	Yenikoy	3C	14.19	8.12	6.56	28.87	19.25	14.01	4.13	9.65
<b>PAMUKOVA</b>	Karapınar Koyu	4A	3.44	0.99	1.64	6.06	2.18	1.82	1.65	4.23
	Gokgoz Koyu	4B	0.00	0.39	1.06	1.45	1.50	1.28	2.59	4.32
	Merkez	4C	2.57	0.80	1.92	5.29	11.10	8.38	5.37	8.19
<b>HENDEK</b>	Dikmen Koyu	Broken								
	Merkez Koyu	5A	0.30	0.63	0.23	1.15	24.51	21.42	6.68	12.82
	Aksu Koyu	5B	3.49	1.14	1.31	5.94	13.82	11.90	4.23	16.70
<b>ADAPAZARI</b>	Meseli Asagidere K	6A	0.00	1.53	1.75	3.27	6.81	4.20	6.19	12.08
	Yazlık	6B	12.45	3.54	4.58	20.56	13.53	14.29	12.30	22.82
<b>KAYNARCA</b>	Guven Koyu	7A	13.63	2.65	2.21	18.49	3.78	3.95	0.00	10.41
	Seyhtimari Koyu	7B	0.00	1.59	0.30	1.89	5.39	5.45	4.24	8.36
	Dudu Koyu	7C	1.06	0.99	0.40	2.45	3.12	3.04	0.00	6.46
<b>KARASU</b>	Namazgah Mevki	8A	1.59	2.35	0.56	4.50	42.42	31.22	3.82	26.80
	Kiziltepe Koyu	8B	0.07	0.90	0.27	1.25	5.74	4.01	2.69	5.95
	Merkez Aziziye Mat	8C	184.97	120.24	122.50	427.71	37.40	27.91	6.81	22.31
<b>AKYAZI</b>	Aktarla Koyu	9A	18.83	4.53	1.83	25.20	10.16	7.61	9.50	18.73
	Eskibedil Koyu	9B	6.18	4.27	7.35	17.80	4.30	32.80	9.31	14.68
	Uzuncular Koyu	9C	12.44	2.12	2.93	17.48	6.27	4.93	12.99	17.03
<b>KARAPURCE</b>	Mesudiye Koyu	10A	0.00	0.45	2.18	2.63	3.08	1.66	3.24	6.61
	Merkez	10B	0.00	0.00	3.55	3.55	10.28	9.25	0.00	0.00
	Yaziligurgen Koyu	10C	0.00	0.46	2.96	3.42	9.47	5.97	6.94	11.18
<b>SAPANCA</b>	Uzunkum Koyu	11A	12.47	2.71	5.34	20.52	19.74	14.56	12.19	19.14
<b>GEYVE</b>	Epceler Koyu	12A	123.57	32.38	23.21	179.16	157.68	134.44	10.91	63.50
	Esme Koyu (Bugda	12B	1.71	1.92	6.32	9.95	10.87	12.62	10.87	16.98
	Esme Koyu (elma)	12C	11.06	3.36	3.02	17.44	7.33	5.02	5.46	11.10
	Merkez	12D	4.08	1.67	0.49	6.23	5.83	3.99	5.60	11.18
	Baglarbasi	12E	294.44	48.01	36.31	378.76	3.91	2.19	3.99	5.72

# DDT/DDDD/DDE Contaminated Soil:

- DDTs contaminated field was unintentionally discovered in 2007.
- The field has been sprayed with DDTs for unknown years.
- The field was used for field our experiments.
- For pot experiment, contaminated soil was collected from the field.

# EXPERIMENT

## Plant Selection:

The two Cucurbitaceae were chosen for the grafting trials.

Selected Cucurbitaceae were grafted by a company (Fide A.S., Antalya-Turkey) as follows:

1. Homografted *Zuke.* : *Zuke.* scion on Zuke rootstock
2. Homografted *W.melon* : *W.melon* scion on *W.melon* rootstock
3. Heterografted *Zuke* : *W.melon* scion on Zuke rootstock
4. Intact plant of *Zuke*
5. Intact plants of *W.melon*

Intact plants and their grafts were transplanted into both pots containing 7.2 kg of soil and field

	Contaminated Soil		Control Soil	
	Field	Pot	Field	Pot
<i>Homografted Zuke</i>	6	6	5	5
<i>Homografted W.melon</i>	6	6	5	5
<i>Heterografted Zuke</i>	6	6	5	5
<i>Intact plant of Zuke</i>	6	6	5	5
<i>Intact plants of W.melon</i>	6	6	5	5

Total 110 plants were transplanted



**Grafted Plants**



**Pot Experiment : Contaminated Soil**

# Pot Experiment : Control Soil



# EXPERIMENT

DDE/DDD/DDT concentrations

(Intact, homografted, and heterografted plants)

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- Bulk Soil
- Pore Water
- Xylem Sap
- Roots
- Shoots
- Aerial Tissues
- Fruits

## Quantitation of p,p'-DDE

Samples were spiked with an internal standard (IS) solution

Soil samples were extracted in 5 replicates, using methods published previously (White, 2005).

Solid-phase microextraction (SPME) was conducted on pore water and xylem sap samples using a 65- $\mu\text{m}$  PDMS-DVB fiber.

The p,p'-DDE content in the samples was determined on a Agilent 6890N gas chromatograph (GC) with a micro-electron capture detector ( $\mu$ -ECD).

# RESULTS

## Soil Samples

DDE, DDD, and DDT were found in all soil samples concentration ranging from

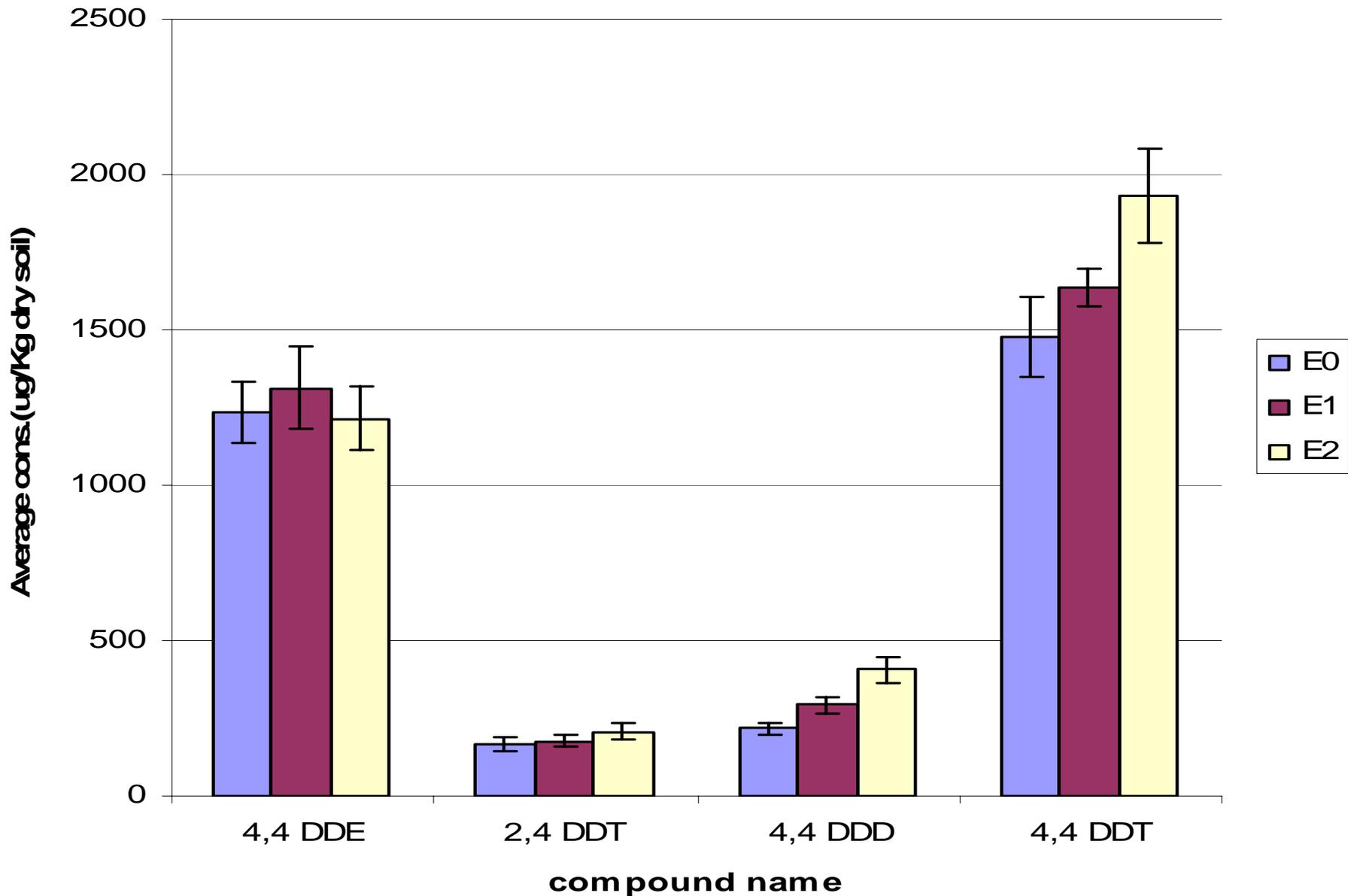
107.17-3299.64 ng/g (DDE)

8.89-407.04 ng/g (DDD)

50.94-1934.88 ng/g (DDT)

Sampe ID	4.4 DDE Cons.( ng/g)	4.4 DDD Cons.( ng/g)	4.4 DDT Cons.(ng/g)	Sum DDEs Cons. (ng/g)
A0	276.67±36.28	43.17±7.64	184.28±58.49	504.13±87.68
A1	578.79±28.19	84.26±13.07	264.82±67.46	927.88±88.27
A2	558.07±47.06	76.38±11.99	315.50±8.77	949.95±55.22
A3	442.25±42.23	58.37±6.61	228.80±43.47	729.44±77.66
B0	913.30±63.66	66.53±4.33	309.91±66.58	1289.75±64.36
B1	887.50±54.55	84.07±2.87	339.54±60.26	1311.13±97.15
B2	1136.66±168.236	84.51±13.49	313.92±94.47	1535.10±263.80
B3	966.27±85.32	39.35±2.68	182.45±86.18	1188.08±83.87
C0	833.28±61.07	106.41±7.07	521.56±51.21	1461.26±97.50
C1	898.98±67.18	69.53±5.52	295.43±55.54	1263.94±70.66
C2	1815.54±123.18	55.92±4.09	200.89±26.82	2072.37±116.12
C3	3299.64±521.78	135.26±28.78	325.94±59.99	3760.85±603.80
D0	51.77±0.98	----	----	51.77±0.98
E0	<b>1232.22±99.59</b>	<b>216.85±19.55</b>	<b>1475.46±127.79</b>	<b>2924.54±214.52</b>
E1	<b>1313.45±130.85</b>	<b>291.88±26.85</b>	<b>1637.91±59.83</b>	<b>3243.25±199.21</b>
E2	<b>1215.34±103.87</b>	<b>407.04±40.39</b>	<b>1934.88±151.62</b>	<b>3557.27±278.21</b>
F0	681.58±41.12	119.26±10.55	576.89±109.13	1377.75±154.87
G0	107.17±11.05	14.78±1.62	50.94±6.63	172.89±17.55
H0	530.39±31.52	8.89±1.67	81.22±22.49	620.50±40.77

**Sample ID : E**  
**E0 < E1 < E2 (Depths from surface)**

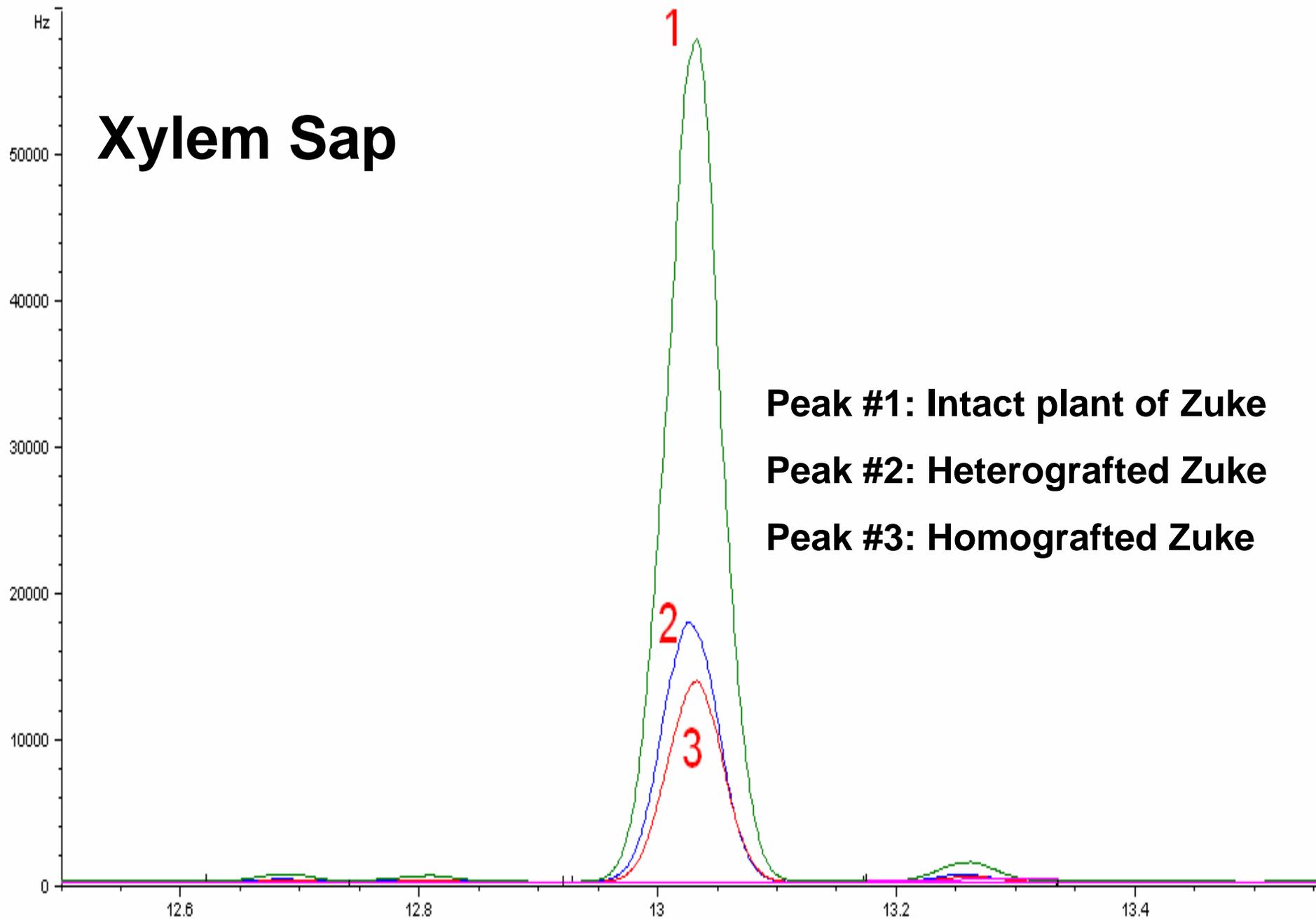


ECD2 B, (101209\SPME0004.D)

ECD2 B, (101309\SPME0004.D)

ECD2 B, (101409\SPME0002.D)

# Xylem Sap



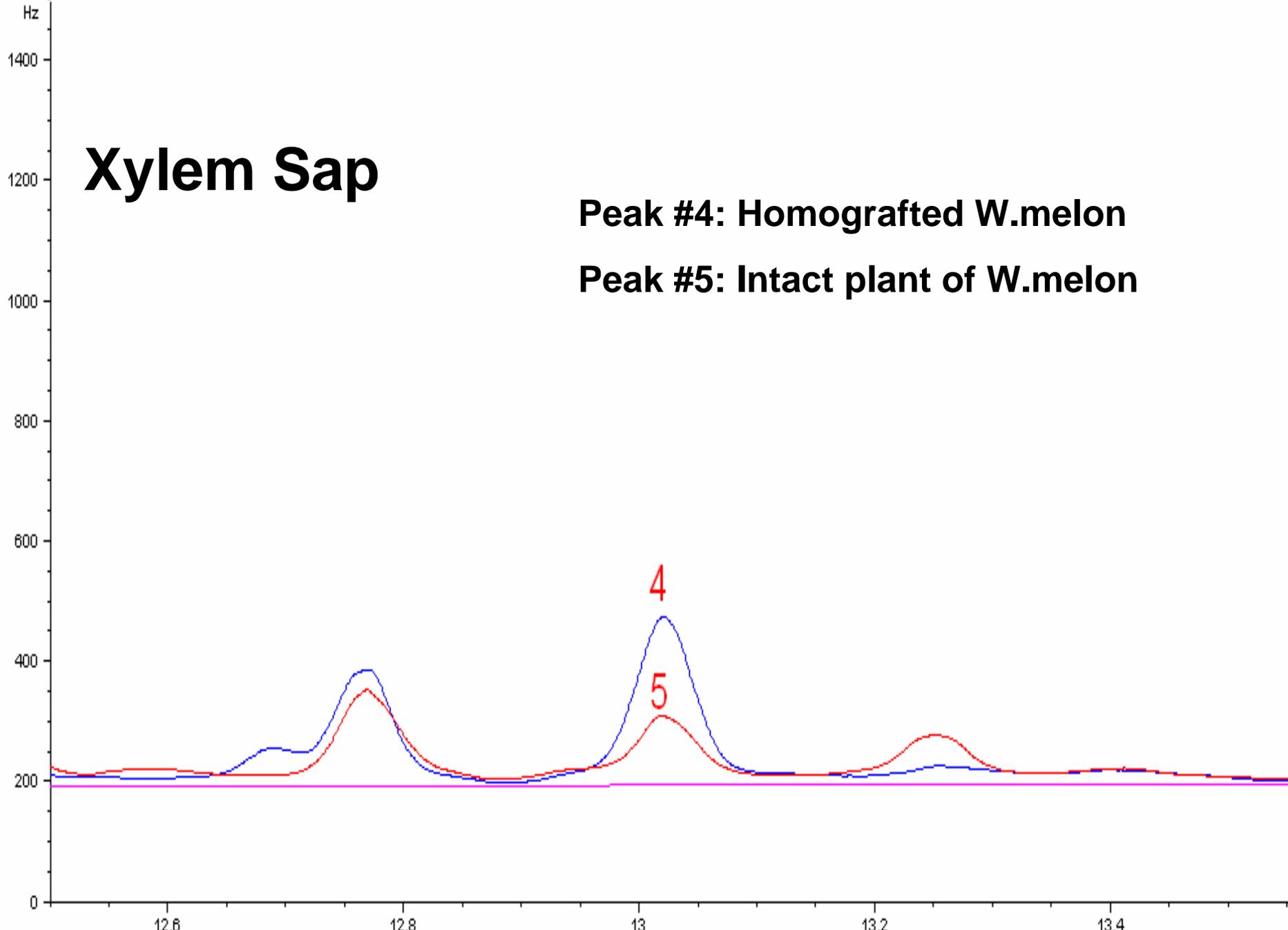
**Peak #1: Intact plant of Zuke**

**Peak #2: Heterografted Zuke**

**Peak #3: Homografted Zuke**

ECD2 B, (101509\SPME0006.D)

ECD2 B, (101609\SPME0003.D)



# Xylem Sap

**Peak #4: Homografted W.melon**

**Peak #5: Intact plant of W.melon**

## Xylem Sap and Pore water

	Contaminated Soil		Control Soil	
<b>Grafted Plants</b>	<b>Xylem Sap(<math>\mu\text{g/L}</math>)</b>	<b>Pore Water(<math>\mu\text{g/L}</math>)</b>	<b>Xylem Sap</b>	<b>Pore Water</b>
Intact plant of Zuke	141.20(B)	0.41(A)	ND	ND
Heterografted Zuke	71.00(C)	0.36(A)	ND	ND
Homografted Zuke	139.94(B)	0.43(A)	ND	ND
Intact plant of W.melon	0.49(A)	0.53(A)	ND	ND
Homografted W.melon	0.50(A)	0.39(A)	ND	ND







## Conclusions

- DDE concentration in rhizosphere soil pore water of grafted and non-grafted plants are the same
- There are no statistically significant differences between any pair of means at the 95,0% confidence level for pore water.
- DDE concentrations in grafted watermelon is much more higher than that of intact plant of watermelon
- Grafted water melon growing in contaminated soil can be dangerous...

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