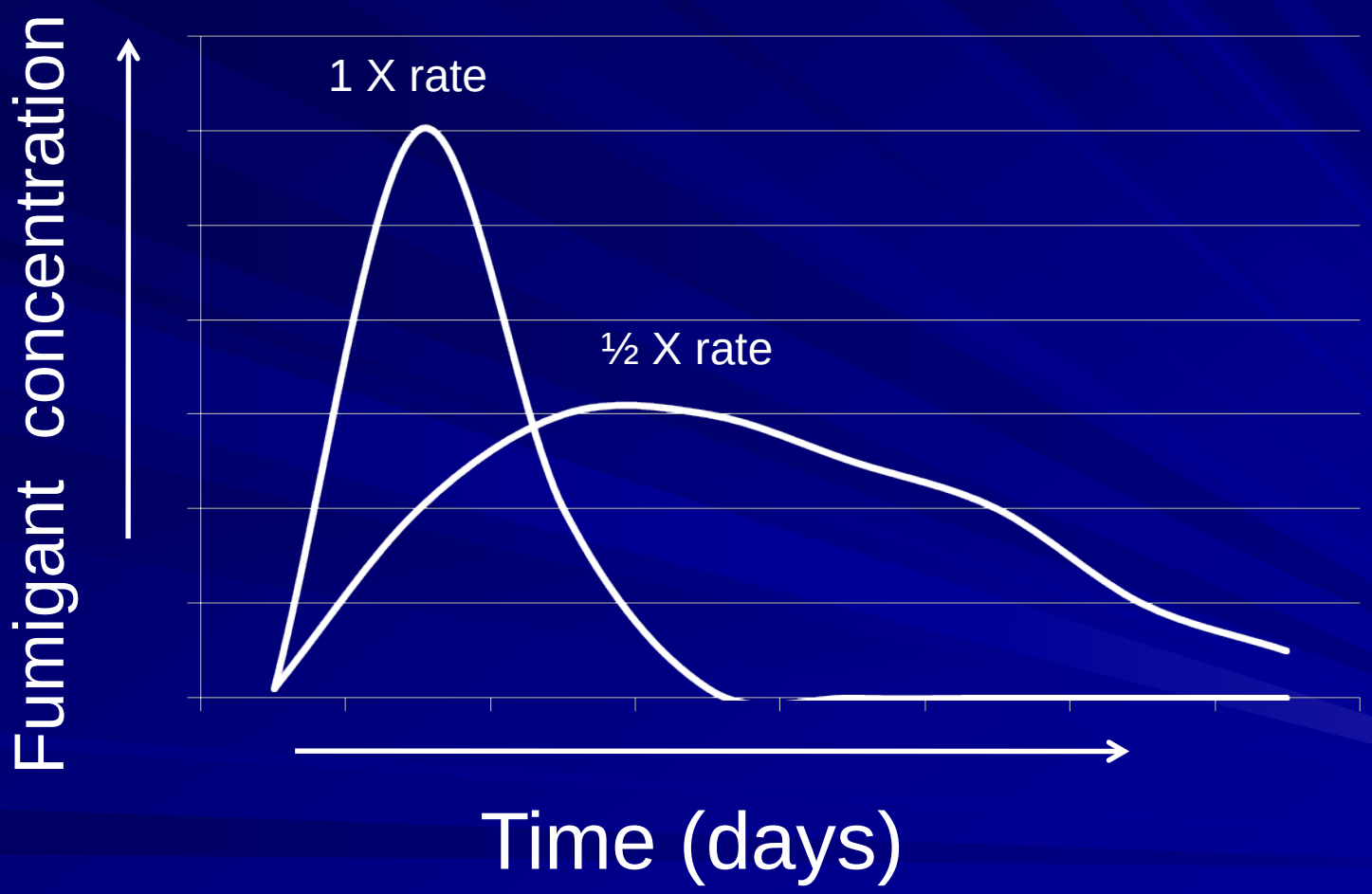
Area Under the Curve
Dan Chellemi, USDA, ARS

Fumigant effectiveness in soil determined by the *C x T* value



Advantages of increasing exposure time to achieve required *C x T* value

- Economics – cutting application rates by 50% or greater will reduce costs significantly
- Regulatory – eliminating fumigant emissions will reduce required buffer zones, PPE restrictions and township caps

Disadvantages of increasing exposure time

- Management: requires additional supervision and maintenance of treated area
- Time: must wait 10 – 21 days to complete the fumigation process


NON POT ABLE WATER
4/3/2007 9:09

Management practices that directly impacting fumigant retention in soil

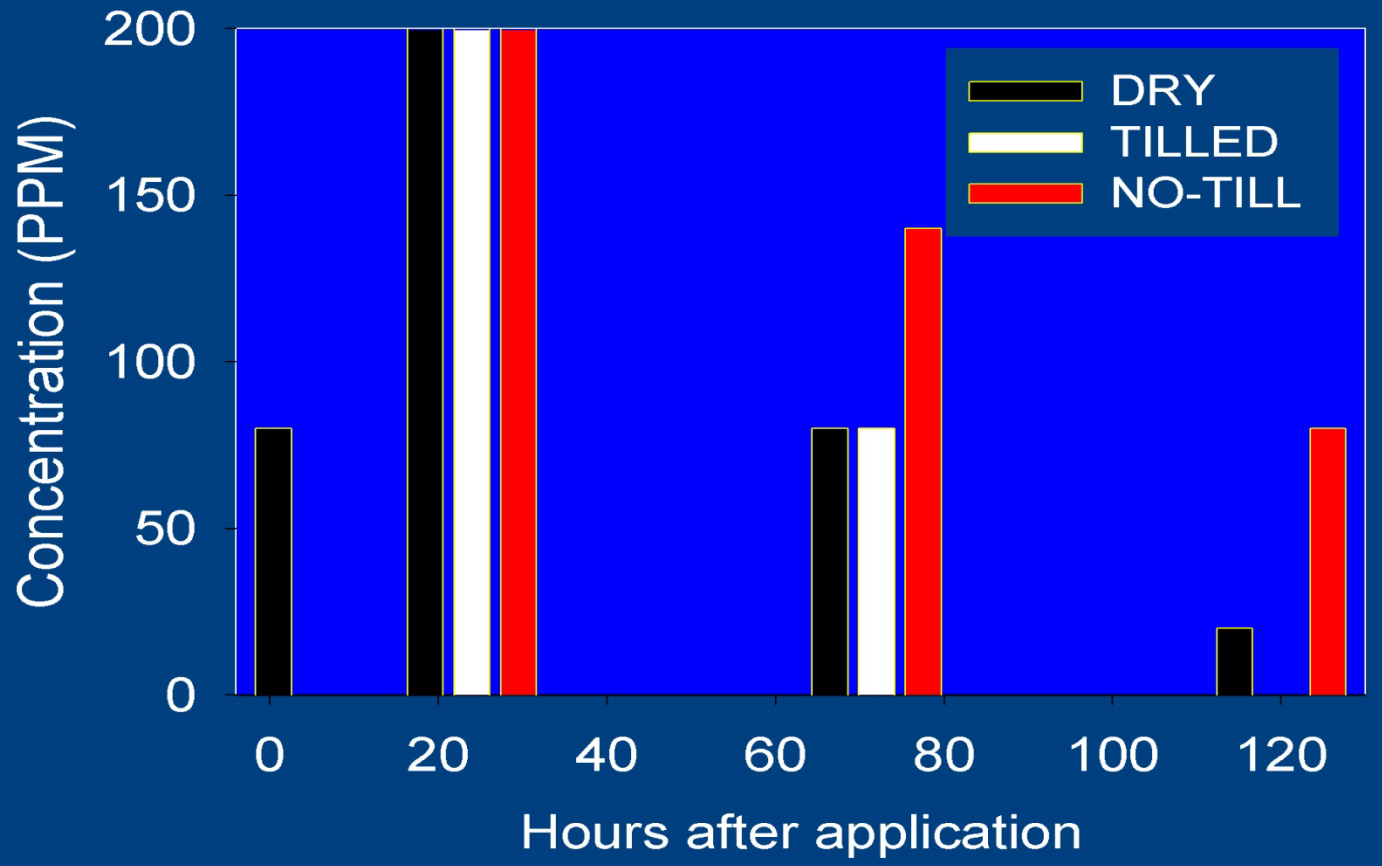
- Soil tillage prior to application

Quantitative determination of fumigant concentration in soil and soil atmosphere

*Based upon EPA methods 5035 and 8260B for soils and NIOSH Method Issue 2 for fumigants in air

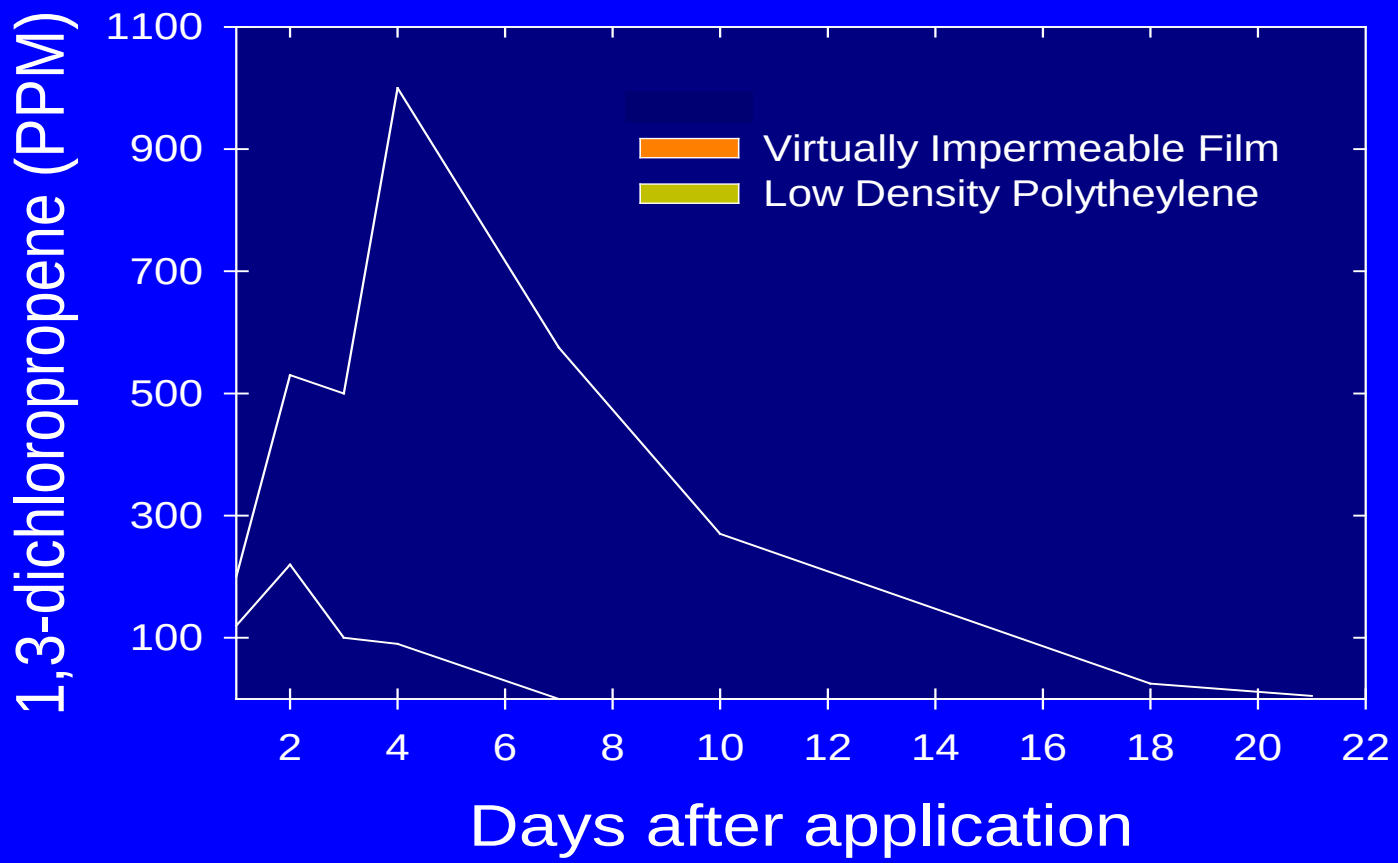
Telone concentration in upper 5 inches of soil

Dry = 4.6% moisture
Tilled and No-till = 8%



Management practices directly impacting fumigant retention in soil

- The type of plastic film used to cover fumigated soil


1,3-dichloropropene (PPM)
1100
900
700
500
300
100
2
4
6
8
10
12
14
16
18
20
22
Days after application
Virtually Impermeable Film
Low Density Polytheylene


4/3/2007 11:03

Permeability of plastic to fumigants

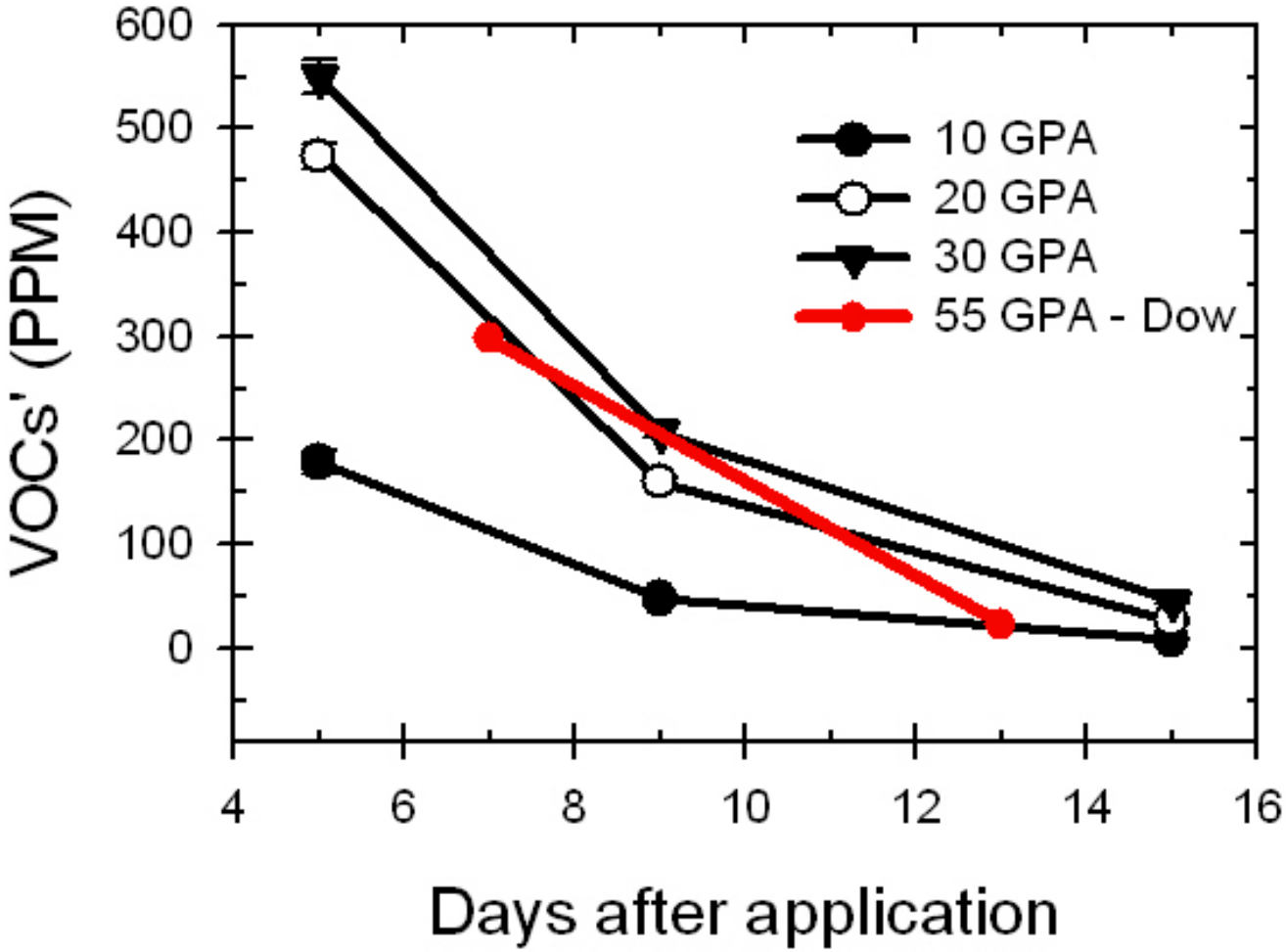
mass diffusion coefficient *h* (cm / hr)

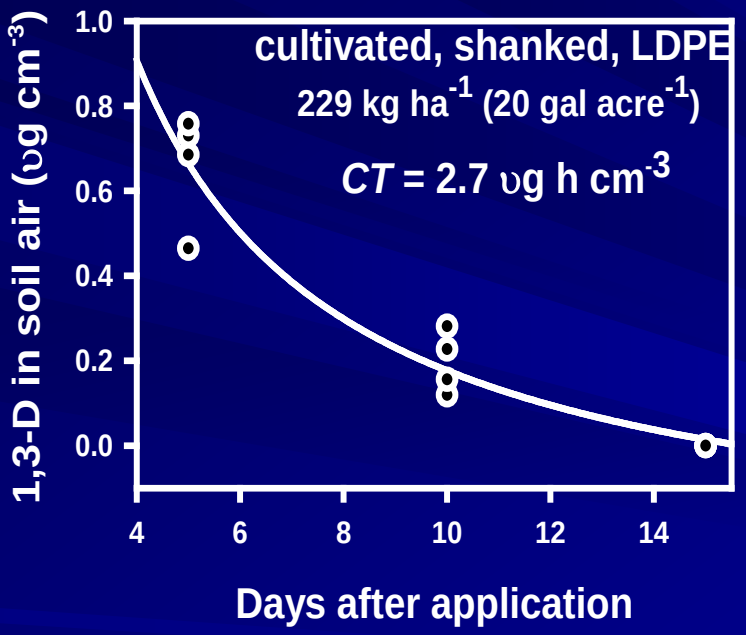
Plastic	MeBr	MeI	1,3-D (cis)	1,3-D (trans)	Pic
LDPE	0.82	1.42	5.1	8.83	1.56
VIF	0.002	0.0013	0.0019	0.0048	0.002

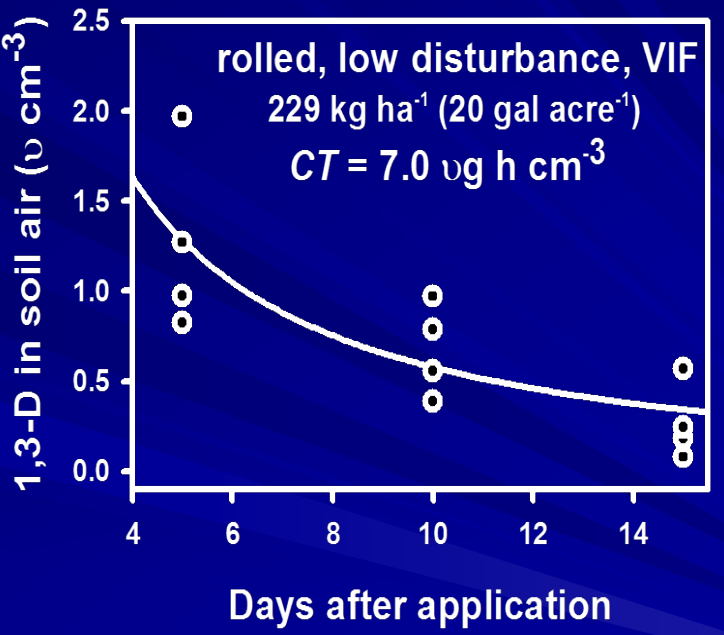
Relative barrier index

1 / mass diffusion coefficient (*h*)

Plastic	MeBr	MeI	1,3-D (cis)	1,3-D (trans)	Pic
Cadillac	1.2	0.7	0.2	0.1	0.6
Bromostop	500	769	526	208	500


600
500
400
300
200
100
0
VOCs' (PPM)
4
6
8
10
12
14
16
Days after application
10 GPA
20 GPA
30 GPA
55 GPA - Dow


cultivated, shanked, LDPE
229 kg ha-1 (20 gal acre-1)
CT = 2.7 υg h cm-3
1,3-D in soil air (υg cm-3)
1.0
0.8
0.6
0.4
0.2
0.0
4
6
8
10
12
14
Days after application


rolled, low disturbance, VIF
229 kg ha-1 (20 gal acre-1)
CT = 7.0 υg h cm-3
1,3-D in soil air (υ cm-3)
2.5
2.0
1.5
1.0
0.5
0.0
4
6
8
10
12
14
Days after application

Fumigant effectiveness in soil determined by the *C x T* value