

Characterizing Phosphine Movement in Upright Concrete Grain Elevators

By Carl Reed
Kansas State University





KSU Studies on Movement of Phosphine in Grain Elevators



Dräger

Pac III

0.00
H3 ppm



LOGGING DATA
Please Don't Disturb
Carl Reed, KSU
785 539 6944



LOGGING DATA

Please Don't Disturb

Carl Reed, KSU

785 539 6944

CRESL

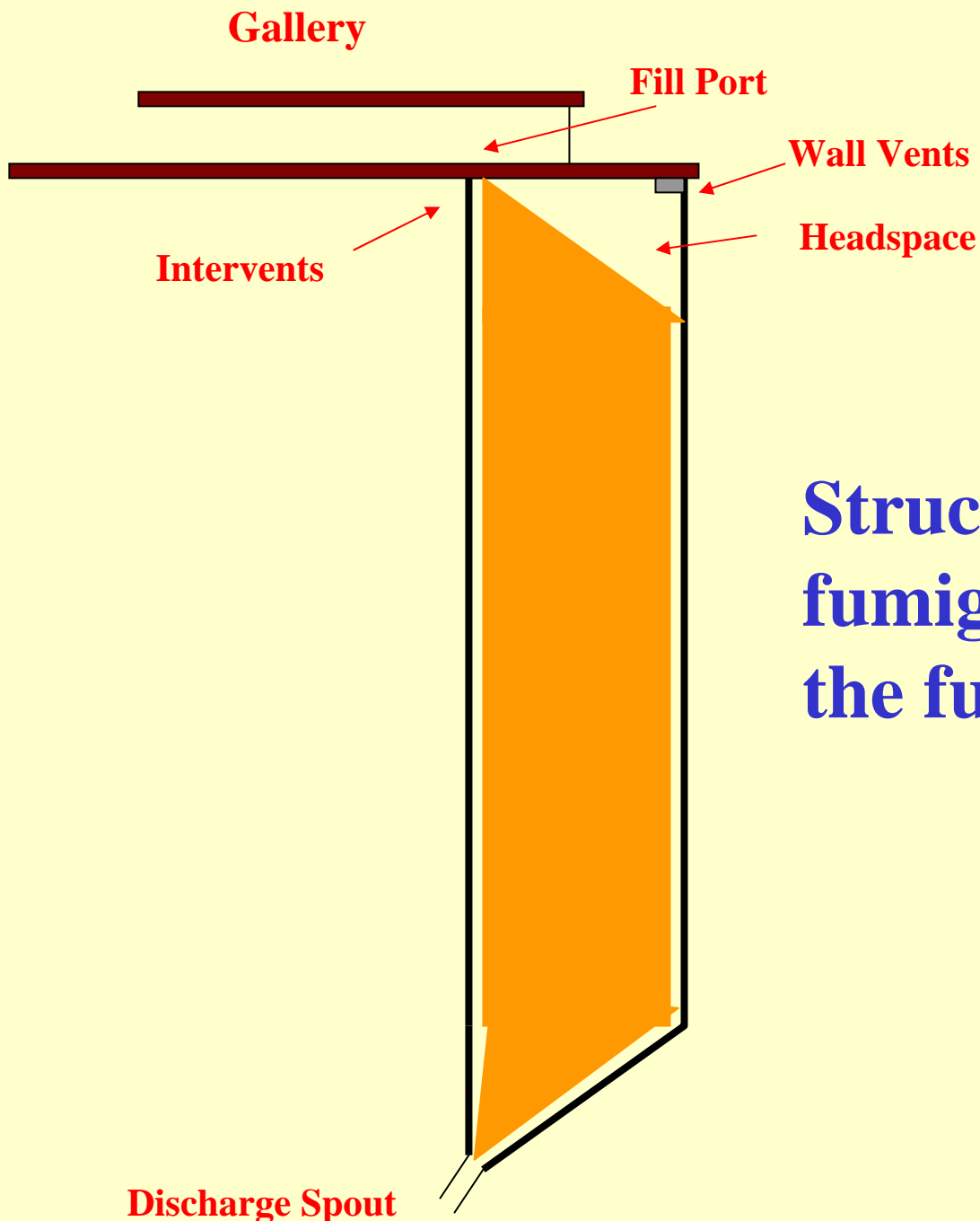






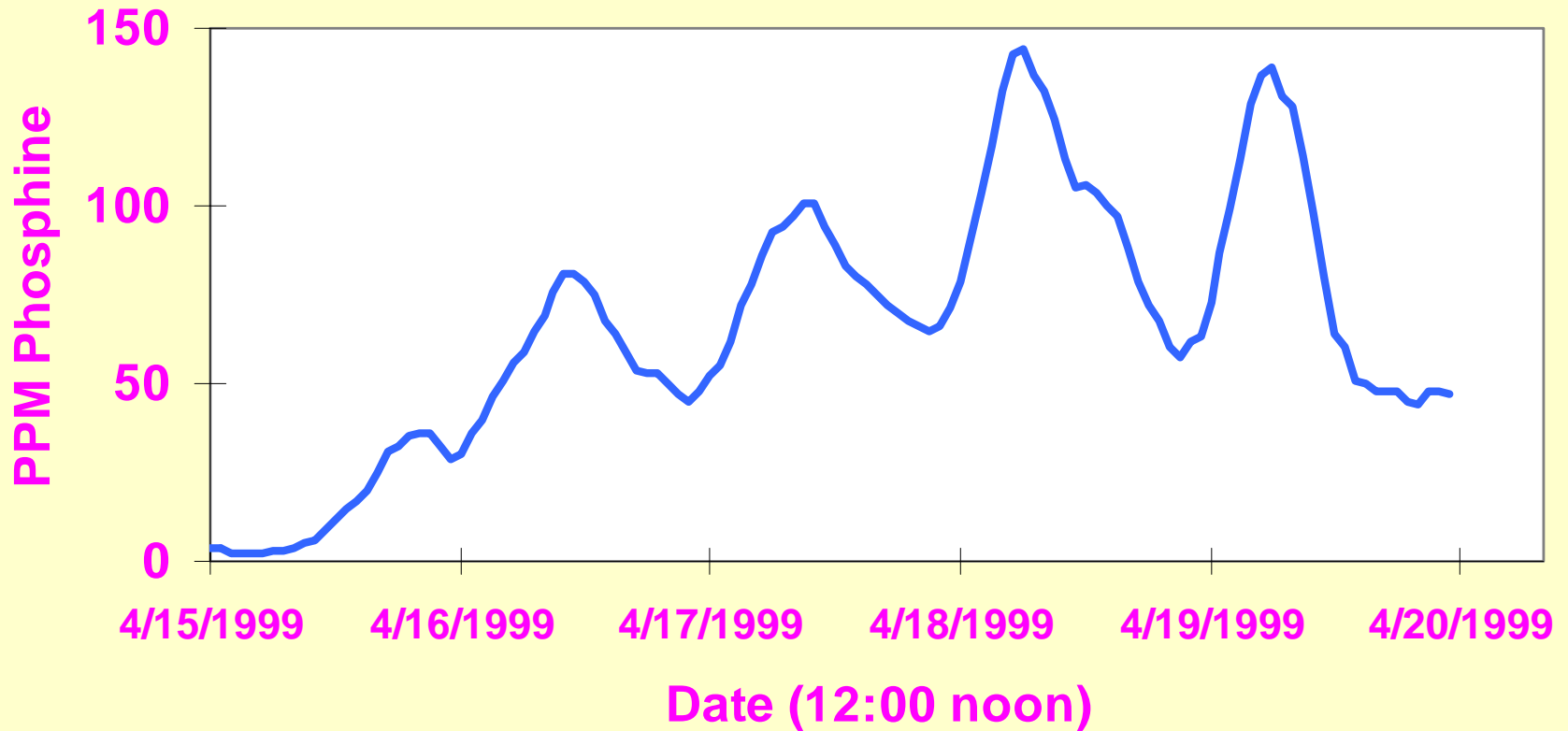




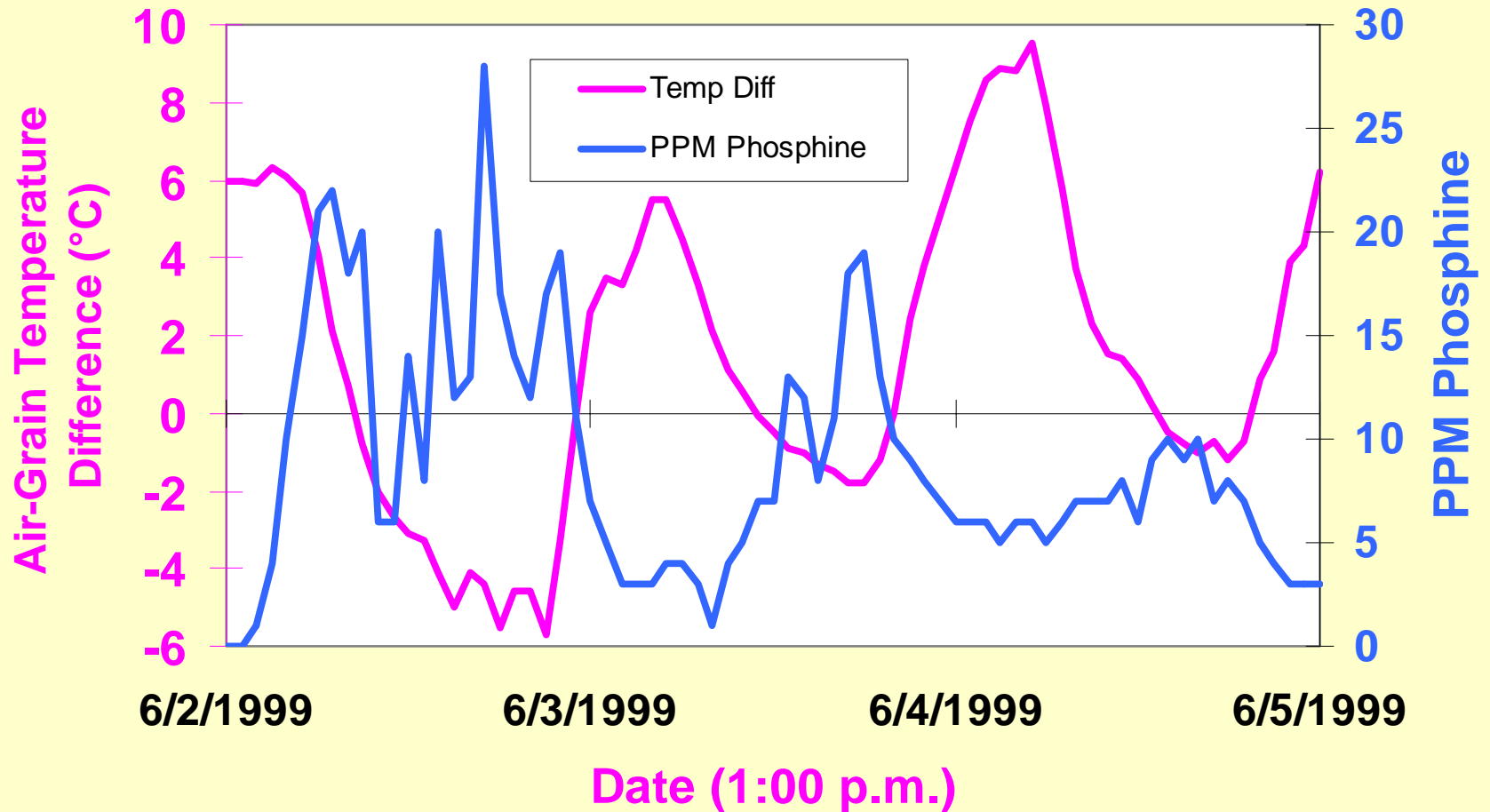


**Structures that influence
fumigant movement in
the fumigated grain**

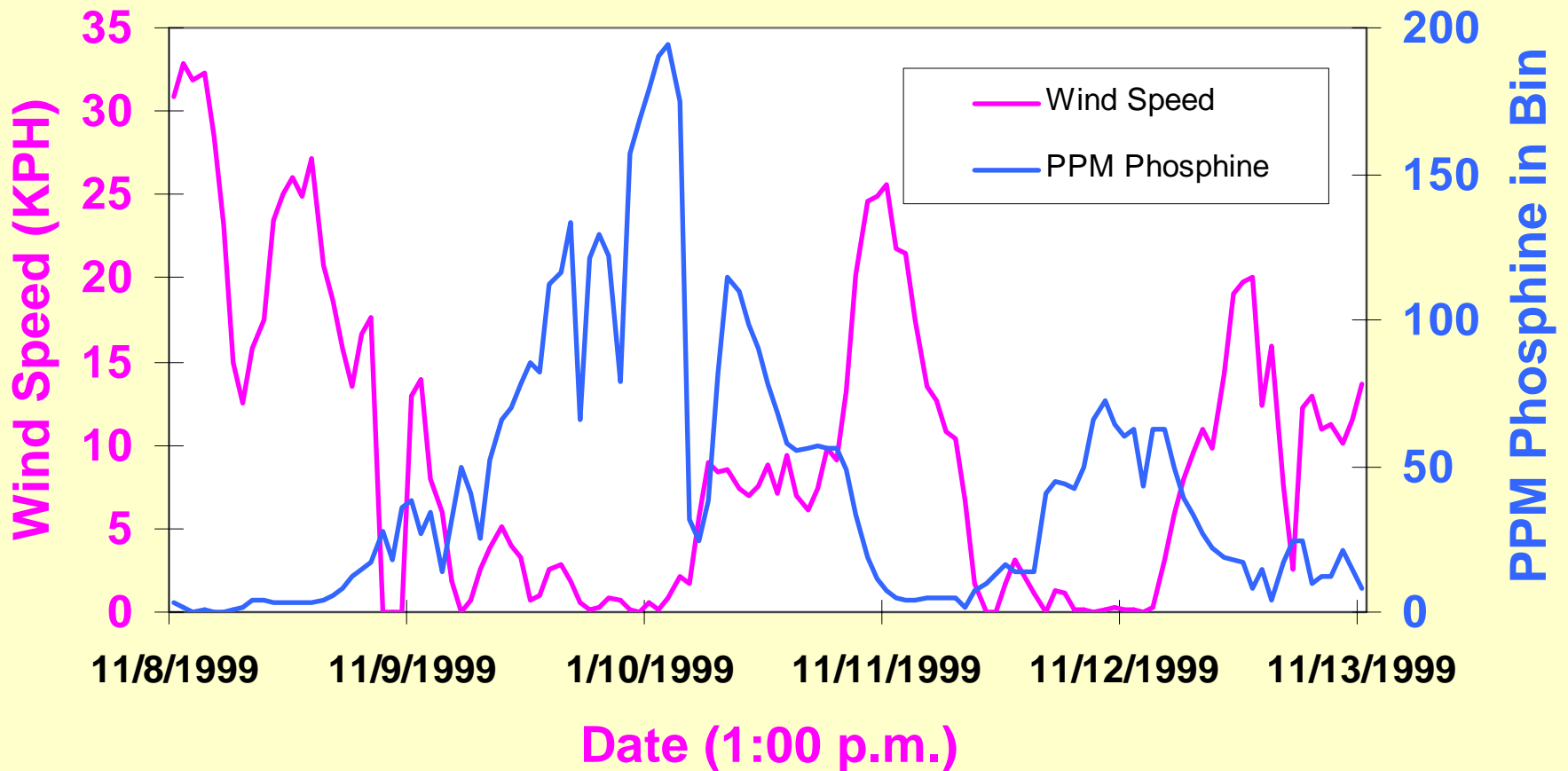
Phosphine concentrations in the headspace of an elevator bin



Phosphine concentration in headspace and the difference between air temperature and grain temperature

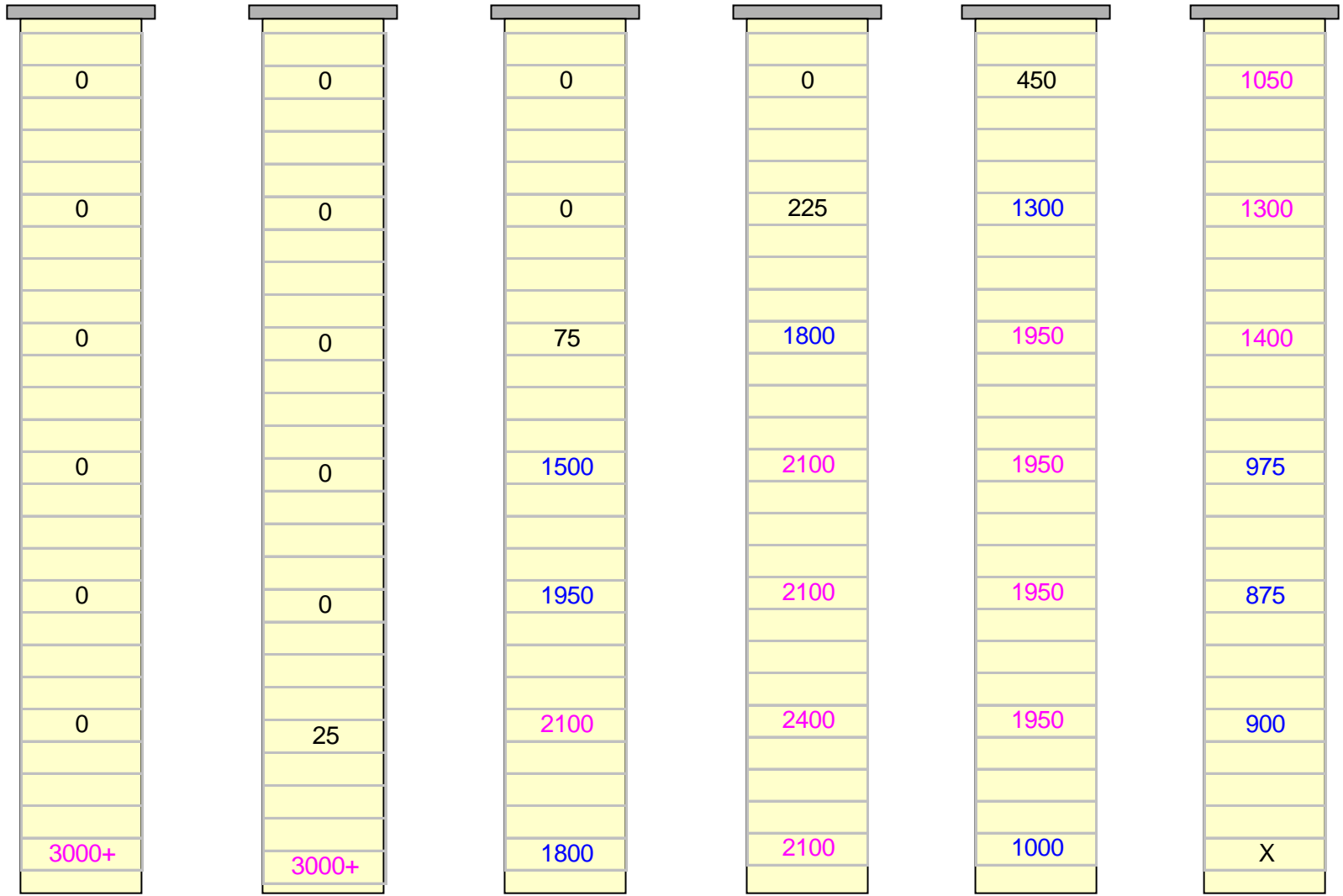


Phosphine concentrations in the headspace and wind speed



Fumigant Movement in 15 ' by 140 ' Bins

Tablets in Bottom of Bin



3/27

3/28

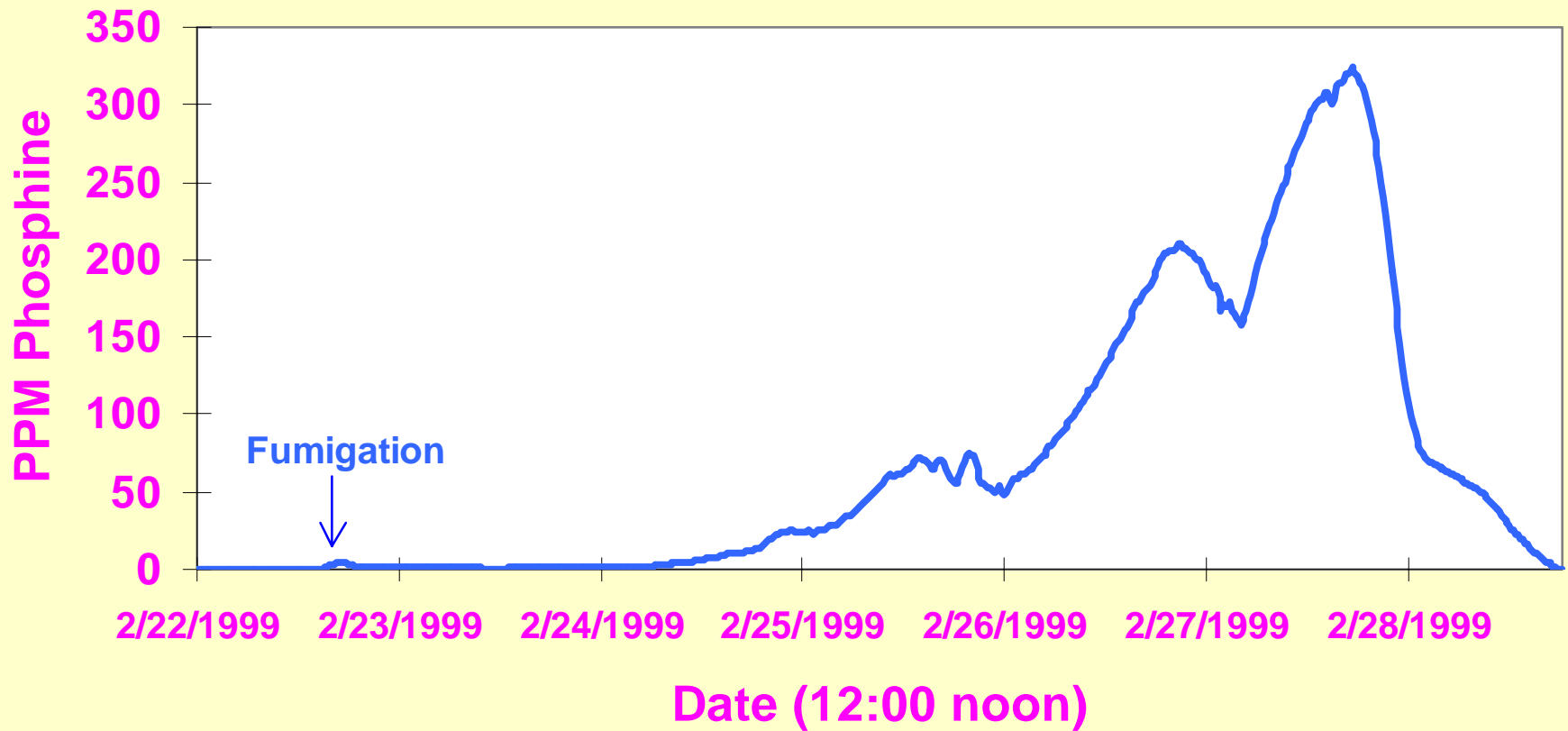
3/29

3/30

3/31

4/03

Phosphine concentrations in the headspace of a bin in which all fumigant was applied to grain in the bottom half of the bin



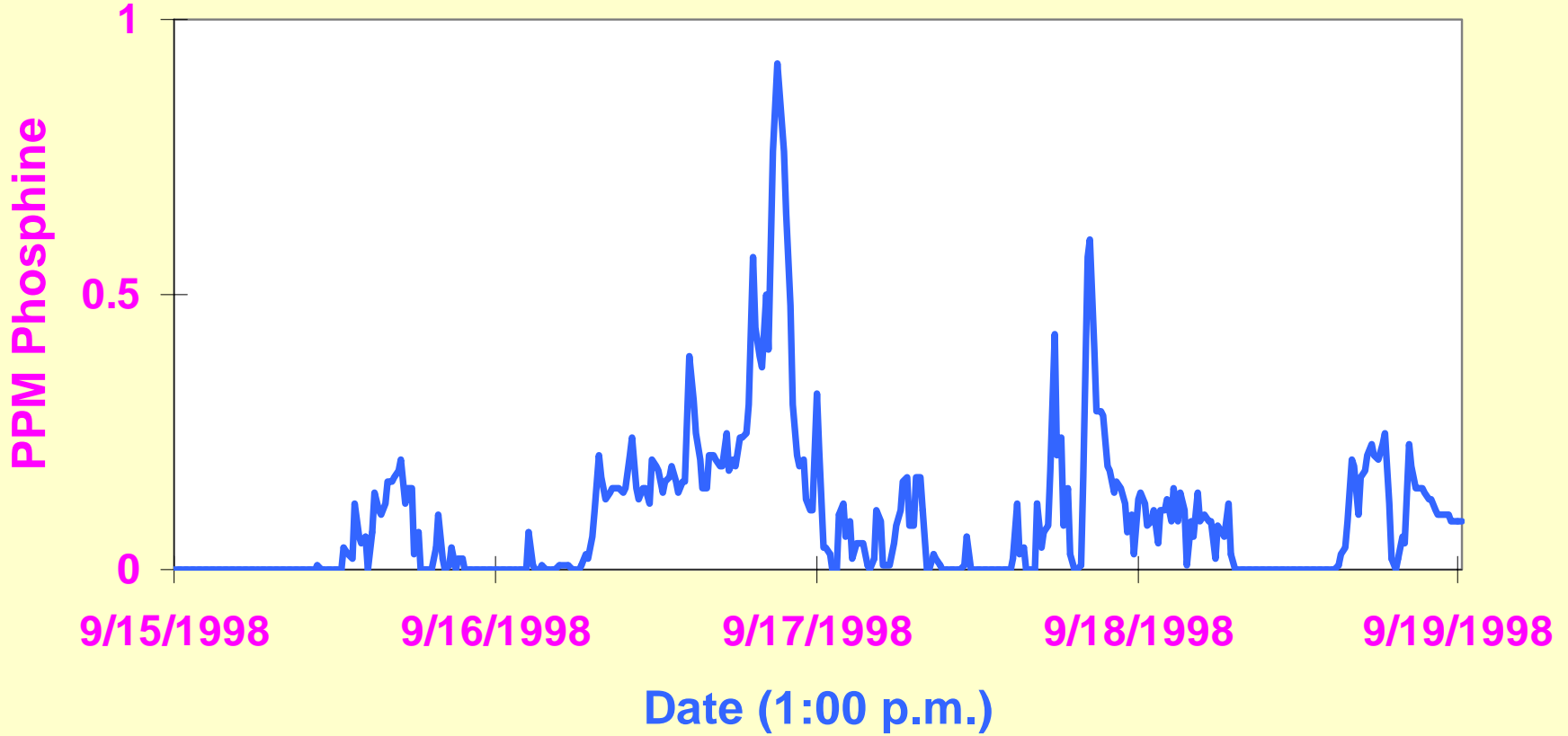
Phosphine concentration ranges at various parts of the elevators

Location	Phosphine Concentrations									
	0 ppm		0-0.3 ppm		0.31-1.0 ppm		1.01-3.0 ppm		>3.01 ppm	
	%	Mean	%	Mean	%	Mean	%	Mean	%	Mean
Ground Inside ^a	71.9	-	22.3	0.09	3.8	0.55	1.6	2.07	0.4	4.8
Bin-Top Inside ^a	27.2	-	37.9	0.11	17.3	0.58	11.8	1.75	5.8	5.12
Ground Outside ^b	99.0	-	1.0	0.02	0.0	-	0.0	-	0.0	-
Bin-Top Outside ^b	90.0	-	9.9	0.05	0.1	0.51	<0.1	1.08	0.0	-

^a Distribution significantly ($p < 0.01$) related to location in inside worker areas

^b Distribution significantly ($p < 0.01$) related to location outside the elevator

Phosphine concentrations in worker breathing zones in the headhouse of a country elevator



Phosphine distribution in 18' by 85' Bin

Air and grain about same temperature

Bin fumigated 1/3/01 at 10' layers

Bin 306	1/6/2001			1/8/2001			1/9/2001			1/10/2001		
	Feet	Inner	Center	Outer	Inner	Center	Outer	Inner	Center	Outer	Inner	Center
10	3550	2380	410	1980	1420	620	1490	860	310	650	130	50
20	4180	1830	1260	2100	1760	820	1500	1000	520	1110	790	110
30	3890	2850	990	2190	1900	810	1450	1060	540	1350	970	640
40	3620	3300	880	2250	1970	800	1400	1130	490	1490	1160	520
50	3400	3850	1070	2290	1790	830	1390	1050	470	1550	1200	460
60	3430	3300	1330	2120	1260	680	1280	830	390	1540	1060	420
70	2720	2050	1260	1700	660	440	1010	540	260	1430	850	320
80	540	610	930	610	90	360	560	100	220	800	470	270
Bot	80			50			200			900		

Bin 306	1/11/2001			1/12/2001			1/16/2001			1/18/2001		
	Feet	Inner	Center	Outer	Inner	Center	Outer	Inner	Center	Outer	Inner	Center
10	80	30	20	180	150	30	310	300	120	210	130	100
20	280	340	40	390	540	120	340	340	150	220	140	70
30	550	720	250	510	640	290	330	330	180	220	150	90
40	820	910	460	600	760	350	330	300	170	220	160	80
50	1080	1020	440	750	820	370	340	280	160	210	150	70
60	1230	1010	430	910	870	400	330	230	180	190	130	90
70	1260	910	350	1000	850	370	310	150	130	170	90	100
80	810	690	290	650	260	290	30	20	100	50	0	70
Bot	50			600			0			0		

Fumigant Movement in 18' by 85' bin

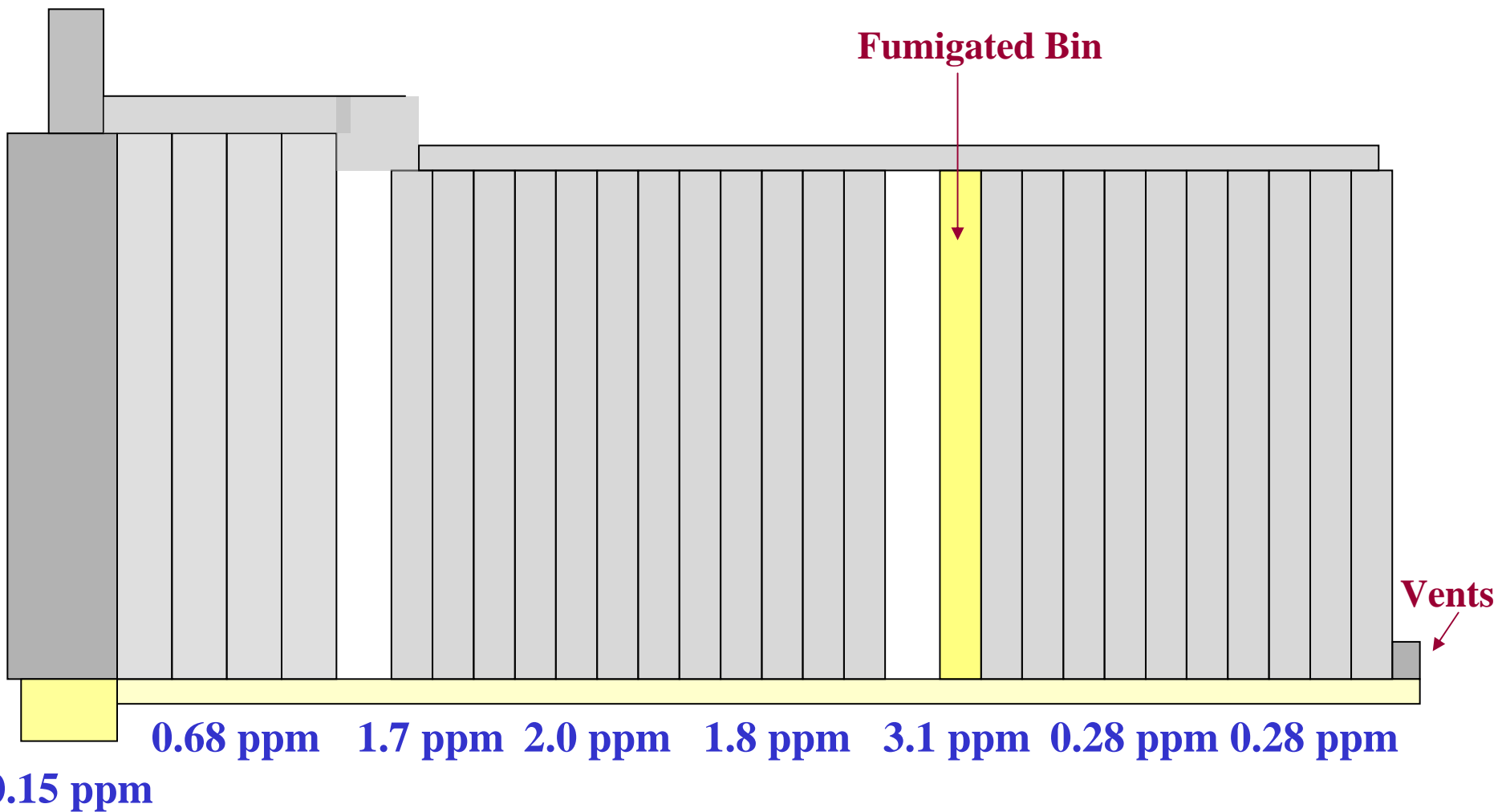
Fumigant layered at 10' intervals, grain cooler than ambient air

Feet Be- low Roof	6/7/2001			6/8/2001			6/9/2001			6/11/2001			6/12/2001		
	In	Cent	Out	In	Cent	Out	In	Cent	Out	In	Cent	Out	In	Cent	Out
10	30	210	470	20	70	600	30	100	540	0	40	130	0	20	60
20	2300	2220	3660	1440	1420	3080	1170	1060	2000	280	270	710	20	40	310
30	2680	2030	3240	2010	2230	2540	1630	2150	2290	830	1160	1380	120	300	930
40	1980	2380	3600	1980	2230	2850	1810	2060	2150	1260	1700	1640	510	1050	1370
50	1510	3180	2210	1830	2410	2070	1850	2120	1970	1500	1770	1660	970	1410	1490
60	3410	3570	2740	2710	2740	2160	2310	2270	1920	1660	1830	1690	1230	1530	1530
70	2350	3050	1690	2640	2710	1740	2570	2440	1820	2000	1930	1730	1500	1620	1570
80	3730	1560	1290	2680	1660	1230	2300	1760	1550	2020	1800	1700	1650	1560	1540
Bot	3290	X	X	2260	X	X	1950	X	X	1700	X	X	1460	X	X

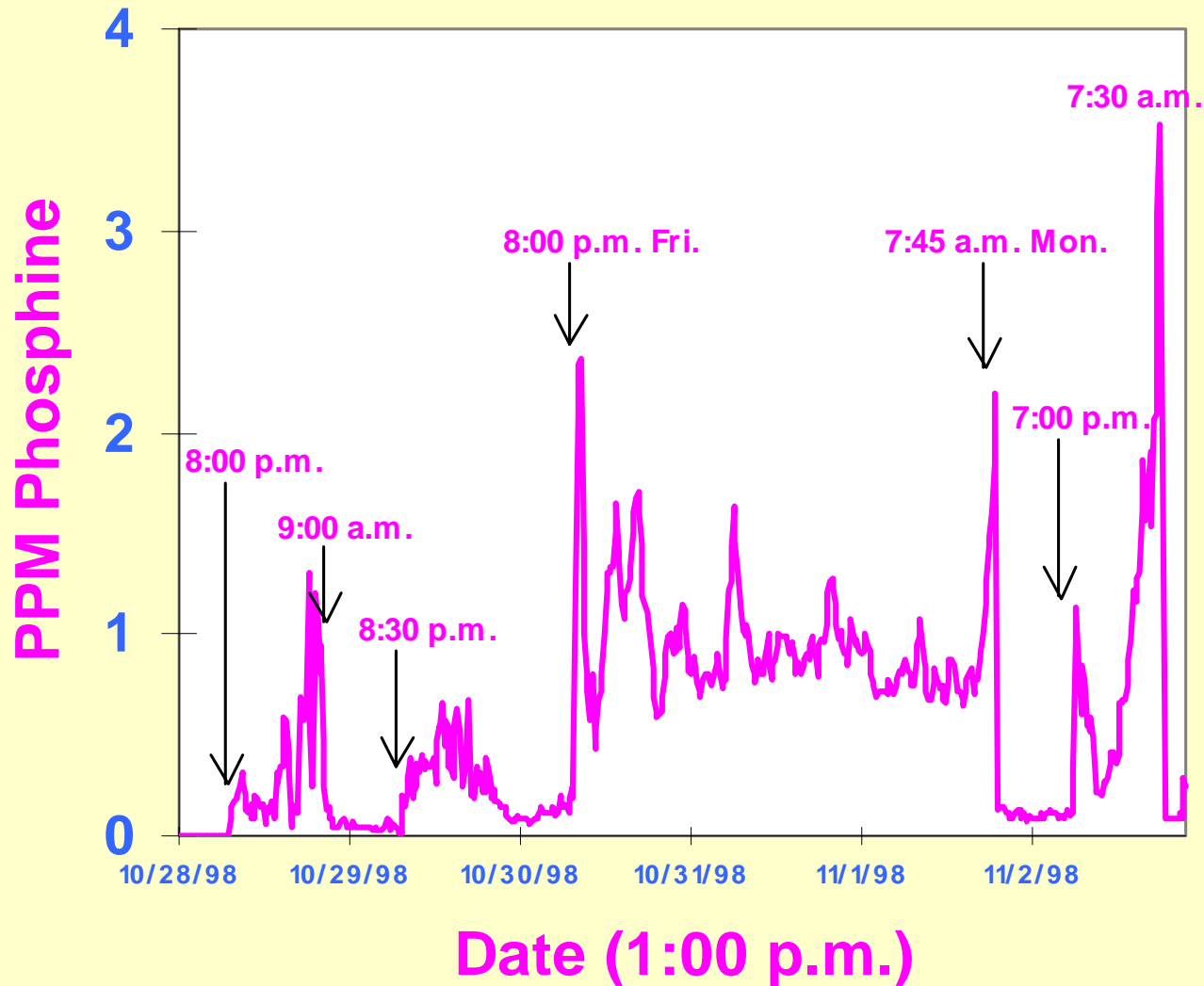
Feet Be- low Roof	6/13/2001			6/14/2001			6/15/2001			6/16/2001			6/18/2001		
	In	Cent	Out	In	Cent	Out	In	Cent	Out	In	Cent	Out	In	Cent	Out
10	0	10	50	0	0	40	0	0	40	0	0	40	0	0	30
20	0	10	200	0	0	120	0	0	140	0	0	120	0	0	80
30	20	90	650	10	30	360	10	40	360	10	60	360	10	20	220
40	90	410	1050	110	210	740	20	150	610	40	170	560	20	100	350
50	460	870	1270	220	420	970	100	290	750	110	250	650	60	160	400
60	840	1200	1360	490	710	1070	280	440	820	230	340	670	120	220	410
70	1170	1400	1420	850	1010	1160	560	650	870	470	470	690	230	270	410
80	1350	1380	1400	1080	1180	1180	820	890	890	610	680	690	300	340	390
Bot	1240	X	X	1070	X	X	810	X	X	460	x	x	300	x	x

Phosphine Levels in the Tunnel

when Fumigant Movement was Downward



Phosphine concentrations as affected by mechanical controls in the gallery of a terminal elevator



Movement of Phosphine in Elevators

Carl Reed

Kansas State University

