Control of Fire blight Disease in Pear caused by *Erwinia amylovora* Using Biological Control Agents, Copper and Antibiotics

Rachel Elkins, Ken Johnson, Todd Temple and Steve Lindow

Treatment Application

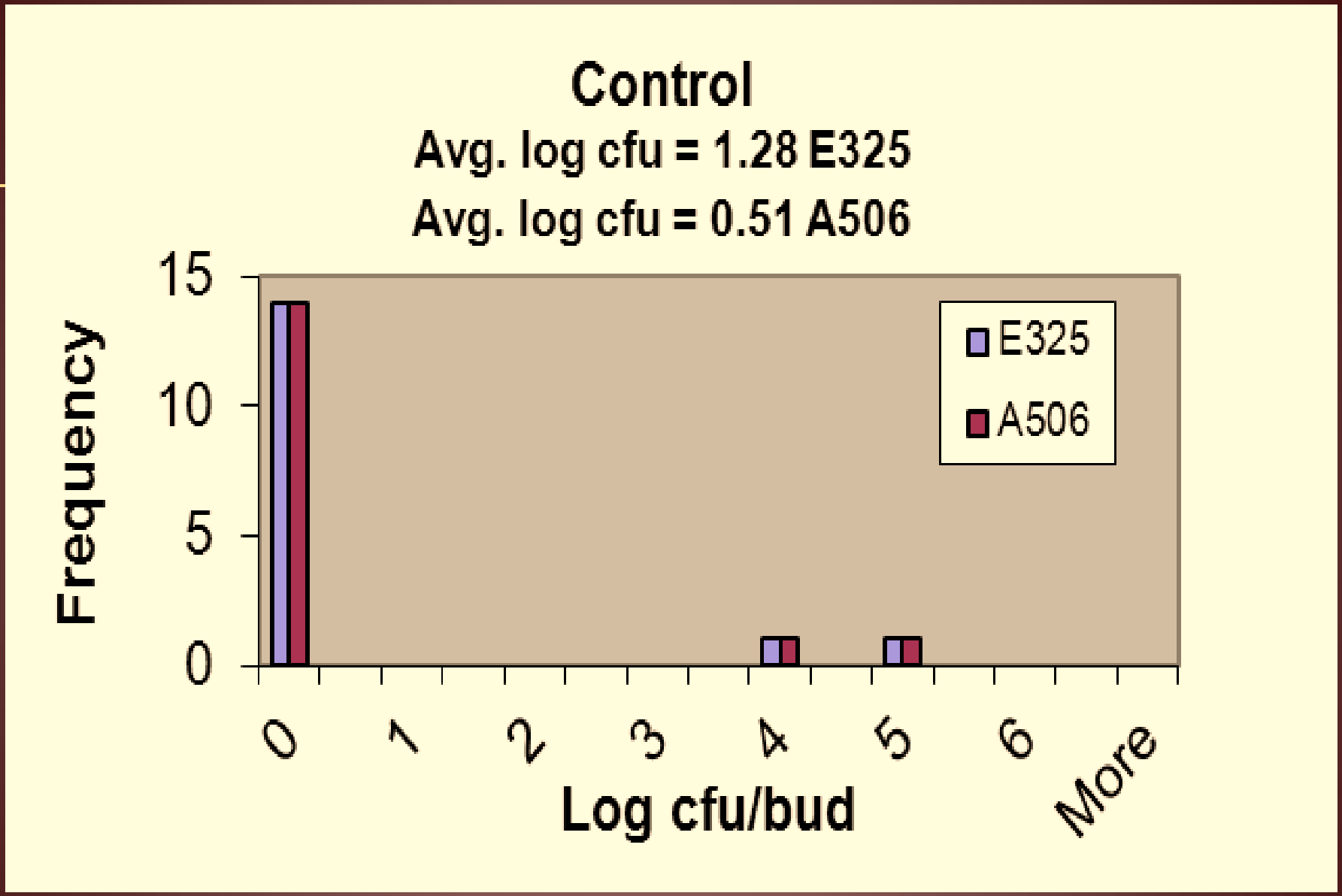
Control
Avg. log cfu = 1.28 E325
Avg. log cfu = 0.51 A506
Frequency
15
10
5
0
E325
A506
0
1
2
3
4
5
6
More
Log cfu/bud

Figure 1

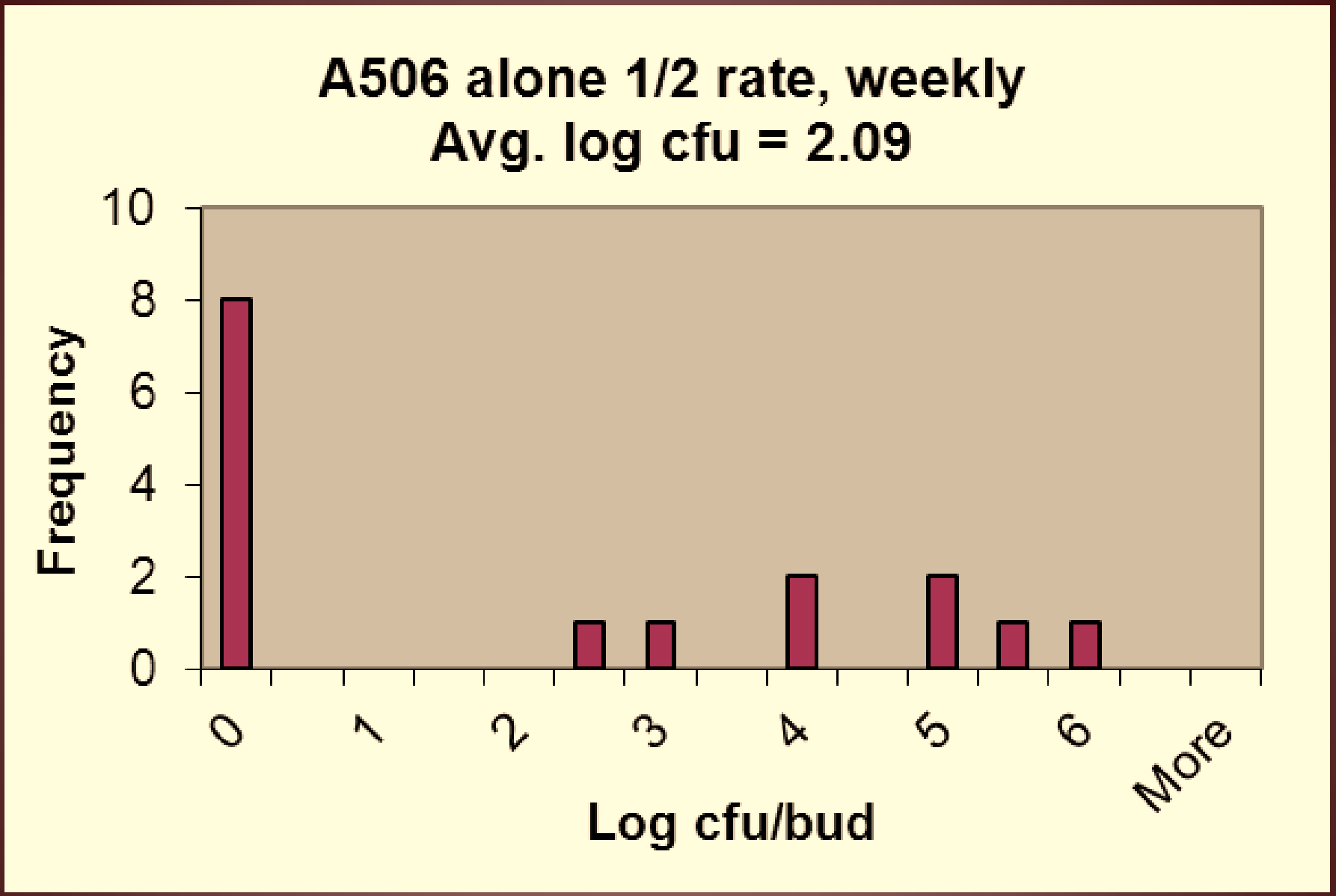
A506 alone 1/2 rate, weekly
Avg. log cfu = 2.09
Frequency
10
8
6
4
2
0
0
1
2
3
4
5
6
More
Log cfu/bud

Figure 2

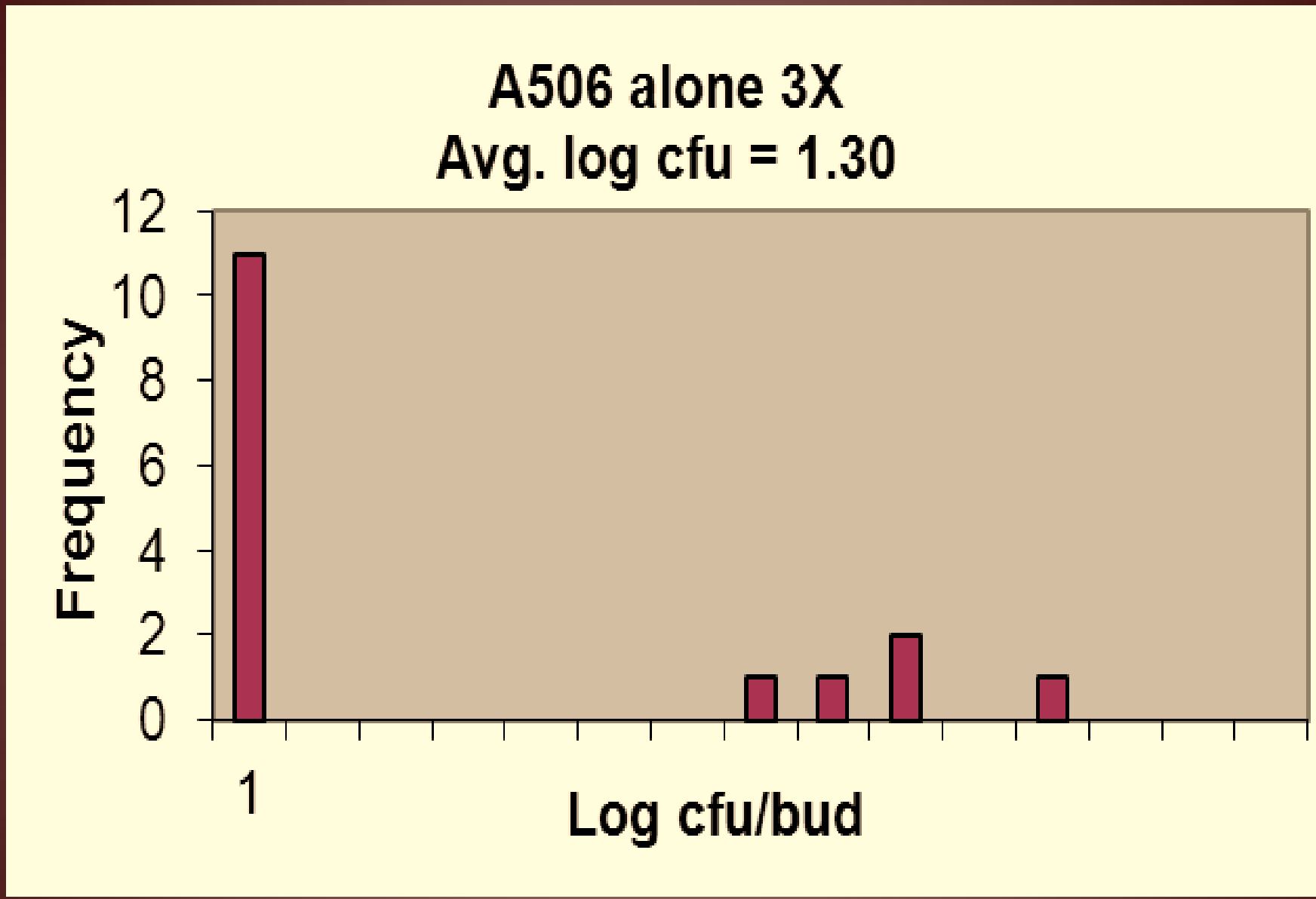
A506 alone 3X
Avg. log cfu = 1.30
Frequency
12
10
8
6
4
2
0
1
Log cfu/bud

Figure 3

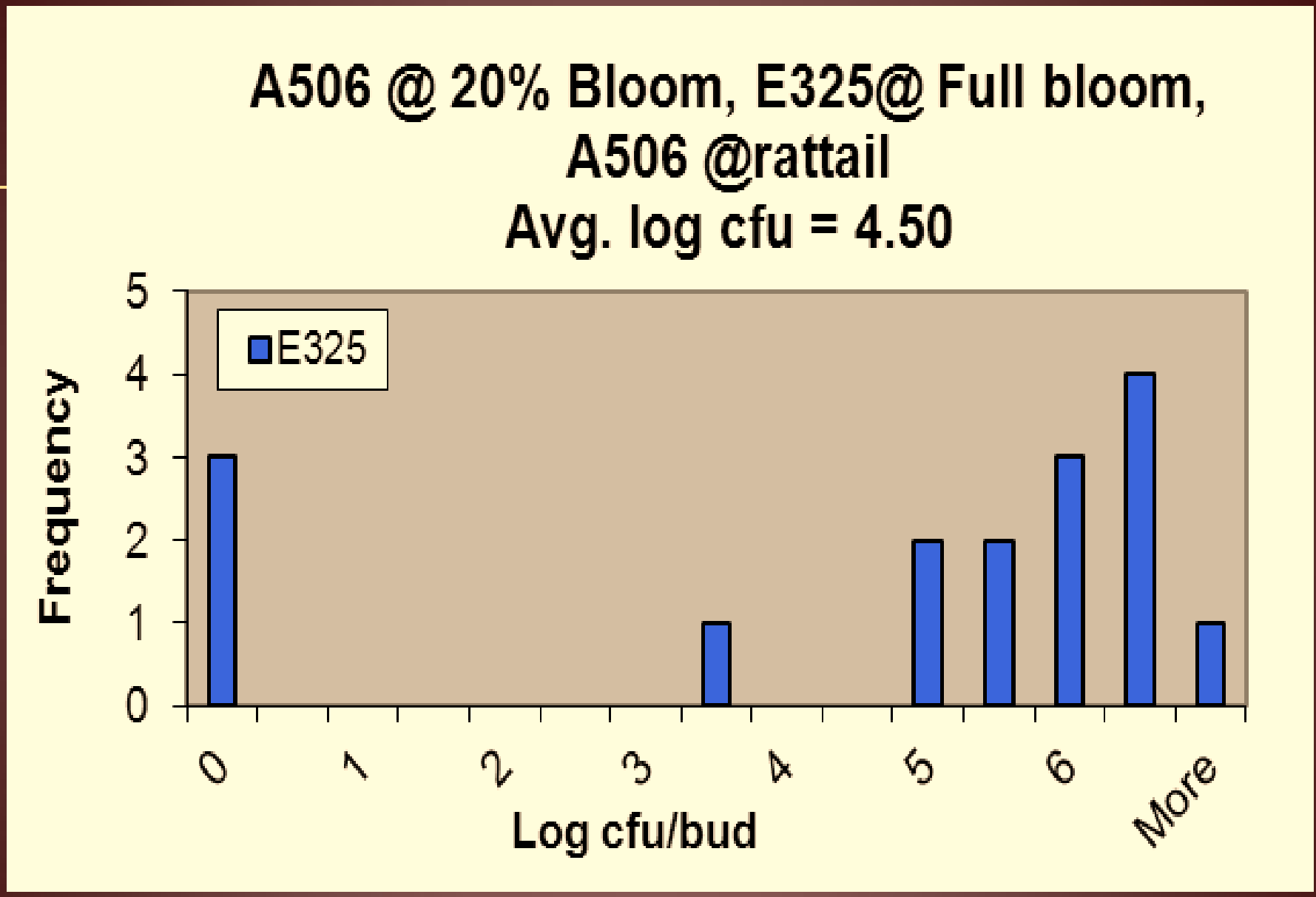
A506 @ 20% Bloom, E325@ Full bloom,
A506 @rattail
Avg. log cfu = 4.50
E325
Frequency
0
1
2
3
4
5
0
1
2
3
4
5
6
More
Log cfu/bud

Figure 4

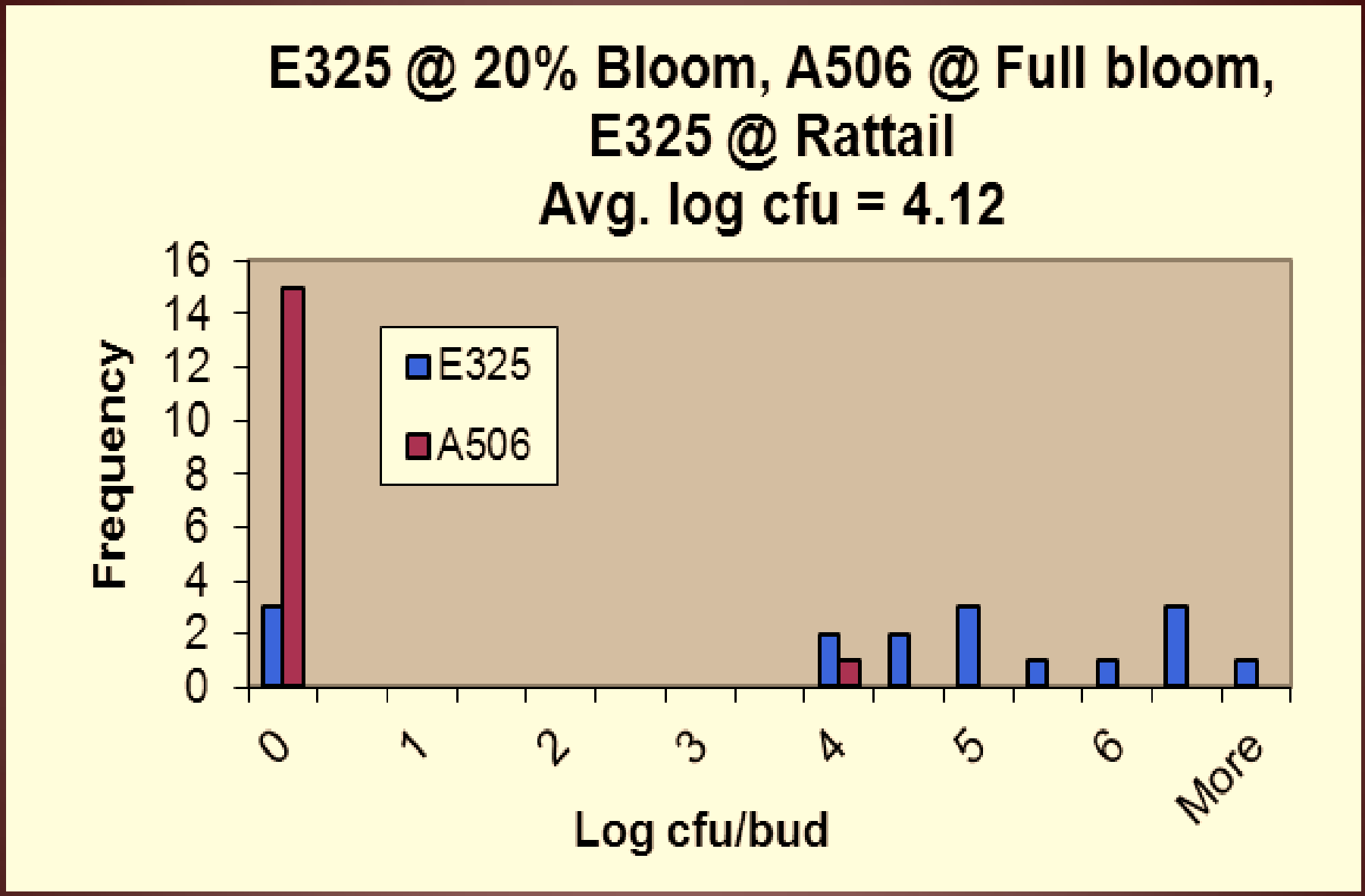
E325 @ 20% Bloom, A506 @ Full bloom,
E325 @ Rattail
Avg. log cfu = 4.12
Frequency
16
14
12
10
8
6
4
2
0
E325
A506
0
1
2
3
4
5
6
More
Log cfu/bud

Figure 5

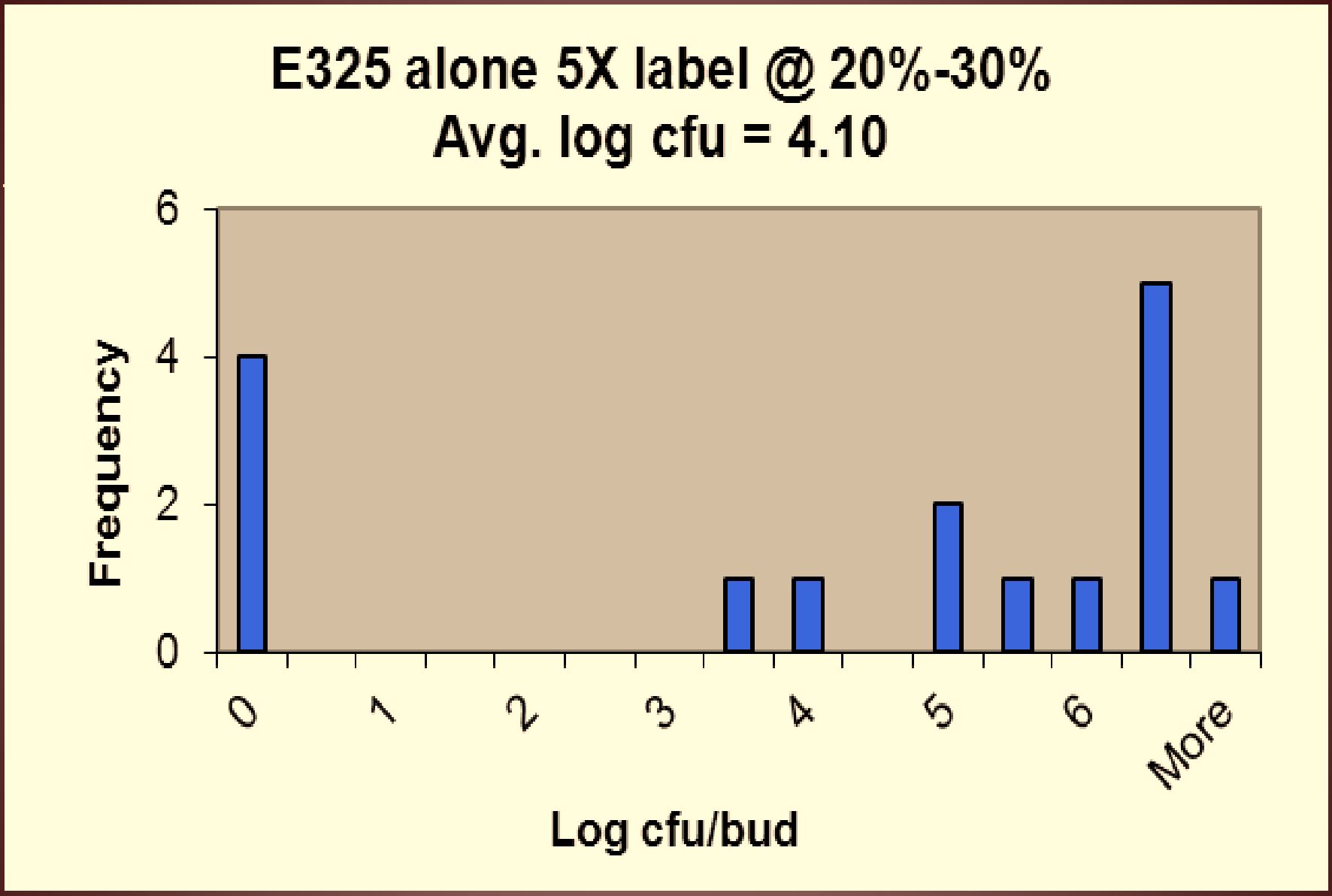
E325 alone 5X label @ 20%-30%
Avg. log cfu = 4.10
Frequency
0
2
4
6
0
1
2
3
4
5
6
More
Log cfu/bud

Figure 6

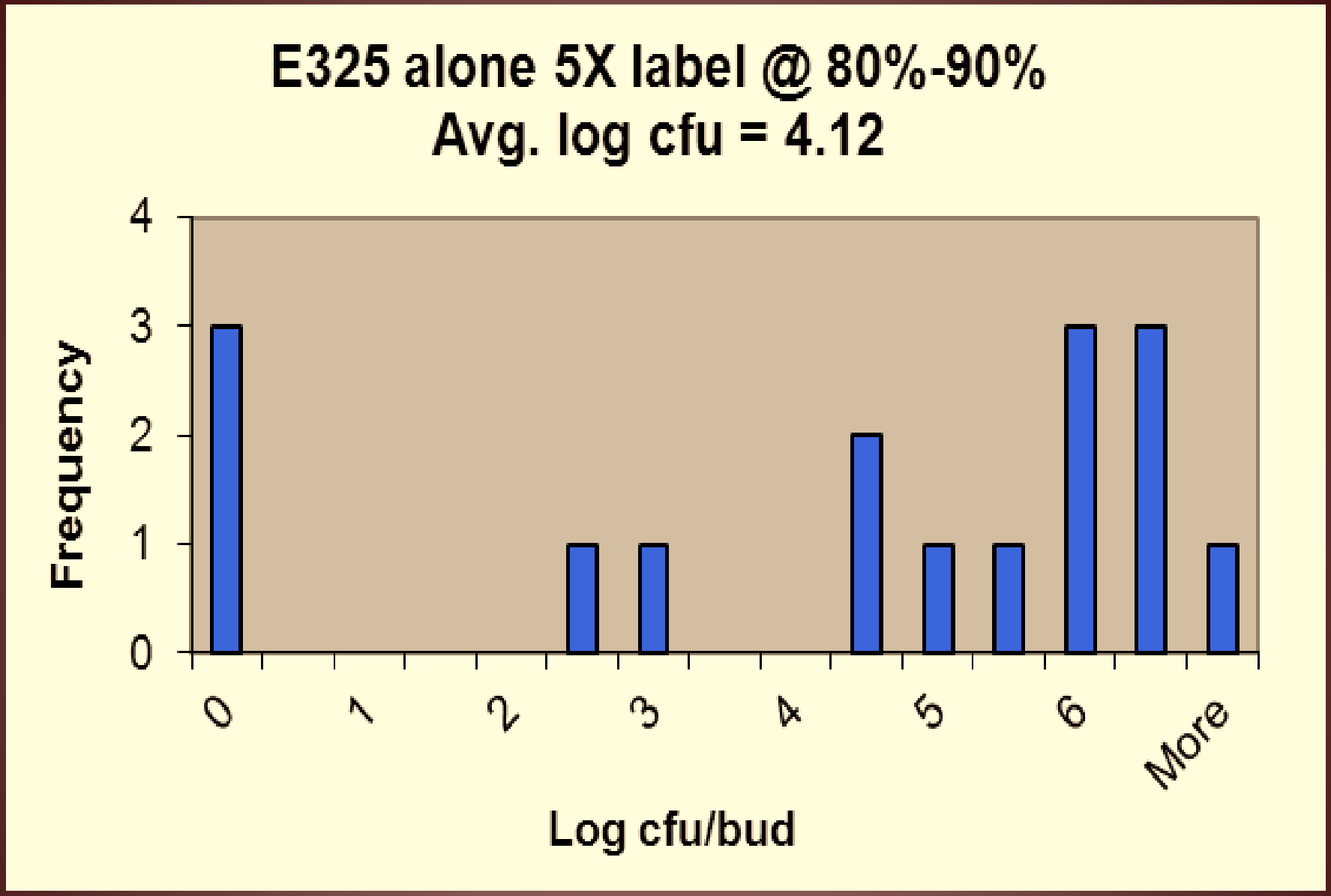
E325 alone 5X label @ 80%-90%
Avg. log cfu = 4.12
Frequency
0
1
2
3
4
0
1
2
3
4
5
6
More
Log cfu/bud

Figure 7

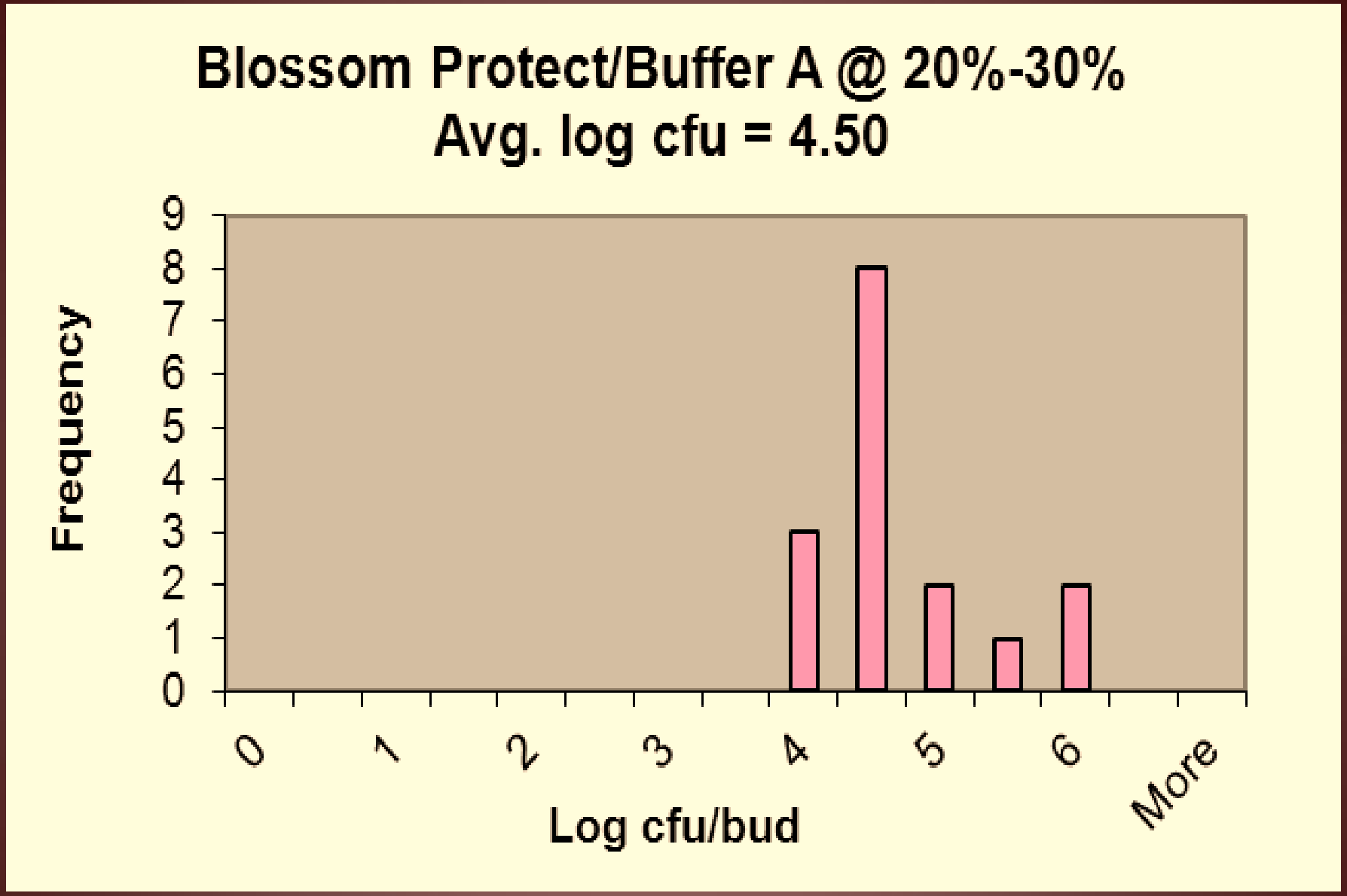
Blossom Protect/Buffer A @ 20%-30%
Avg. log cfu = 4.50
Frequency
0
1
2
3
4
5
6
7
8
9
0
1
2
3
4
5
6
More
Log cfu/bud

Figure 8

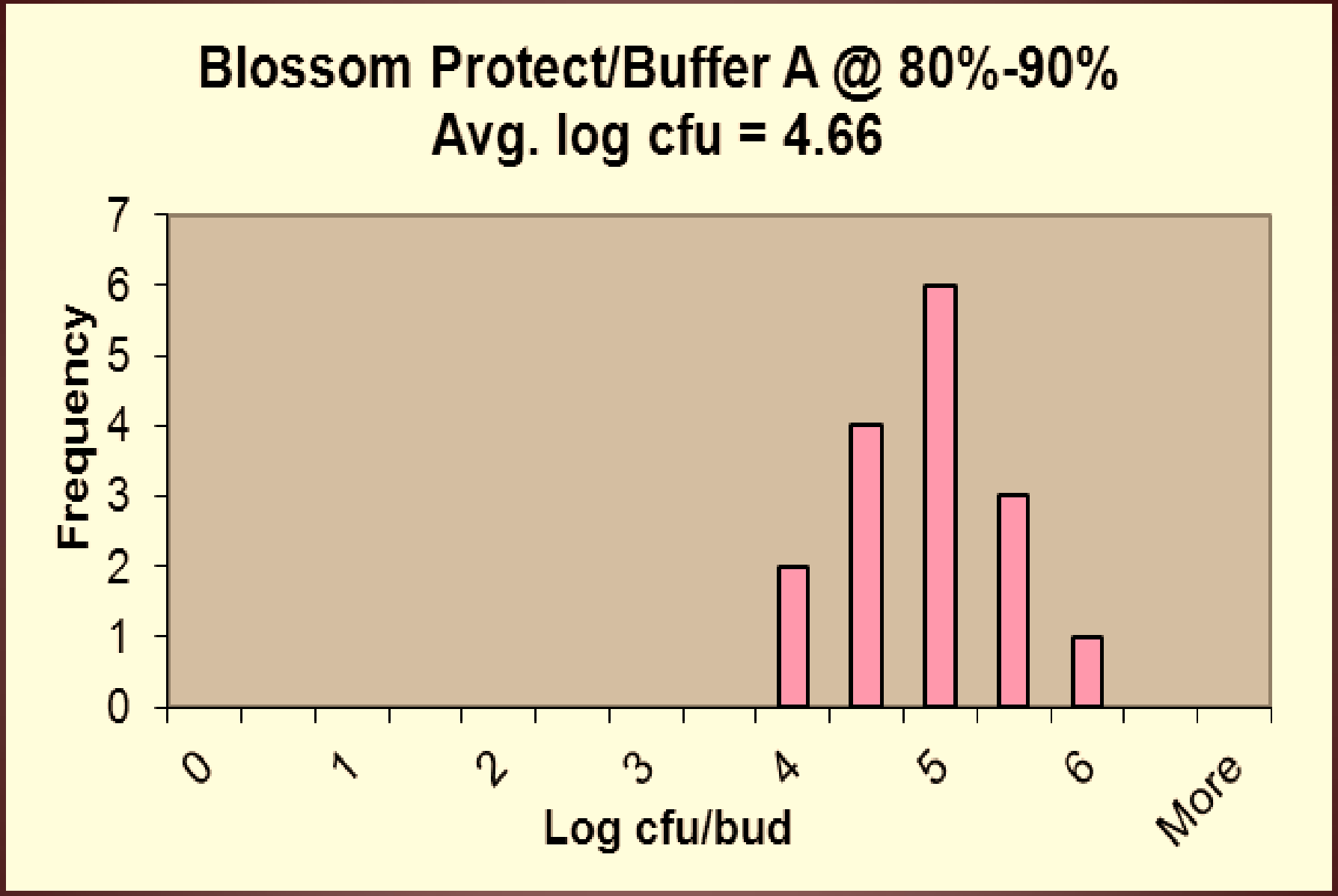
Blossom Protect/Buffer A @ 80%-90%
Avg. log cfu = 4.66
Frequency
0
1
2
3
4
5
6
7
0
1
2
3
4
5
6
More
Log cfu/bud

Figure 9

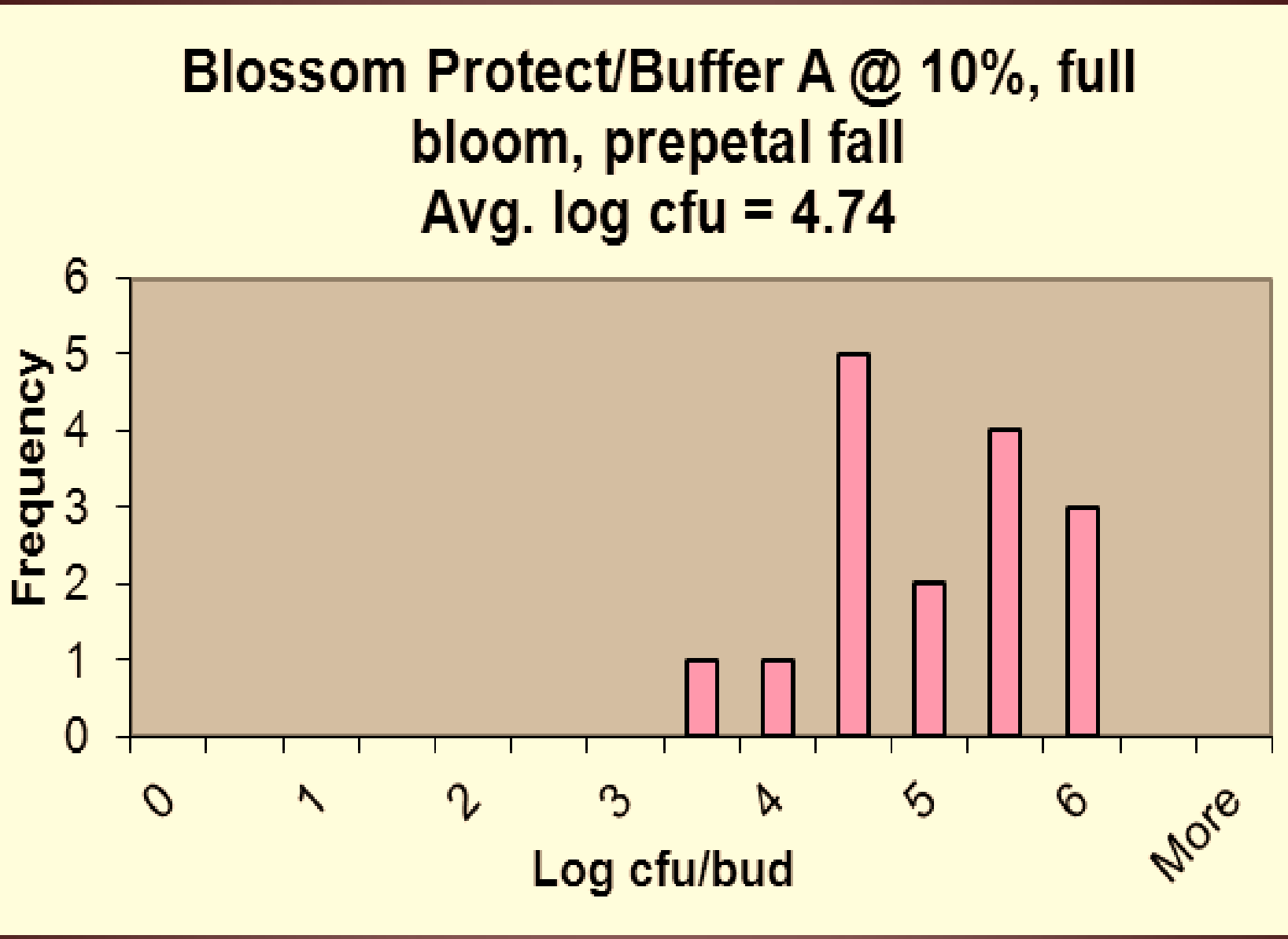
Blossom Protect/Buffer A @ 10%, full bloom, prepetal fall
Avg. log cfu = 4.74
Frequency
0
1
2
3
4
5
6
0
1
2
3
4
5
6
More
Log cfu/bud

Figure 10

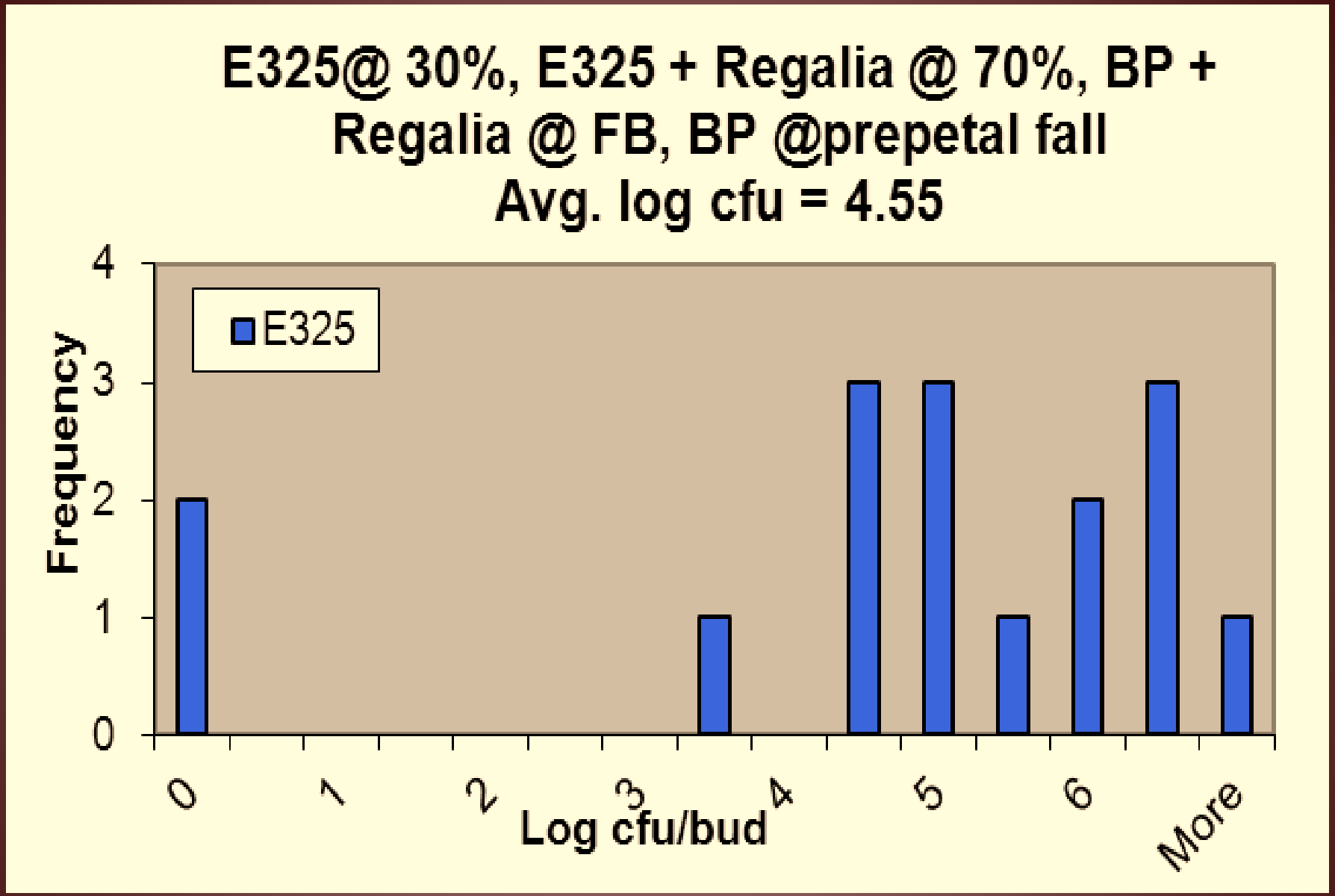
E325@ 30%, E325 + Regalia @ 70%, BP + Regalia @ FB, BP @prepetal fall
Avg. log cfu = 4.55
E325
Frequency
0
1
2
3
4
0
1
2
3
4
5
6
More
Log cfu/bud

Figure 11

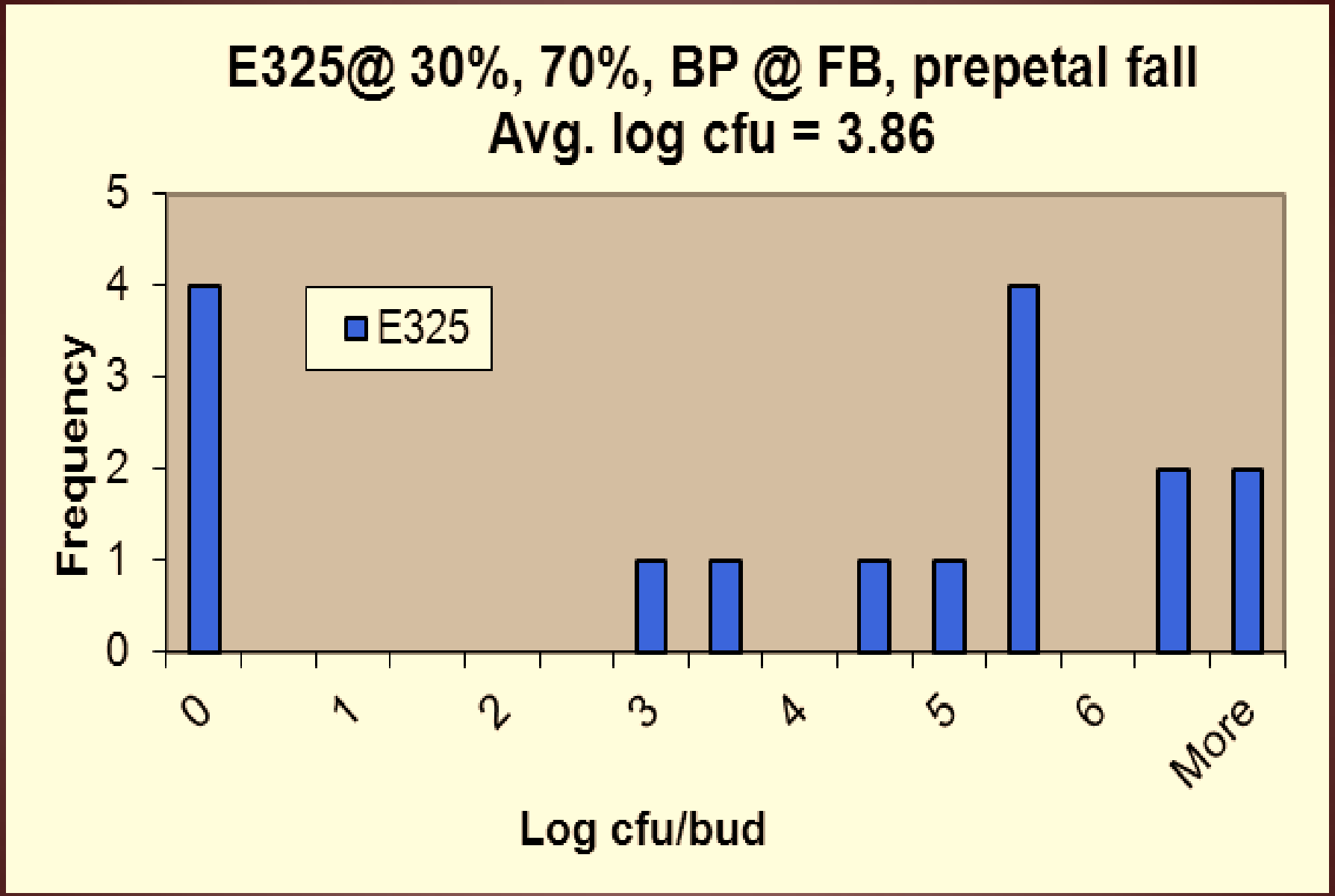
E325@ 30%, 70%, BP @ FB, prepetal fall
Avg. log cfu = 3.86
Frequency
0
1
2
3
4
5
E325
0
1
2
3
4
5
6
More
Log cfu/bud

Figure 12

Average number of fire blight strikes in Bartlett pears, Seely orchard, Lake County, CA, 2012.

Treatment[1]	Average Number of Weekly Strikes 5/16	5/23	5/30	6/6	6/26	Average No. Weekly Strikes	Average Cumulative Strikes
Control (Untreated)	0.0	0.2	0.0	0.0	0.0	0.04 c	0.2
A506 alone 1/2 rate, weekly	0.6	0.8	0.0	0.2	1.0	0.52 abc	2.6
A506 alone 3X @ 20% bloom, full bloom, rattail (PF)	0.0	0.0	0.0	0.2	0.0	0.19 c	0.2
A506 @ 20% bloom, E325 @ full bloom, A506 @ rattail (PF)	0.0	1.0	0.0	0.2	0.4	0.32 bc	1.6
E325@ 20% bloom, A506 @ full bloom, E325 @ rattail (PF)	0.0	0.4	0.4	0.4	0.2	0.28 bc	1.4
E325 alone 5x label @ 20%-30%	0.6	1.2	0.6	0.6	0.6	0.72 ab	3.6
E325 alone 5x label @ 80%-90%	0.4	1.6	0.6	0.4	0.6	0.72 ab	3.6
Blossom Protect + Buffer A @ 20%-30%	0.6	1.2	0.6	0.2	0.2	0.56 abc	2.8
Blossom Protect +Buffer A @ 80%-90%	0.2	0.2	0.0	0.2	0.0	0.12 bc	0.6
Blossom Protect/Buffer A @ 10% bloom, full bloom, pre-petal fall	0.2	0.8	0.4	0.2	0.2	0.36 bc	1.8
Regalia Alone @ 20%, full bloom, rattail	0.6	0.6	0.2	0.2	0.8	0.48 abc	2.4
E325 @ 30%, E325 + Regalia @ 70%, BP+ Regalia @ FB, BP@ pre-petal fall	1.4	2.0	0.2	0.8	0.6	1.00 a	5.0
E325 @ 30%, 70%, BP @ FB, pre-petal fall	0.0	0.0	0.4	0.0	0.0	0.08 bc	0.4
Badge 2X weekly	0.0	0.6	0.2	0.2	0.6	0.32 bc	1.6
Streptomycin/Terramycin tank mix, weekly	0.0	0.2	0.0	1.4	0.6	0.44 abc	2.2
Average	0.3	0.7	0.2	0.3	0.4	0.4	2.0
ANOVA[2]							
Treatment (P-value)	NS (0.41)	NS (0.58)	NS (0.22)	NS (0.86)	NS (0.58)	** (0.01) ***	NS (0.23)
Block (P-value)	*(0.02)	** (0.01)	*** (<0.001)	NS (0.32)	*(0.03)	(<0.001)	*** (0.001)
Date (P-value)	----	----	----	----	----	* (0.02) ***	----
Treatment x Block (P-value)	----	----	----	----	----	(<0.001)	----

[1] Within columns, treatment means significantly different (Duncan $P \leq 0.05$).

[2] *, **, *** Indicates significance at $P \leq 0.05$, 0.01 and 0.001 respectively. NS indicates not significant $P > 0.05$.

Data normalized using (SQRT +1) transformation.

Average fruit russeting, percent russet severity and percent frost damage in Bartlett pears harvested in Seely orchard, Lake County, California, 2012

Treatment[1]	Average Russeting	Russet Severity (greater than 7%)	Russet Severity (less than 3%)	Frost Damage (%)
Control	0.4 bc	0.7 b	99.4 ab	16.7
A506 Alone 1/2 rate, weekly	1.4 a	5.4 a	90.7 c	12.1
A506 Alone 3X @ 20%, Full, rattail	0.7 bc	1.3 b	98.0 ab	12.7
A506 @ 20%, E325 @ Full, then A506 @ rattail	0.5 bc	0.0 b	98.7 ab	19.4
E325 @ 20%, A506 @ Full, then E325 @ rattail	0.7 abc	0.0 b	98.6 ab	18.2
E325 alone 5X label @20%-30%	0.5 bc	0.7 b	99.3 ab	20.0
E325 alone 5X label @80%-90%	0.5 bc	0.0 b	99.4 ab	14.6
Blossom Protect/Buff A @ 20%-30%	0.3 c	0.0 b	100.0 a	17.1
Blossom Protect/Buff A @ 80%-90%	0.6 bc	0.0 b	98.7 ab	17.4
Blossom Protect/Buff A @ 10%, Full, pre-petal fall	1.1 ab	1.5 b	93.3 bc	12.6
Regalia alone @20%, Full, Rattail	0.8 abc	1.3 b	96.0 abc	12.1
E325 @ 30%, E325 + Regalia @70%, BP + Regalia @ Full, BP @ pre-petal fall	0.8 abc	0.7 b	95.8 abc	18.8
E325 @ 30%, 70%, BP @ Full, pre-petal fall	0.8 abc	1.3 b	96.6 abc	14.6
Badge 2X weekly	1.0 abc	1.3 b	95.3 abc	14.1
Strep/Terra Tank Mix, weekly	0.6 bc	0.7 b	97.8 ab	8.4
ANOVA[2]				
Treatment (P-value)	NS (0.10)	NS (0.18)	NS (0.08)	NS (0.87)
Block	NS (0.06)	* (0.02)	NS (0.10)	NS (0.49)

[1] Within columns, rootstock treatment means significantly different (Duncan, $P \leq 0.05$).
[2] * Indicates significance at $P \leq 0.05$. NS indicates not significant $P > 0.05$.

Average fruit russeting, percent russet severity and percent frost damage in Bartlett pears harvested in Seely orchard, Lake County, California, 2011

	Average Russeting	Russet Severity		Frost Damage
		(greater than 7%)	(less than 3%)	(%)
Treatment[1]				
Control	4.6 abc	22.9 ab	55.3 abc	5.4
A506 Alone 1/2 rate, weekly	3.7 abc	16.8 ab	63.8 abc	9.7
A506 Alone 3X @ 20%, Full, rattail	3.0 c	8.4 b	76.8 ab	7.2
A506 @ 20%, E325 @ Full, then A506 @ rattail	3.7 abc	15.8 ab	68.2 abc	7.9
A506 alternated with Blossom Protect/Buff A, weekly	3.3 bc	9.5 b	70.5 abc	9.0
E325 alone 1/2 rate, weekly	4.2 abc	21.0 ab	64.3 abc	7.6
E325 alone 3X @ 20%, Full, rattail	3.0 c	10.5 b	75.9 ab	8.4
E325 @ 20%, A506 @ Full, then E325 @ rattail	2.6 c	8.1 b	77.5 ab	7.6
A506 + E325 Tank mix @ 20%, Full, rattail	2.7 c	8.6 b	79.5 a	6.2
Blossom Protect/Buff A @ 10%, 40%, 70%, 90%	5.9 a	36.4 a	44.7 c	5.5
A506+Blossom Protect/Buff A @ 20%, Full, rattail	5.7 ab	36.2 a	47.3 bc	4.2
A506+Blossom Protect @ 20%, Full, rattail	3.9 abc	15.8 ab	64.7 abc	11.9
Actinovate, weekly starting @ 10%	4.0 abc	19.5 ab	62.0 abc	7.5
Strep/Terra Tank Mix, weekly	3.0 c	9.4 b	75.7 ab	6.6
Badge X2, weekly	3.9 abc	16.1 ab	65.8 abc	7.3
ANOVA[2]				
Treatment (P-value)	NS (0.09)	* (0.05)	NS (0.18)	NS (0.74)
Block	NS (0.69)	NS (0.57)	NS (0.42)	* (0.04)

[1] Within columns, rootstock treatment means significantly different (Duncan, $P \leq 0.05$).

[2] * Indicates significance at $P \leq 0.05$. NS indicates not significant $P > 0.05$.

[3] Samples rated August 12, 2011.

Average fruit russeting, percent russet severity and percent frost damage in Bartlett pears harvested in Dan Goff orchard, Lake County, California, 2012

	Average Russeting	Russet Severity (greater than 7%)	Russet Severity (less than 3%)	Frost Damage (%)
Treatment[1]				
Control	0.4 b	0.0	100.0 a	4.1
Blossom Protect/Buff A @ 20%-30%	0.8 a	0.6	98.5 ab	2.2
Blossom Protect/Buff A @ 80%-90%	0.5 ab	0.7	98.7 ab	4.7
Bloomtime 5x label @ 30%	0.8 ab	0.8	96.0 b	6.3
Bloomtime 5x label @ 80%	0.4 ab	0.0	99.3 ab	3.5
Bloomtime @ 30%, 70%; BP @ FB and prepetal fall	0.8 ab	0.0	98.0 ab	2.0
Regalia @ 1 qt. mixed in with 70% Bloomtime & BP's FB	0.5 ab	0.0	98.5 ab	1.1
ANOVA[2]				
Treatment (P-value)	NS (0.08)	NS (0.65)	NS (0.29)	NS (0.53)
Block	* (0.01)	NS (0.32)	NS (0.07)	NS (0.65)

[1] Within columns, rootstock treatment means significantly different (Duncan, $P \leq 0.05$).

[2] * Indicates significance at $P \leq 0.05$. NS indicates not significant $P > 0.05$.

Acknowledgements

- Pear Pest Management Research Fund
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Thank you!

THANK YOU!!