

2020 Rule Change Proposal 17

Purpose of the Rule: The purpose of this rule is to add germination procedures for Maximillian sunflower, *Helianthus maximiliani*.

Present Rule: New Rule

Proposed Rule:

Kind of Seed	Substrate ^a	Temperature (C°)	First Count (days)	Final Count (days)	Specific requirements	Fresh and Dormant
<i>Helianthus maximiliani</i> , Maximillian sunflower	T	15-30	7	14	Ungerminated seeds: see sec. 6.2f and 6.9m	7 day prechill at 3-5C

Harmonization and Impact Statement: *Helianthus maximiliani* is not recognized in the Federal Seed Act, the Canadian Methods or Procedures, or ISTA Rules for Testing Seeds.

Supporting Evidence:

Materials and methods:

Four lots of *Helianthus maximiliani* were tested in house to determine the optimal germination procedures. Lots were requested from different regions to account for geographical variability and different years of production. The lots were planted at 20C, 15-30C, and 20-30C with water and KNO₃ as the wetting agent. The lots were also planted with a seven-day prechill using water and then placed at 20C, 15-30C, and 20-30C. Dormancy was determined via tetrazolium testing on the firm seeds at the end of the test.

Five different lots of *Helianthus maximiliani* were obtained to send to other laboratories for referee testing. Lots were requested from different regions and different production years. The five lots were sent out to 12 laboratories. They were asked to test the lots with a 7-day prechill at 5C then germinate for 14 days with a 7-day first count at 15-30C. Dormancy was to be determined on firm seeds left at the end of the test. They were also asked if willing to, to also test the lots without a prechill at 15-30C with KNO₃ for 14 days with a 7-day first count. Dormancy was to be determined on the firm seeds left at the end of the test if possible.

Results:

The results of the in-house germination methods determined that 15-30C temperature was significantly better than 20C and 20-30C (Table 1). 15-30C seen higher germination percentages and lower dormancy. Between the 15-30 no prechill with the use of KNO₃ and the 15-30 with a seven-day prechill the germination was slightly higher on two of the lots and the same on the other two lots. The dormancy was very similar on lots 1, 2, and 3. Dormancy in lot 4 was lower with the seven-day prechill than the use of KNO₃ (Table 2). The inhouse individual replicates for the different methods are in the appendix Tables 3 to 6.

Eleven laboratories returned results for the lab referee comparing the pre-chill versus no pre-chill for 15-30C. There were a few laboratories that did not conduct testing for all methods. There were also a few laboratories that did not determine dormancy on the ungerminated seeds.

With lot 1 five labs had higher germination results without pre-chill compared to lab 3 and two labs had similar results between pre-chill and no pre-chill (Figure 1). The pre-chilled replicates for lot 1 had higher dormancy than those without pre-chill.

With lot 2 most labs had similar germination results between pre-chill and no pre-chill. Some labs also had higher dormancy in the pre-chilled replicates of lot 2 and some had higher dormancy in the replicates of lot 2 without prechill (Figure 2).

With lot 3 five labs had higher germination results without pre-chill compared to two labs that had higher results with pre-chill. Again, the pre-chill replicates of lot 3 had higher dormancy than the ones without pre-chill (Figure 3).

With lot 4 four labs had higher germination results with prechill compared to two labs that had higher results without pre-chill. The pre-chilled replicates of lot 4 had higher dormancy in most labs than the ones without pre-chill (Figure 4).

With lot 5 five labs had significantly higher germination results without pre-chill compared to two labs that had higher results with pre-chill. The pre-chilled replicates showed higher dormancy in more labs than without pre-chill (Figure 5).

Based off the results of the lab referee pre-chilling should be conducted on freshly harvested samples. There is no consistent trend on showing that the use or lack of using the pre-chill gives better germination results. A TZ must be conducted at the end of the test as well, because a high percentage of dormant seed remained on some lots even with a pre-chill.

Tables 7 - 16 show the individual replicate data for each lot for the lab referee.

Treatment	Total germination (%)			
	Lot 1	Lot 2	Lot 3	Lot 4
20, H	69	68	76	26
20, K	80	66	81	39
15-30, H	82	65	80	34
15-30, K	87	69	84	51
20-30, H	55	69	70	17
20-30, K	56	62	72	16
20, H, PC	79	65	82	34
15-30, H, PC	87	74	84	56
20-30, H, PC	76	69	75	31
Mean	74	67	78	34
Max	87	74	84	56
Min	55	62	70	16
SD	12.1	3.5	5.3	13.6

Table 1. Comparison of germination results among in house treatments for the four lots

Treatment	Total Dormant Seed (%)			
	Sample 1	Sample 2	Sample 3	Sample 4

20, H	16	3	6	65
20, K	7	3	5	46
15-30, H	11	6	5	45
15-30, K	4	3	0	38
20-30, H	21	4	11	70
20-30, K	15	1	9	52
20, H, PC	13	0	9	52
15-30, H, PC	5	1	3	27
20-30, H, PC	11	0	10	52
Mean	11	2	6	50
Max	21	6	11	70
Min	4	0	0	27
SD	5.5	1.9	3.6	13.1

Table 2. Comparison of dormancy among in house treatments for the four lots

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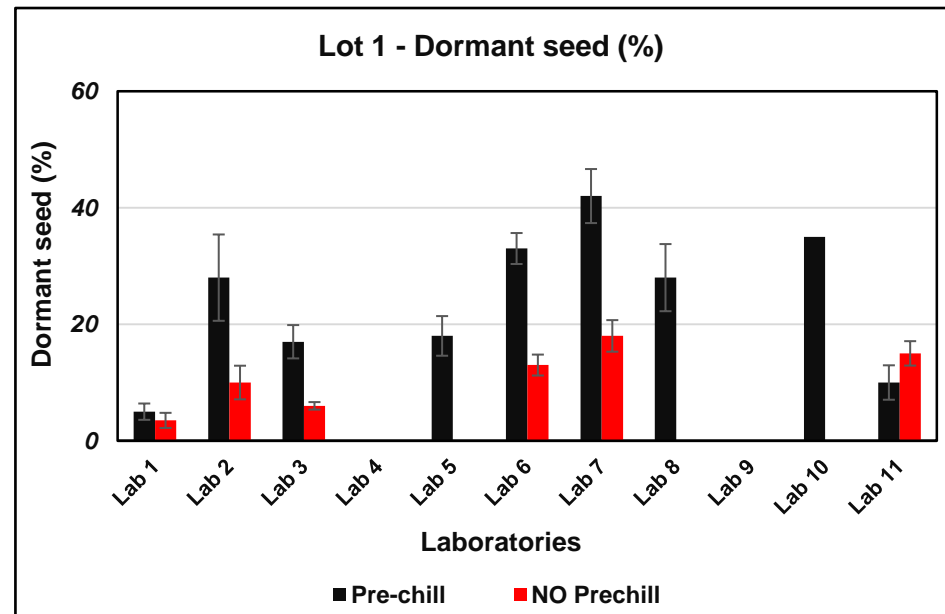
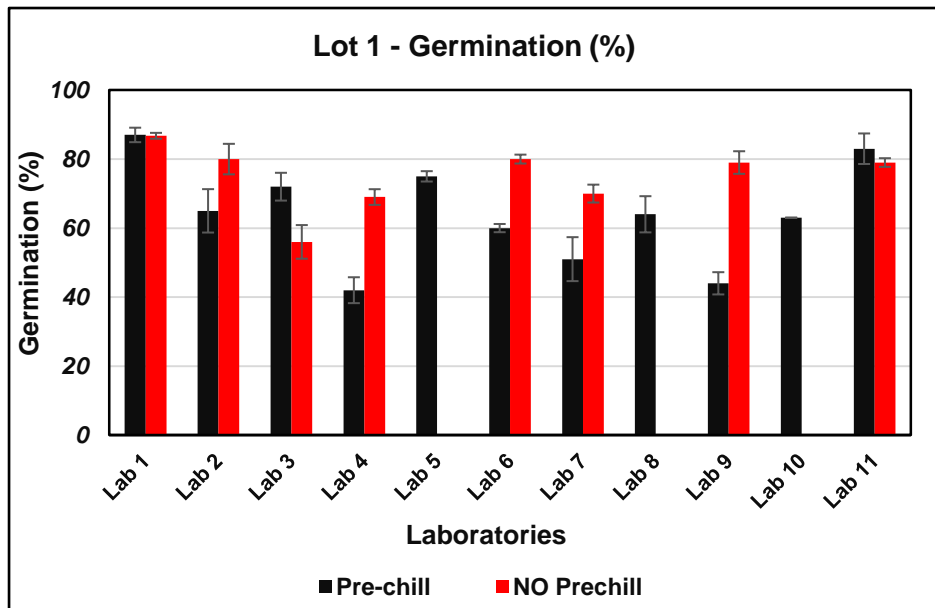


Figure 1. Comparison of germination and number of dormant seeds at the end of the germination test (14d) of Maximillian sunflower lot No. 1 tested with and without pre-chilling treatment (10C for 7d) at 15-30C in 11 labs. Means with overlapped error bars are not significantly different at $P \leq 0.05$.

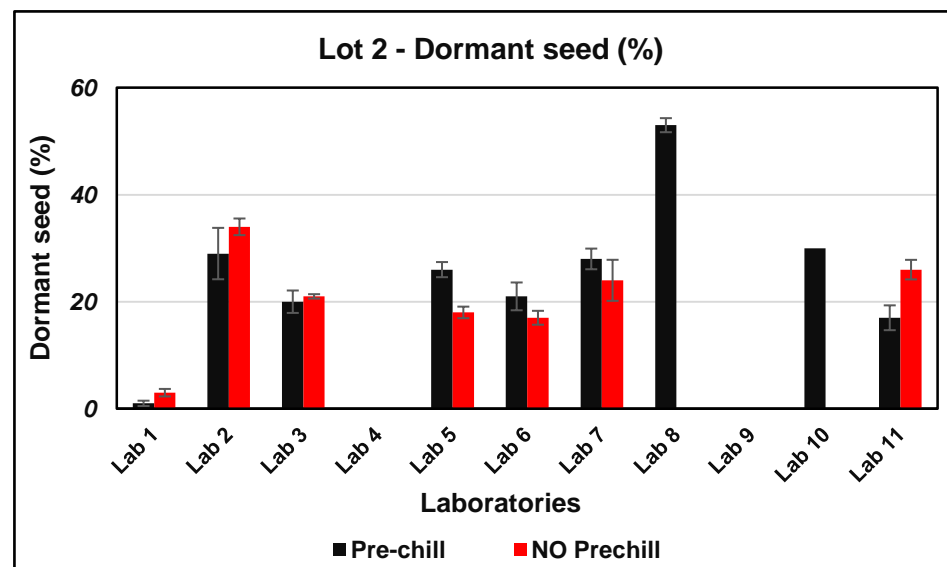
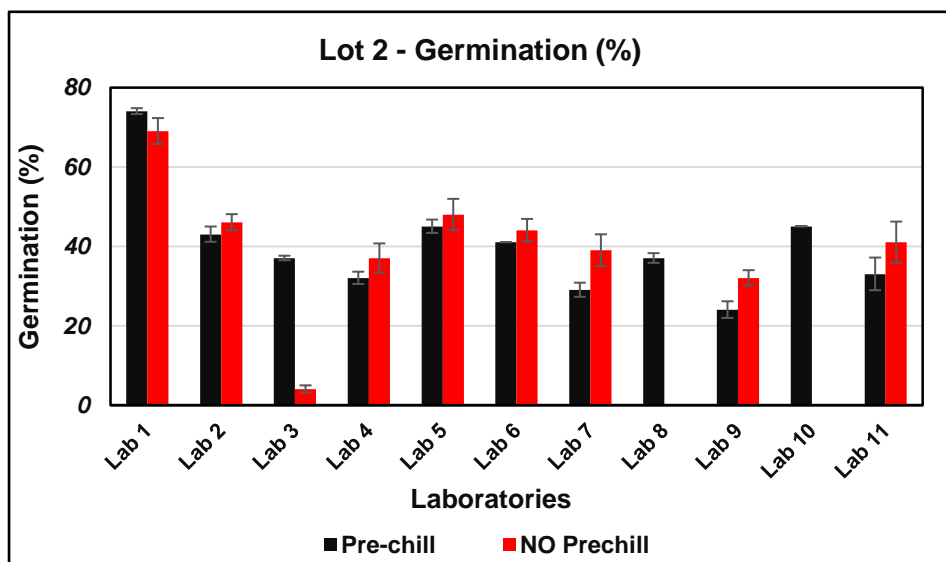


Figure 2. Comparison of germination and number of dormant seeds at the end of the germination test (14d) of Maximillian sunflower lot No. 2 tested with and without pre-chilling treatment (10C for 7d) at 15-30C in 11 labs. Means with overlapped error bars are not significantly different at $P \leq 0.05$.

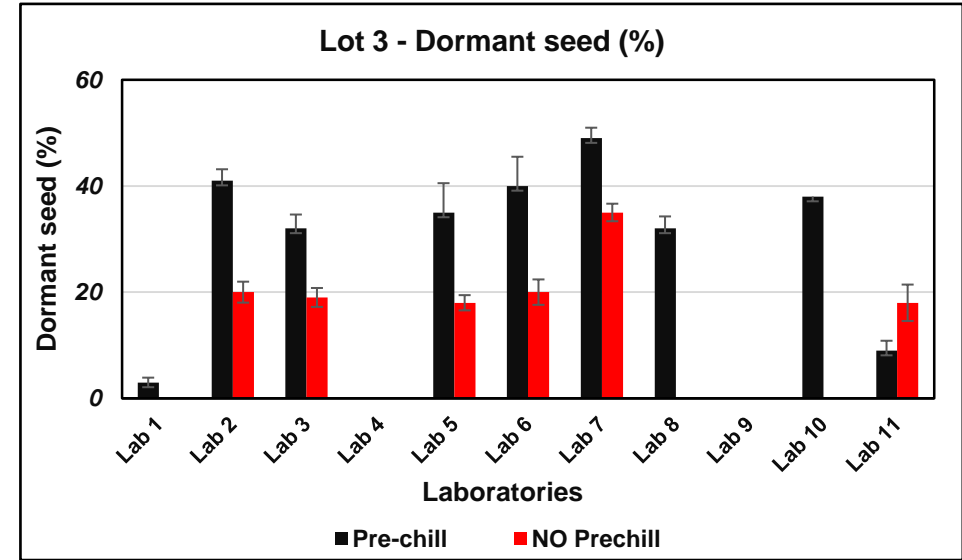
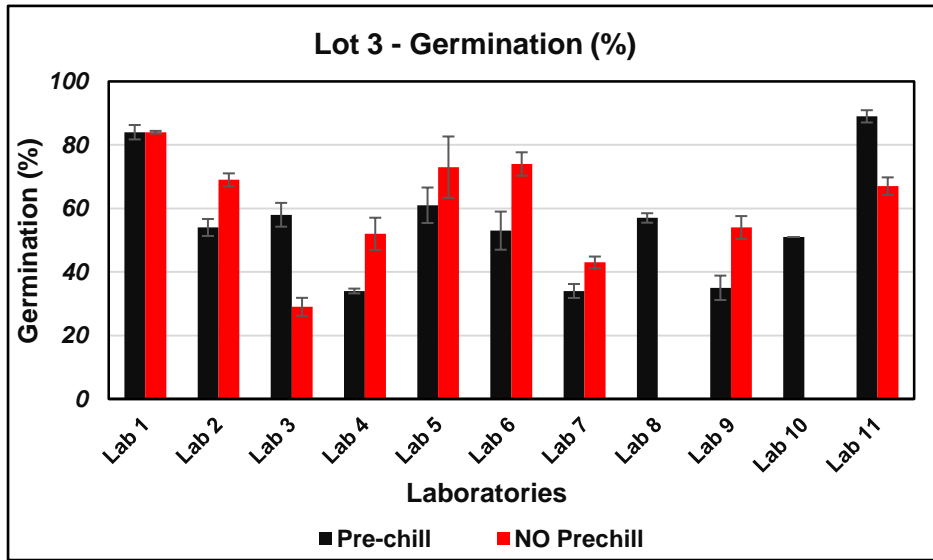


Figure 3. Comparison of germination and number of dormant seeds at the end of the germination test (14d) of Maximillian sunflower lot No. 3 tested with and without pre-chilling treatment (10C for 7d) at 15-30C in 11 labs. Means with overlapped error bars are not significantly different at $P \leq 0.05$.

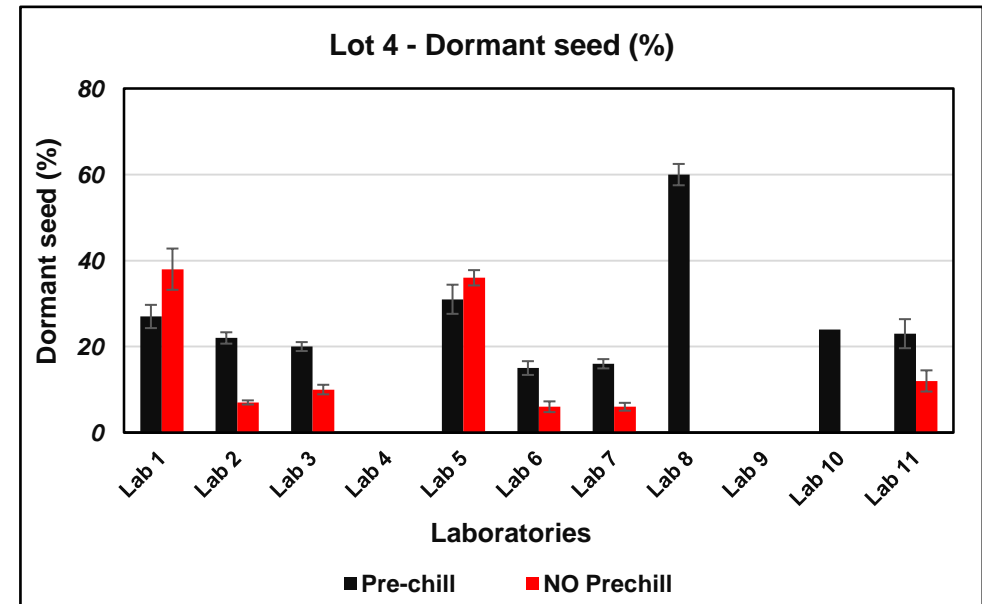
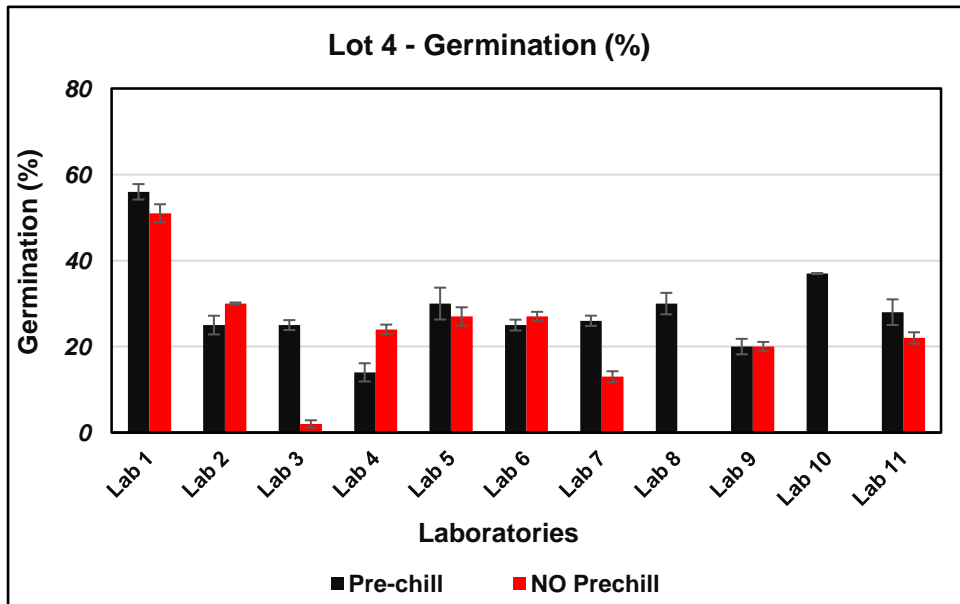


Figure 4. Comparison of germination and number of dormant seeds at the end of the germination test (14d) of Maximillian sunflower lot No. 4 tested with and without pre-chilling treatment (10C for 7d) at 15-30C in 11 labs. Means with overlapped error bars are not significantly different at $P \leq 0.05$.

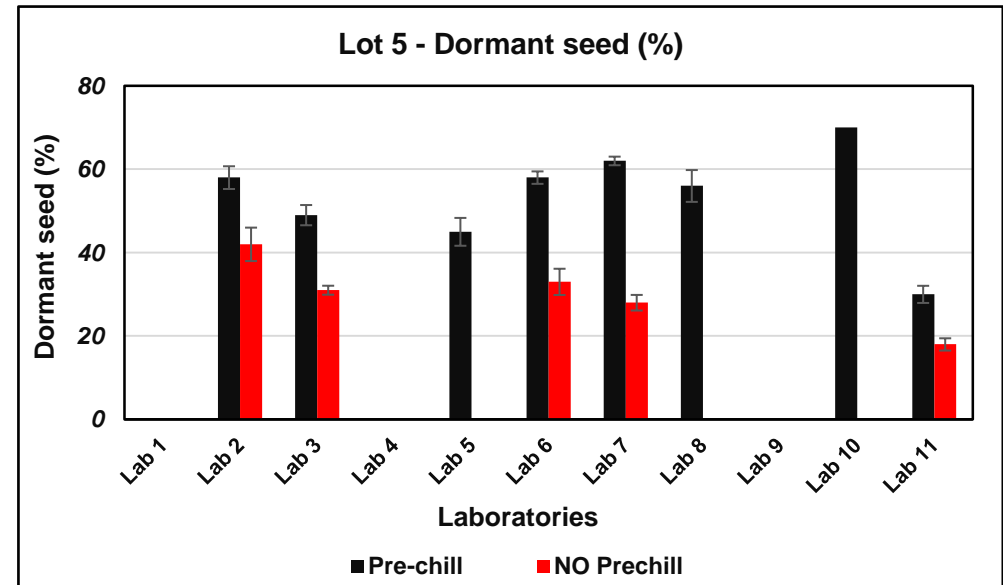
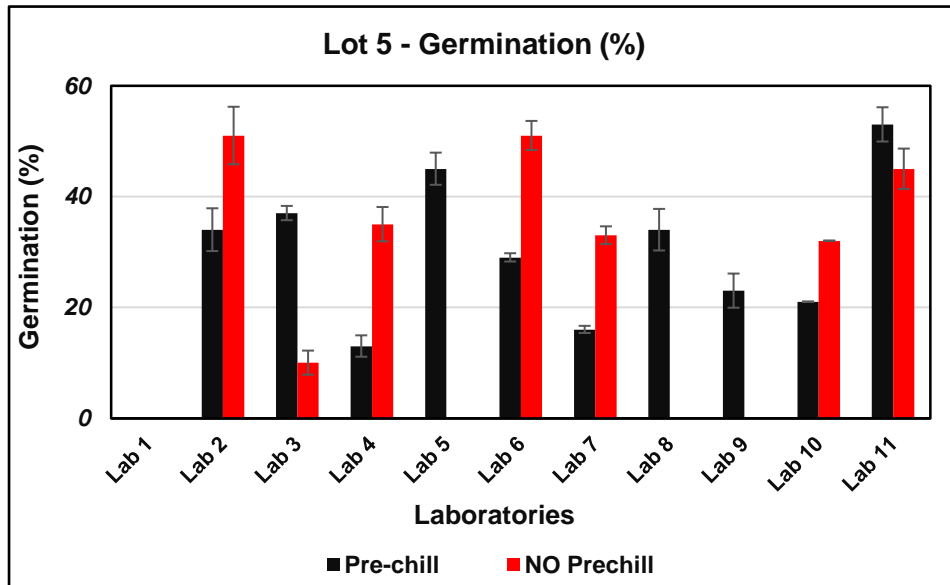


Figure 5. Comparison of germination and number of dormant seeds at the end of the germination test (14d) of Maximillian sunflower lot No. 5 tested with and without pre-chilling treatment (10C for 7d) at 15-30C in 11 labs. Means with overlapped error bars are not significantly different at $P \leq 0.05$.

20, H	1ST COUNT	2ND COUNT	3RD COUNT	FINAL COUNT	DORMANT
REP 1	72	0	0	0	14
REP 2	68	2	0	0	14
REP 3	69	2	0	0	15
REP 4	64	0	0	0	20
20, K	1ST COUNT	2ND COUNT	3RD COUNT	FINAL COUNT	DORMANT
REP 1	77	5	0	0	7
REP 2	70	0	0	0	8
REP 3	78	2	0	0	6
REP 4	84	2	0	0	8
15-30, H	1ST COUNT	2ND COUNT	3RD COUNT	FINAL COUNT	DORMANT
REP 1	82	2	0	0	11
REP 2	82	2	0	0	9
REP 3	81	2	0	0	7
REP 4	68	8	1	0	15
15-30, K	1ST COUNT	2ND COUNT	3RD COUNT	FINAL COUNT	DORMANT
REP 1	82	4	0	0	0
REP 2	85	2	0	1	6
REP 3	80	5	1	1	4
REP 4	82	7	0	0	4
20-30, H	1ST COUNT	2ND COUNT	3RD COUNT	FINAL COUNT	DORMANT
REP 1	68	0	0	0	13
REP 2	53	0	0	0	17
REP 3	43	2	1	0	34
REP 4	52	0	0	0	19
20-30, K	1ST COUNT	2ND COUNT	3RD COUNT	FINAL COUNT	DORMANT
REP 1	56	1	0	0	14
REP 2	56	1	0	0	16
REP 3	51	2	0	0	15
REP 4	58	0	0	0	16
20, H, PC	1ST COUNT	2ND COUNT	3RD COUNT	FINAL COUNT	DORMANT
REP 1	72	0	0	1	15
REP 2	88	0	0	0	10
REP 3	77	0	0	0	14
REP 4	77	0	0	0	12
15-30, H, PC	1ST COUNT	2ND COUNT	3RD COUNT	FINAL COUNT	DORMANT
REP 1	91	1	0	0	3
REP 2	88	1	0	0	4
REP 3	86	0	0	0	4
REP 4	82	0	0	0	9
20-30, H, PC	1ST COUNT	2ND COUNT	3RD COUNT	FINAL COUNT	DORMANT
REP 1	78	0	0	0	10
REP 2	85	0	0	0	11
REP 3	70	0	0	0	9
REP 4	71	0	0	0	15

Table 3. Individual replicate data for in house research on lot 1

20, H	1ST COUNT	2ND COUNT	3RD COUNT	FINAL COUNT	DORMANT
REP 1	69	5	0	0	1
REP 2	62	6	0	0	5
REP 3	52	6	2	0	2
REP 4	64	6	0	1	5
20, K	1ST COUNT	2ND COUNT	3RD COUNT	FINAL COUNT	DORMANT
REP 1	65	7	0	0	2
REP 2	65	2	4	1	4
REP 3	59	3	0	0	3
REP 4	61	3	0	0	3
15-30, H	1ST COUNT	2ND COUNT	3RD COUNT	FINAL COUNT	DORMANT
REP 1	58	12	3	0	4
REP 2	50	15	0	0	5
REP 3	51	7	2	0	6
REP 4	61	6	1	0	8
15-30, K	1ST COUNT	2ND COUNT	3RD COUNT	FINAL COUNT	DORMANT
REP 1	62	9	1	0	5
REP 2	49	10	0	1	2
REP 3	60	14	1	0	3
REP 4	58	12	0	0	2
20-30, H	1ST COUNT	2ND COUNT	3RD COUNT	FINAL COUNT	DORMANT
REP 1	61	5	2	2	3
REP 2	63	5	2	0	3
REP 3	69	2	1	0	2
REP 4	64	8	1	0	6
20-30, K	1ST COUNT	2ND COUNT	3RD COUNT	FINAL COUNT	DORMANT
REP 1	59	9	1	0	0
REP 2	57	6	4	0	1
REP 3	45	13	1	0	0
REP 4	50	10	1	0	1
20, H, PC	1ST COUNT	2ND COUNT	3RD COUNT	FINAL COUNT	DORMANT
REP 1	62	3	0	0	0
REP 2	66	2	0	0	0
REP 3	62	0	1	0	0
REP 4	62	1	0	0	1
15-30, H, PC	1ST COUNT	2ND COUNT	3RD COUNT	FINAL COUNT	DORMANT
REP 1	76	0	0	0	0
REP 2	75	0	0	0	2
REP 3	72	1	1	0	0
REP 4	73	0	0	0	1
20-30, H, PC	1ST COUNT	2ND COUNT	3RD COUNT	FINAL COUNT	DORMANT
REP 1	68	1	1	0	1
REP 2	74	2	0	0	0
REP 3	72	0	0	0	0
REP 4	60	0	0	0	0

Table 4. Individual replicate data for in house research on lot 2

20, H	1ST COUNT	2ND COUNT	3RD COUNT	FINAL COUNT	DORMANT
REP 1	74	1	0	0	3
REP 2	78	1	0	0	6
REP 3	71	2	0	0	8
REP 4	74	1	0	0	6
20, K	1ST COUNT	2ND COUNT	3RD COUNT	FINAL COUNT	DORMANT
REP 1	79	3	0	0	6
REP 2	73	7	0	0	4
REP 3	79	1	1	0	8
REP 4	78	4	0	1	3
15-30, H	1ST COUNT	2ND COUNT	3RD COUNT	FINAL COUNT	DORMANT
REP 1	73	4	0	0	4
REP 2	79	8	1	0	3
REP 3	68	10	0	0	5
REP 4	65	11	0	0	8
15-30, K	1ST COUNT	2ND COUNT	3RD COUNT	FINAL COUNT	DORMANT
REP 1	76	9	0	0	0
REP 2	70	13	0	0	0
REP 3	67	17	0	0	0
REP 4	72	12	2	0	0
20-30, H	1ST COUNT	2ND COUNT	3RD COUNT	FINAL COUNT	DORMANT
REP 1	73	0	1	0	11
REP 2	73	0	0	0	7
REP 3	61	5	0	0	9
REP 4	63	3	0	0	16
20-30, K	1ST COUNT	2ND COUNT	3RD COUNT	FINAL COUNT	DORMANT
REP 1	60	3	0	0	11
REP 2	67	5	0	0	11
REP 3	68	6	0	0	6
REP 4	74	4	0	0	9
20, H, PC	1ST COUNT	2ND COUNT	3RD COUNT	FINAL COUNT	DORMANT
REP 1	82	0	0	0	7
REP 2	80	0	0	0	10
REP 3	83	0	0	0	9
REP 4	81	0	0	0	9
15-30, H, PC	1ST COUNT	2ND COUNT	3RD COUNT	FINAL COUNT	DORMANT
REP 1	85	0	1	0	1
REP 2	90	0	0	0	2
REP 3	80	0	1	0	5
REP 4	81	0	0	0	4
20-30, H, PC	1ST COUNT	2ND COUNT	3RD COUNT	FINAL COUNT	DORMANT
REP 1	79	0	0	0	10
REP 2	70	0	0	0	13
REP 3	78	0	0	0	9
REP 4	71	0	0	0	9

Table 5. Individual replicate data for in house research on lot 3

20, H	1ST COUNT	2ND COUNT	3RD COUNT	FINAL COUNT	DORMANT
REP 1	17	9	1	0	57
REP 2	18	6	0	1	66
REP 3	22	7	1	1	67
REP 4	18	8	0	0	71
20, K	1ST COUNT	2ND COUNT	3RD COUNT	FINAL COUNT	DORMANT
REP 1	28	13	1	0	41
REP 2	20	20	0	0	46
REP 3	18	13	1	0	52
REP 4	30	12	0	0	43
15-30, H	1ST COUNT	2ND COUNT	3RD COUNT	FINAL COUNT	DORMANT
REP 1	28	13	1	1	32
REP 2	20	14	0	1	45
REP 3	15	18	0	2	50
REP 4	15	13	0	0	54
15-30, K	1ST COUNT	2ND COUNT	3RD COUNT	FINAL COUNT	DORMANT
REP 1	23	22	0	0	50
REP 2	20	35	2	0	27
REP 3	27	24	0	0	33
REP 4	22	31	1	2	43
20-30, H	1ST COUNT	2ND COUNT	3RD COUNT	FINAL COUNT	DORMANT
REP 1	16	3	0	0	63
REP 2	15	1	0	0	77
REP 3	12	1	0	0	63
REP 4	18	2	0	0	77
20-30, K	1ST COUNT	2ND COUNT	3RD COUNT	FINAL COUNT	DORMANT
REP 1	15	4	1	0	50
REP 2	11	2	0	0	47
REP 3	14	1	0	0	54
REP 4	16	2	0	1	55
20, H, PC	1ST COUNT	2ND COUNT	3RD COUNT	FINAL COUNT	DORMANT
REP 1	34	1	0	1	50
REP 2	30	0	2	0	47
REP 3	32	1	0	1	54
REP 4	37	0	0	0	55
15-30, H, PC	1ST COUNT	2ND COUNT	3RD COUNT	FINAL COUNT	DORMANT
REP 1	49	3	3	0	26
REP 2	56	2	0	0	20
REP 3	58	2	0	0	27
REP 4	54	1	1	0	33
20-30, H, PC	1ST COUNT	2ND COUNT	3RD COUNT	FINAL COUNT	DORMANT
REP 1	36	0	0	0	45
REP 2	31	0	0	0	48
REP 3	28	2	0	0	56
REP 4	25	1	0	0	60

Table 6. Individual replicate data for in house research on lot 4

	REP 1					REP 2					REP 3					REP 4					
	1ST COUN T	2ND COUN T	ABS	DORMAN T	DEA D	1ST COUN T	2ND COUN T	ABS	DORMAN T	DEA D	1ST COUN T	2ND COUN T	ABS	DORMAN T	DEAD	1ST COUN T	2ND COUN T	ABS	DORMAN T	DEAD	
LAB 1																					
LAB 2	83	0	0	10	7	63	2	0	29	8	48	5	0	46	6	60	2	0	32	8	
LAB 3	80	1	0	10	9	74	2	1	15	9	62	3	0	23	12	64	1	0	20	15	
LAB 4	48	0	0		52	31	1	2		66	39	0	3		58	43	4	0		53	
LAB 5	58	19	3	11	9	56	15	0	25	4	62	15	2	13	8	63	10	2	22	3	
LAB 6	55	3	0	34	3	55	3	2	35	5	54	5	0	37	4	60	3	0	25	12	
LAB 7	54	6	3	37	0	46	6	5	42	1	28	5	7	55	5	54	6	1	34	6	
LAB 8	58	4	3	30	5	68	5	5	16	6	67	4	2	23	4	46	4	3	43	4	
LAB 9	52	0	0			44	3	1			39	1	1			34	4	3			
LAB 10	did not give replicate data																				
LAB 11	66	11	0	8	15	65	8	0	18	9	75	14	0	9	2	85	6	0	4	5	

Table 7. Individual lab replicate data for lot 1 with a 7 day pre-chill at 15-30C.

	REP 1					REP 2					REP 3					REP 4					
	1ST COUNT	2ND COUNT	ABS	DORMANT	DEAD	1ST COUNT	2ND COUNT	ABS	DORMANT	DEAD	1ST COUN T	2ND COUN T	ABS	DORMANT	DEAD	1ST COUN T	2ND COUN T	ABS	DORMAN T	DEAD	
LAB 1																					
LAB 2	86	5	0	5	4	77	7	0	5	11	64	9	1	15	12	64	9	0	15	12	
LAB 3	35	9	0	5	51	50	10	2	4	34	43	11	0	6	40	46	21	0	7	26	
LAB 4	71	4	1		24	61	3	1		35	66	3	3		28	64	4	1		31	
LAB 5																					
LAB 6	52	25	4	13	6	59	22	1	16	2	62	21	4	9	4	60	19	0	17	4	
LAB 7	66	12	0	10	12	57	11	1	20	11	57	11	1	20	11	50	17	1	22	11	
LAB 8																					
LAB 9	79	5	1			68	9	2			79	6	3			65	6	4			
LAB 10	did not give replicate data																				
LAB 11	51	24	0	16	9	55	24	0	19	2	64	17	0	9	10	62	17	0	15	6	

Table 8. Individual lab replicate data for lot 1 with no pre-chill at 15-30C

	REP 1					REP 2					REP 3					REP 4				
	1ST COUNT	2ND COUNT	ABS	DORMANT	DEAD	1ST COUNT	2ND COUNT	ABS	DORMANT	DEAD	1ST COUNT	2ND COUNT	ABS	DORMANT	DEAD	1ST COUNT	2ND COUNT	ABS	DORMANT	DEAD
LAB 1																				
LAB 2	32	5	0	37	26	40	5	0	26	29	42	3	0	35	20	40	4	0	16	40
LAB 3	34	2	2	16	46	33	5	1	26	35	34	4	2	19	41	31	5	0	20	44
LAB 4	29	3	4		64	26	3	10		61	25	5	3		67	33	3	5		59
LAB 5	33	16	7	30	14	29	17	9	24	21	32	12	6	24	26	23	18	5	26	28
LAB 6																				
LAB 7	20	6	7	32	35	18	8	6	31	37	21	10	9	26	34	26	7	9	24	34
LAB 8	21	14	7	55	3	29	6	9	54	2	32	6	6	53	3	30	10	7	49	4
LAB 9	16	2	13			24	2	8			23	4	4			23	3	9		
LAB 10	did not give replicate data																			
LAB 11	20	25	0	11	44	12	18	0	22	48	14	14	0	17	55	17	11	0	19	53

Table 9. Individual lab replicate data for lot 2 with a 7 day pre-chill at 15-30C.

	REP 1					REP 2					REP 3					REP 4				
	1ST COUNT	2ND COUNT	ABS	DORMANT	DEAD	1ST COUNT	2ND COUNT	ABS	DORMANT	DEAD	1ST COUNT	2ND COUNT	ABS	DORMANT	DEAD	1ST COUNT	2ND COUNT	ABS	DORMANT	DEAD
LAB 1																				
LAB 2	36	10	2	35	19	22	19	3	36	23	46	5	2	29	20	39	7	1	34	20
LAB 3	5	0	0	22	73	3	0	1	20	77	4	2	0	21	73	2	0	0	21	77
LAB 4	27	5	2		66	24	7	2		67	29	9	2		60	32	15	0		53
LAB 5	19	28	10	16	27	20	27	11	17	25	26	32	5	18	19	21	18	13	21	27
LAB 6	12	28	4	20	36	24	16	6	17	37	20	25	5	14	36	23	29	4	15	29
LAB 7	39	11	3	13	34	30	5	8	26	31	17	15	5	28	35	28	9	7	30	26
LAB 8																				
LAB 9	26	8	10			24	9	3			19	7	7			19	15	6		
LAB 10	did not give replicate data																			
LAB 11	18	27	0	30	25	24	30	0	22	24	13	18	0	24	45	8	27	0	28	37

Table 10. Individual lab replicate data for lot 2 with no pre-chill at 15-30C

	REP 1					REP 2					REP 3					REP 4				
	1ST COUNT	2ND COUNT	ABS	DORMANT	DEAD	1ST COUNT	2ND COUNT	ABS	DORMANT	DEAD	1ST COUNT	2ND COUNT	ABS	DORMANT	DEAD	1ST COUNT	2ND COUNT	ABS	DORMANT	DEAD
LAB 1																				
LAB 2	45	12	0	40	3	47	3	0	44	6	42	7	0	44	7	55	5	0	35	5
LAB 3	63	3	0	27	7	51	2	0	37	10	47	3	2	36	12	58	4	0	28	10
LAB 4	32	3	1		64	30	3	2		65	33	3	2		62	27	6	5		62
LAB 5	61	13	3	21	2	36	13	2	47	2	41	14	2	39	4	53	13	0	32	2
LAB 6	37	10	1	43	9	38	7	2	49	4	38	12	1	44	5	59	12	1	24	4
LAB 7	29	10	7	44	10	30	2	5	51	12	24	5	7	53	11	30	6	6	48	10
LAB 8	52	8	8	25	7	49	9	6	32	4	52	6	5	34	3	48	5	6	35	6
LAB 9	37	6	2			26	2	2			27	1	4			37	2	2		
LAB 10	did not give me replicate data																			
LAB 11	62	32	0	4	2	60	27	0	8	5	63	26	0	9	2	53	32	0	13	2

Table 11. Individual lab replicate data for lot 3 with a 7 day pre-chill at 15-30C.

	REP 1					REP 2					REP 3					REP 4				
	1ST COUNT	2ND COUNT	ABS	DORMANT	DEAD	1ST COUNT	2ND COUNT	ABS	DORMANT	DEAD	1ST COUNT	2ND COUNT	ABS	DORMANT	DEAD	1ST COUNT	2ND COUNT	ABS	DORMANT	DEAD
LAB 1																				
LAB 2	55	13	2	17	15	54	21	1	17	8	54	12	0	22	12	48	19	0	25	8
LAB 3	16	4	0	16	64	21	10	0	17	52	24	7	0	19	50	27	5	0	24	44
LAB 4	32	5	2		61	50	8	3		39	46	13	3		38	43	9	2		46
LAB 5	44	30	6	18	2	52	17	6	18	7	26	8	6	15	5	46	28	2	22	2
LAB 6	45	39	0	14	2	39	29	5	22	5	39	30	3	25	3	42	33	2	18	5
LAB 7	21	26	3	31	19	31	13	1	38	17	30	10	5	33	22	31	8	3	37	21
LAB 8																				
LAB 9	44	13	0			40	7	3			40	10	1			51	12	1		
LAB 10	did not give me replicate data																			
LAB 11	26	46	0	12	16	22	37	0	28	13	23	46	0	17	14	25	41	0	16	18

Table 12. Individual lab replicate data for lot 3 with no pre-chill at 15-30C

	REP 1					REP 2					REP 3					REP 4				
	1ST COUNT	2ND COUNT	ABS	DORMANT	DEAD	1ST COUNT	2ND COUNT	ABS	DORMANT	DEAD	1ST COUNT	2ND COUNT	ABS	DORMANT	DEAD	1ST COUNT	2ND COUNT	ABS	DORMANT	DEAD
LAB 1																				
LAB 2	17	4	0	25	54	24	7	0	20	49	20	6	0	22	52	19	4	0	19	58
LAB 3	22	5	8	19	46	19	4	7	17	53	17	6	3	20	54	19	8	6	22	45
LAB 4	8	4	3		85	12	8	5		82	14	3	1		82	9	2	0		92
LAB 5	10	16	11	35	28	18	18	6	28	30	19	18	11	23	29	9	13	6	38	34
LAB 6	17	8	3	14	58	11	16	11	13	49	17	8	6	14	55	11	10	10	20	49
LAB 7	14	15	12	13	46	12	12	12	18	46	11	13	16	17	43	16	9	12	16	47
LAB 8	15	19	5	57	4	16	7	6	66	5	13	20	8	55	4	22	7	6	62	3
LAB 9	14	4	11			18	7	10			13	6	7			15	2	9		
LAB 10	did not give replicate data																			
LAB 11	6	14	0	30	50	13	21	0	15	51	12	14	0	19	55	10	20	0	26	44

Table 13. Individual lab replicate data for lot 4 with a 7 day pre-chill at 15-30C

	REP 1					REP 2					REP 3					REP 4				
	1ST COUNT	2ND COUNT	ABS	DORMANT	DEAD	1ST COUNT	2ND COUNT	ABS	DORMANT	DEAD	1ST COUNT	2ND COUNT	ABS	DORMANT	DEAD	1ST COUNT	2ND COUNT	ABS	DORMANT	DEAD
LAB 1																				
LAB 2	16	13	0	8	63	22	8	0	8	62	26	4	0	7	63	24	6	0	6	64
LAB 3	1	2	0	12	85	0	0	0	11	89	2	0	0	9	89	4	0	0	7	89
LAB 4	17	5	6		72	15	8	5		72	18	9	10		63	17	8	2		73
LAB 5	12	13	10	39	26	14	18	9	31	28	12	10	13	36	29	16	12	11	38	23
LAB 6	15	15	10	5	55	8	19	9	3	61	7	18	9	6	60	10	16	8	9	57
LAB 7	10	3	1	4	82	8	5	3	7	77	9	6	1	5	79	6	3	2	8	81
LAB 8																				
LAB 9	14	4	10			13	6	8			15	5	11			13	10	11		
LAB 10	did not give replicate data																			
LAB 11	5	13	0	6	76	6	18	0	11	65	6	16	0	11	67	5	18	0	18	59

Table 14. Individual lab replicate data for lot 4 with no pre-chill at 15-30C

	REP 1					REP 2					REP 3					REP 4				
	1ST COUNT	2ND COUNT	ABS	DORMANT	DEAD	1ST COUNT	2ND COUNT	ABS	DORMANT	DEAD	1ST COUNT	2ND COUNT	ABS	DORMANT	DEAD	1ST COUNT	2ND COUNT	ABS	DORMANT	DEAD
LAB 1																				
LAB 2	27	4	0	62	7	23	4	0	61	12	29	5	0	57	9	38	7	0	50	5
LAB 3	23	11	1	46	19	26	10	0	55	9	33	7	2	50	8	29	9	2	44	16
LAB 4	7	2	1		90	8	8	2		82	14	3	1		82	9	2	0		89
LAB 5	22	21	2	51	4	24	21	3	42	10	18	20	5	50	7	31	21	5	37	6
LAB 6	18	9	2	61	10	20	10	1	54	15	18	12	1	59	10	17	11	3	57	12
LAB 7	7	7	6	64	16	8	9	4	61	18	10	6	5	60	19	9	6	3	64	18
LAB 8	25	13	6	52	4	21	11	4	58	6	18	6	4	67	5	31	10	5	50	4
LAB 9	18	3	2			28	4	6			19	2	3			14	4	4		
LAB 10	did not give replicate data																			
LAB 11	23	35	0	26	16	20	29	0	27	24	24	22	0	35	19	25	33	0	31	11

Table 15. Individual lab replicate data for lot 5 with a 7 day pre-chill at 15-30C

	REP 1					REP 2					REP 3					REP 4				
	1ST COUNT	2ND COUNT	ABS	DORMANT	DEAD	1ST COUNT	2ND COUNT	ABS	DORMANT	DEAD	1ST COUNT	2ND COUNT	ABS	DORMANT	DEAD	1ST COUNT	2ND COUNT	ABS	DORMANT	DEAD
LAB 1																				
LAB 2	30	24	0	40	6	22	20	1	47	11	18	25	0	50	7	30	34	0	32	4
LAB 3	7	1	0	30	62	5	1	0	29	65	9	2	1	34	54	9	7	0	31	53
LAB 4	17	5	6		72	20	11	5		64	22	9	3		66	35	2	3		60
LAB 5																				
LAB 6	15	33	5	30	17	23	35	3	26	13	17	34	0	38	11	16	30	2	39	13
LAB 7	19	19	2	23	37	22	10	4	28	34	18	14	5	32	31	19	12	4	29	36
LAB 8																				
LAB 9	24	13	3			23	13	8			19	10	6			16	14	8		
LAB 10	did not give replicate data																			
LAB 11	14	28	0	18	40	15	23	0	22	40	14	32	0	15	39	30	25	0	17	28

Table 16. Individual lab replicate data for lot 5 with no pre-chill at 15-30C

