Germination: Calculation and expression of results

Presentation of the Calculator that can be used to determine the germination result that should be reported

The following Excel file contains a computer programme that calculates: the result that should be reported after testing the germination of a seed lot. The programme will inform the user whether a result can be reported or whether a retest is required. When retests are carried out the programme determines the result that should be reported or whether a further retest is required.

The calculations carried out by this programme are in accordance with those developed and published by Miles 1963 in the "**Handbook of tolerances and measures of precision for seed testing**" *Proceedings of the International Seed Testing Association*, **28,** 525-686.

For example:

A. If we conduct a 400 seed germination test and obtain the following results for the four replicates of 100 seeds:
91, 88, 84, and 89.

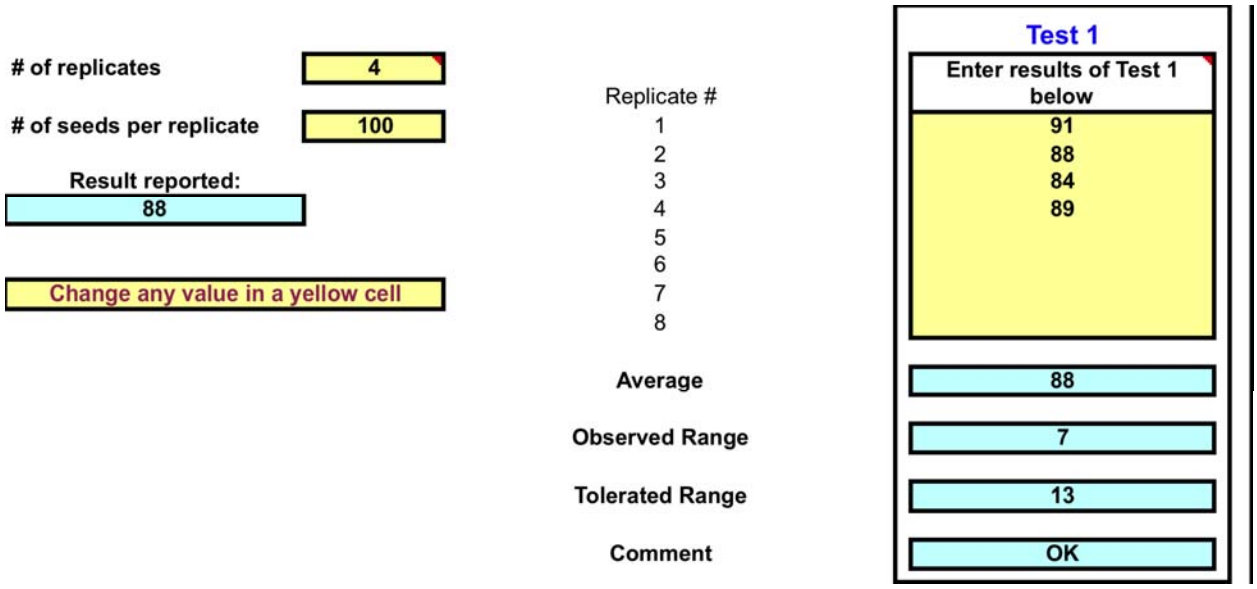
First we enter into the calculator, the number of replicates and the number of seeds in each replicate:

# of replicates	**4**
# of seeds per replicate	**100**

The replicate results are now entered into the first four yellow cells of Test 1 of the calculator.

Replicate #	**Enter results of Test 1 below**
1	**91**
2	**88**
3	**84**
4	**89**
5	
6	
7	
8	

The calculator reveals that the average is 88, the observed range is 7, the tolerated range is 13 and that the result is OK as the replicates are in tolerance so that a result of 88 should be reported.



B. If we conduct a 400 seed germination test and obtain the following results for the four replicates of 100 seeds:
91, 88, 74, and 89.

First we enter into the calculator, the number of replicates and the number of seeds in each replicate:

# of replicates	**4**
# of seeds per replicate	**100**

The replicate results are now entered into the first four yellow cells of Test 1 of the calculator.

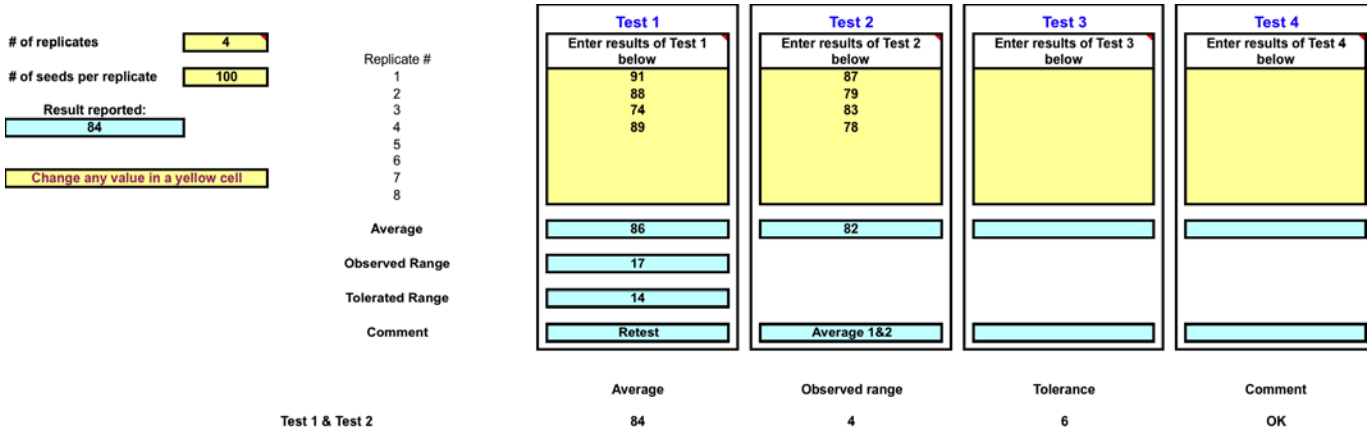
Replicate #	**Test 1** **Enter results of Test 1 below**
1	**91**
2	**88**
3	**74**
4	**89**
5	
6	
7	
8	

The calculator reveals that the average is 86, the observed range is 17, the tolerated range is 14 and that a retest is required as the replicates are out of tolerance.

A second test is carried out and the results of the four replicates of 100 seeds are 87, 79, 83 and 78. These results are now entered into first four yellow cells of Test 2 of the calculator.

Replicate #	Test 1 Enter results of Test 1 below	Test 2 Enter results of Test 2 below
1	91	87
2	88	79
3	74	83
4	89	78
5		
6		
7		
8		

The calculator reveals that the average of test 1 is 86, the average of test 2 is 82, the observed range between test 1 and test 2 is 4, the tolerated range is 6 and that the results of test 1 and test 2 are in tolerance so that the average germination result of test 1 and test 2, which 84 is should be reported.



C. If we conduct a 400 seed germination test and obtain the following results for the four replicates of 100 seeds:
91, 88, 74, and 89.

First we enter into the calculator, the number of replicates and the number of seeds in each replicate:

# of replicates	**4**
# of seeds per replicate	**100**

The replicate results are now entered into the first four yellow cells of Test 1 of the calculator.

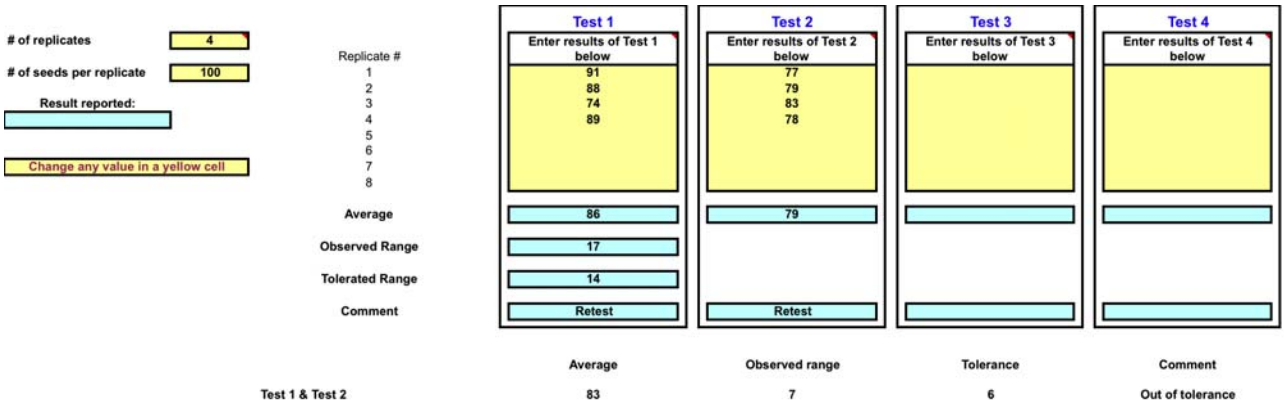
Replicate #	Test 1 Enter results of Test 1 below
1	91
2	88
3	74
4	89
5	
6	
7	
8	

The calculator reveals that the average is 86, the observed range is 17, the tolerated range is 14 and that a retest is required as the replicates are out of tolerance.

A second test is carried out and the results of the four replicates of 100 seeds are 77, 79, 83 and 78. These results are now entered into first four yellow cells of Test 2 of the calculator.

Replicate #	Test 1 Enter results of Test 1 below	Test 2 Enter results of Test 2 below
1	91	77
2	88	79
3	74	83
4	89	78
5		
6		
7		
8		

The calculator reveals that the average of test 1 is 86, the average of test 2 is 79, the observed range between test 1 and test 2 is 7, the tolerated range is 6 and that the results of test 1 and test 2 are out of tolerance so that another retest should be carried out.



A third test is carried out and the results of the four replicates of 100 seeds are 80, 82, 82 and 82. These results are now entered into first four yellow cells of Test 3 of the calculator.

Replicate #	Test 1 Enter results of Test 1 below	Test 2 Enter results of Test 2 below	Test 3 Enter results of Test 3 below
1	91	77	80
2	88	79	82
3	74	83	82
4	89	78	82
5			
6			
7			
8			

The calculator reveals that the average of test 1 is 86, the average of test 2 is 79, the average of test 3 is 82. It also shows that although tests 1 and 2 are out of tolerance, test 1, 2 and 3 are in tolerance as are test 1 and 3 and tests 2 and 3. As a result the average of tests1, 2 and 3, which is 82 should be reported.

# of replicates	4
# of seeds per replicate	100
Result reported:	82

Change any value in a yellow cell

Replicate #	Test 1 Enter results of Test 1 below	Test 2 Enter results of Test 2 below	Test 3 Enter results of Test 3 below	Test 4 Enter results of Test 4 below
1	91	77	80	
2	88	79	82	
3	74	83	82	
4	89	78	82	
5				
6				
7				
8				
Average	86	79	82	
Observed Range	17			
Tolerated Range	14			
Comment	Retest	Retest	Average 1&2&3	

	Average	Observed range	Tolerance	Comment
Test 1 & Test 2	83	7	6	Out of tolerance
Test 1 & Test 2 & Test 3	82	7	7	OK
Test 1 & Test 3	84	4	6	OK
Test 2 & Test 3	81	3	6	OK

These examples illustrate some of the situations that are experienced when testing germination. They do not however cover all possible circumstances that the calculator is designed to deal with e.g. where more than 2 retests are required; where several pairs of tests are in tolerance and a decision is required on the result that should be reported.

People involved in the project:
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