# SCST Proficiency Testing Task Force Report

## Background

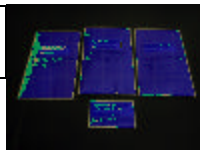
During the 2002 annual business meeting SCST members voted to send every Registered Seed Technologist (RST) three proficiency testing samples as a pilot proficiency-testing program. The results of these tests would be used to "take the pulse" of the Society and to help establish a permanent proficiency testing program. Members volunteered to assist with the process and a task force was formed. The task force met in September and chose the species and test to be performed. A purity and germination on *Triticum aestivum* (wheat), *Cucumis melo* (cantaloupe) germination and *Glycine max* (soybean) germination were selected. Volunteers were chosen to provide seed for the samples, prepare the samples, develop forms for recording results and to prepare education materials. A time line was developed for completion of these tasks.

## Selection of Seed Lots and Preparation of samples

**Dividing down with a riffle divider**

Seed lots exhibiting mid-range germination and low levels of inert matter were selected and sent to the sample preparation volunteers. The sample prep volunteers mixed the samples according to the ISTA Referee Sample Preparation Protocol. Samples were randomly selected for heterogeneity testing and sent to experienced RSTs for analysis (see Appendix A). The results were statistically analyzed to guarantee that the samples were uniform. In addition, the contaminants for the wheat samples were sent to a third party for species verification before they were added to the proficiency samples.

**Contaminants**



**Labeled and filled envelopes**

The SCST Executive Director was responsible for providing labeled sample envelopes. Each RST was assigned a unique sample number. The same number was used for all three species. Envelopes were sent to the sample prep volunteers and the filled samples were returned to the Executive Director. Samples and result recording forms were sent to each RST. To ensure confidentiality only the Executive Director has access to the result forms and sample assignments.

Results were due February 1st for the wheat and cantaloupe and March 1st for the soybean. Three months were given to complete the tests and return the results.

## Analysis

All the results received before March 15th were included in the analysis. The mean, median, and standard deviation were calculated for normal seedlings, abnormal seedlings, dead seed and the purity components. Graphs are used to illustrate results and where they fall in relation to one and two standard deviations.

The proficiency testing task force donated considerable time and resources to make this pilot proficiency testing a positive and educational experience for SCST members (see Appendix B). The task force will hold an open meeting at the annual meeting in Seattle, WA Monday June 9th. Everyone is invited to attend.

Respectfully submitted,
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**Analysis of Results**

*Cucumis melo* (cantaloupe) Germination Analysis

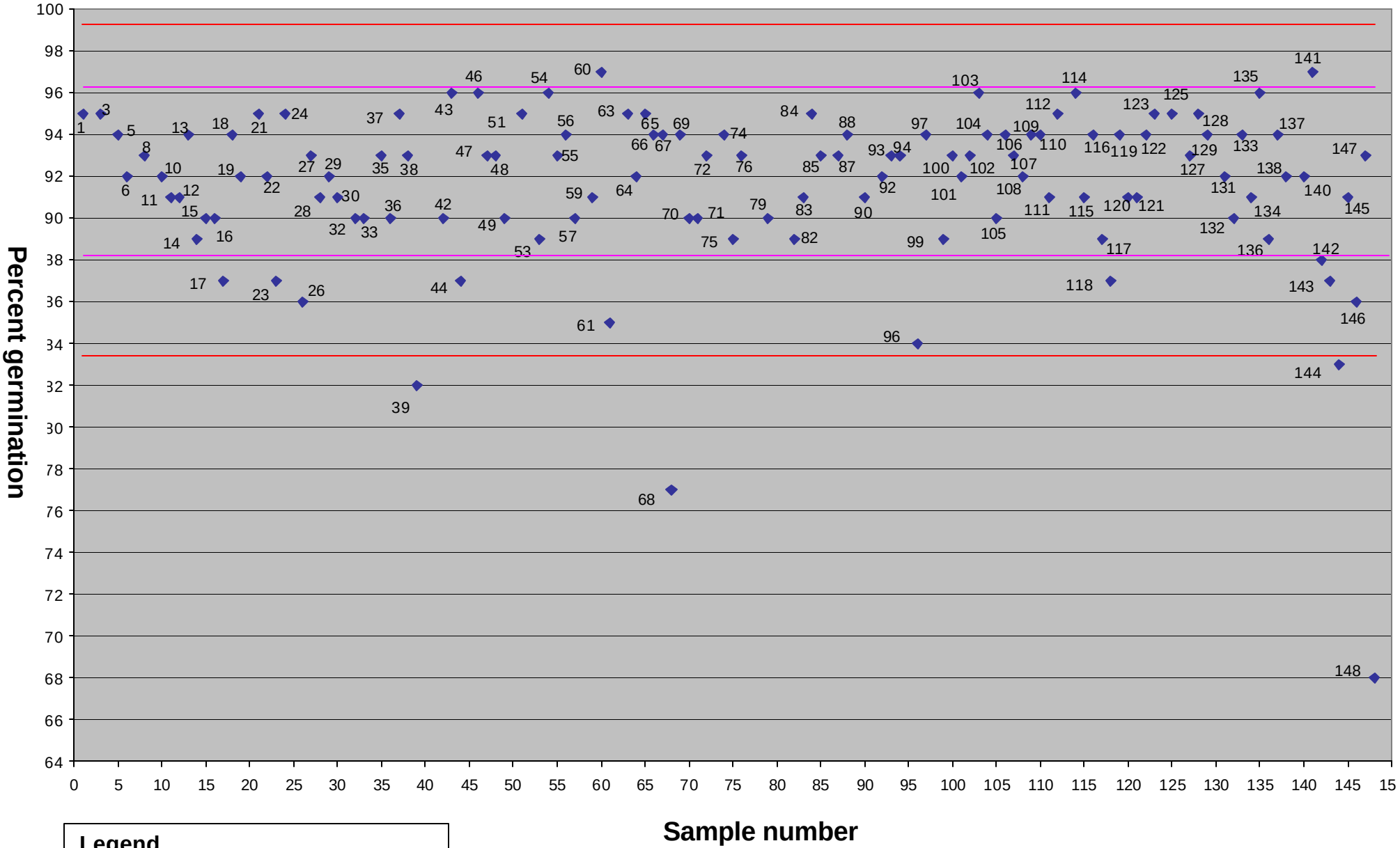
Normal seedling evaluation (118 results returned)
- 86% fell within one standard deviation of the mean
- 96% fell within two standard deviations of the mean
- Outlier sample numbers: 39, 68, 144, 148

Abnormal seedlings evaluation (116 results returned)
- 89% fell within one standard deviation of the mean
- 97% fell within two standard deviations of the mean
- Outlier sample numbers: 61, 68, 96, 144

Dead seed evaluation (116 results returned)
- 94% fell within one standard deviation of the mean
- 99% fell within two standard deviations of the mean
- Outlier sample number: 148

| ***Cucumis melo*** germination | Normal seedlings | Abnormal seedlings | Dead seed |
|---|---|---|---|
| Mean | 91.64 | 3.36 | 4.93 |
| Median | 92.5 | 3 | 5 |
| Standard deviation | 3.90 | 2.58 | 2.71 |
| Mean + 1 standard deviation | 95.54 | 5.94 | 7.64 |
| Mean - 1 standard deviation | 87.73 | 0.78 | 2.22 |
| Mean + 2 standard deviation | 99.44 | 8.52 | 10.34 |
| Mean - 2 standard deviation | 83.83 | -1.80 | -0.481 |

# *Cucumis melo* Germination Graph



*Glycine max* (soybean) Germination Analysis

Normal seedling evaluation (111 results)

- 81% fell within one standard deviation of the mean
- 95% fell within two standard deviations of the mean
- Outlier sample numbers: 15, 32, 48, 51, 92, 136

Abnormal seedlings evaluation (111 returned)

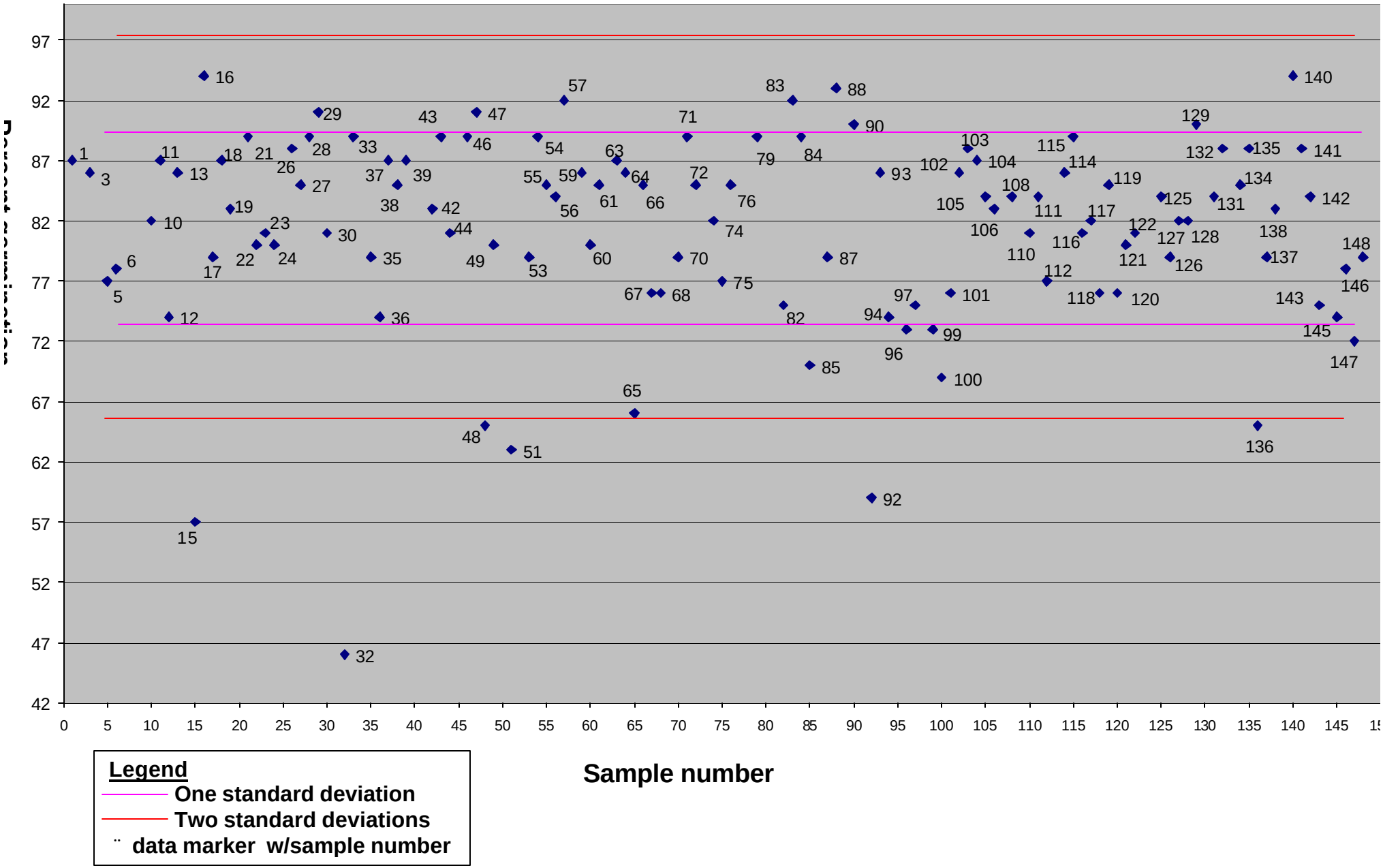
- 74% fell within one standard deviation of the mean
- 92% fell within two standard deviations of the mean
- Outlier sample numbers: 15, 16, 32, 48, 51, 57, 59, 92, 100

Dead seed evaluation (111 results returned)

- 73% fell within one standard deviation of the mean
- 95% fell within two standard deviations of the mean
- Outlier sample number: 32, 65, 136, 92, 94

| ***Glycine max*** germination | Normal seedlings | Abnormal seedlings | Dead seed | Hard seed |
|---|---|---|---|---|
| Mean | 81.50 | 13.49 | 5.05 | 0.05 |
| Median | 83 | 13 | 4 | 0 |
| Standard deviation | 7.95 | 5.83 | 4.11 | 0.33 |
| Mean + 1 standard deviation | 89.45 | 19.32 | 9.16 | 0.38 |
| Mean - 1 standard deviation | 73.56 | 7.65 | 0.93 | -0.27 |
| Mean + 2 standard deviation | 97.40 | 25.15 | 13.27 | 0.71 |
| Mean - 2 standard deviation | 65.61 | 1.82 | -3.18 | -0.60 |

# *Glycine max* Germination Graph



*Triticum aestivum (* wheat) Germination Analysis

Normal seedling evaluation (116 results returned)

- 65% fell within one standard deviation of the mean
- 97% fell within two standard deviations of the mean
- Outlier sample numbers: 18, 46, 47, 72

Abnormal seedlings evaluation (116 results returned)

- 69% fell within one standard deviation of the mean
- 97% fell within two standard deviations of the mean
- Outlier sample numbers: 18, 44, 47, 120

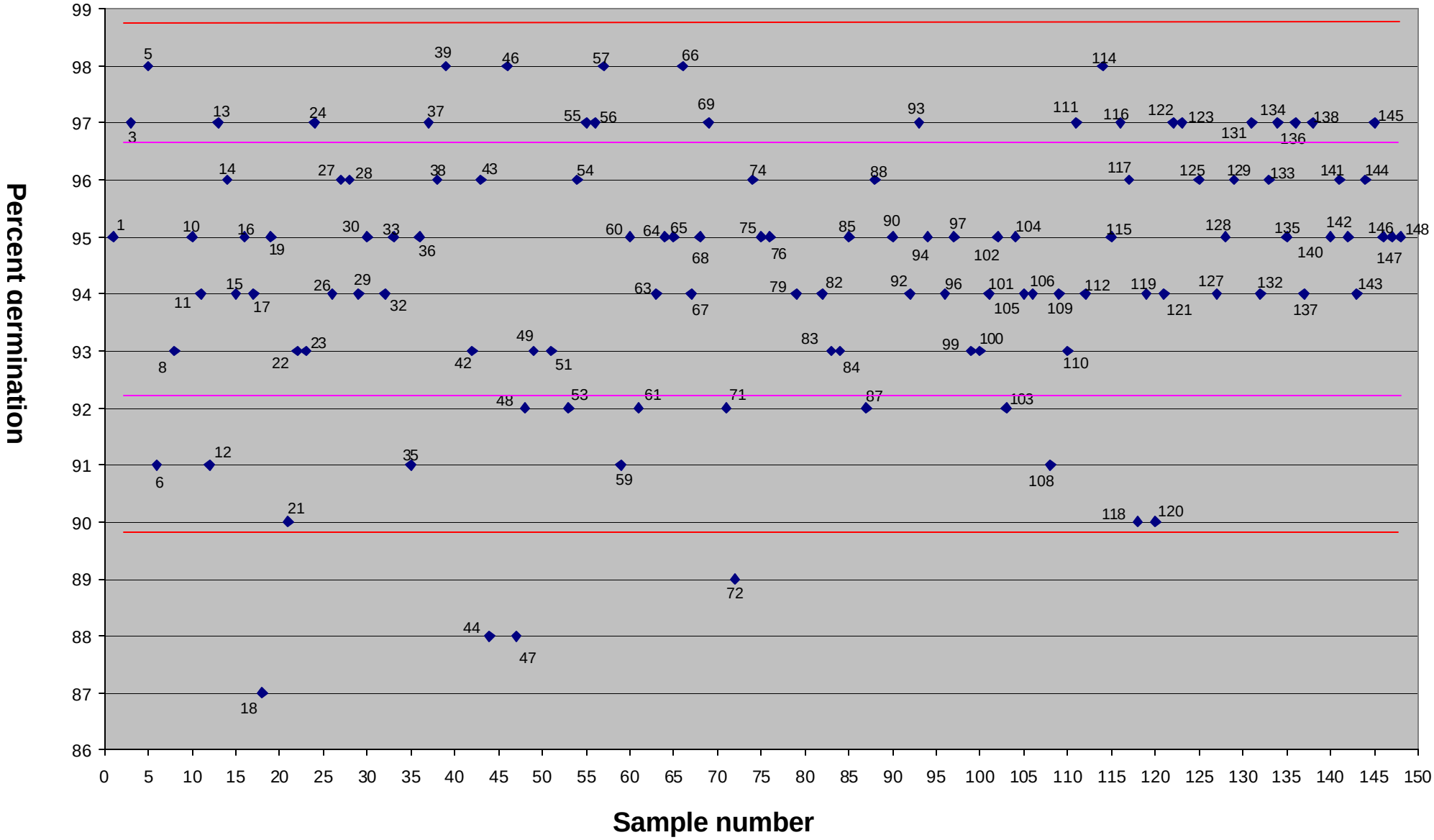
Dead seed evaluation (116 results returned)

- 66% fell within one standard deviation of the mean
- 99% fell within two standard deviations of the mean

Outlier sample number: 72

| ***Triticum aestivum*** germination | Normal seedlings | Abnormal seedlings | Dead seed |
|---|---|---|---|
| Mean | 94.48 | 3.42 | 2.09 |
| Median | 95 | 95 | 3 |
| Standard deviation | 2.24 | 2.24 | 1.97 |
| Mean + 1 standard deviation | 96.73 | 5.39 | 3.11 |
| Mean - 1 standard deviation | 92.24 | 1.46 | 1.08 |
| Mean + 2 standard deviation | 98.97 | 7.63 | 5.07 |
| Mean - 2 standard deviation | 89.99 | -0.79 | -0.88 |

# *Triticum aestivum* Germination Graph




**Legend**

One standard deviation

Two standard deviations

¨ data marker w/sample number

*Triticum aestivum (* wheat) Purity Analysis

Pure seed evaluation (116 results returned)
- 73% fell within one standard deviation
- 94% fell within two standard deviations
- Outlier sample numbers: 8, 26, 44, 65, 67, 143, 145

Inert matter evaluation (116 results returned)
- 70% fell within one standard deviation
- 93% fell within two standard deviations
- Outlier sample numbers: 8, 61, 65, 67, 79, 128, 132

Weed seed evaluation (116 results returned)
- 86% fell within one standard deviation
- 95% fell within two standard deviations
- Outlier sample number: 15, 67, 96, 109, 143

Crop seed evaluation (116 results returned)
- 91% fell within one standard deviation
- 97% fell within two standard deviations
- Outlier sample number: 44, 48, 147

| ***Triticum aestivum*** purity | % Pure seed | % Inert matter | % Weed seed | % Crop seed |
|---|---|---|---|---|
| Mean | 99.10 | 0.60 | 0.16 | 0.14 |
| Median | 99.12 | 0.62 | 0.17 | 0.13 |
| Standard deviation | 0.22 | 0.20 | 0.04 | 0.09 |
| Mean + 1 standard deviation | 99.33 | 0.81 | 0.21 | 0.23 |
| Mean - 1 standard deviation | 98.88 | 0.40 | 0.12 | 0.05 |
| Mean + 2 standard deviation | 99.55 | 1.01 | 0.25 | 0.33 |
| Mean - 2 standard deviation | 98.66 | 0.20 | 0.08 | -0.0422 |

Contaminants

The samples had an admixture of two *Convolvulus arvensis* (field bindweed), three *Aegilops cylindrica* (jointed goatgrass), 1 *Avena fatua* (wild oat), and 6 *Secale cereale* (rye). The lot itself contained *Horduem vulgare* and Triticum aestivum ssp. (white wheat) these were reported in a few samples.

| | C. arvensis | A. fatua | A. cyclidrica | S. cereale | Other |
|---|---|---|---|---|---|
| Mean | 1.86 | 0.99 | 3 | 4.96 | 0.41 |
| Median | 2 | 1 | 3 | 6 | 0 |
| St. deviation | 0.39 | 0.09 | 0.81 | 1.58 | 1.5 |

*Convolvulus arvensis:*

- 88%reported two seeds of *Convolvulus arvensis*
- 11% reported one seed of *Convolvulus arvensis* and one seed of the following species:

1 *Ipomea sp*.
3 *Ipomea purpurea*
2 *Convolvulus equitans*
6 *Calystegia sepium*
1 *Fallopia convolvulus*

- 1% did not report *Convolvulus arvensis*

*Aegilops cylindrica*

- 99% reported at least three seeds of *Aegilops cylindrica*
- 1% did not report *Aegilops cylindrical*

*Avena fatua*

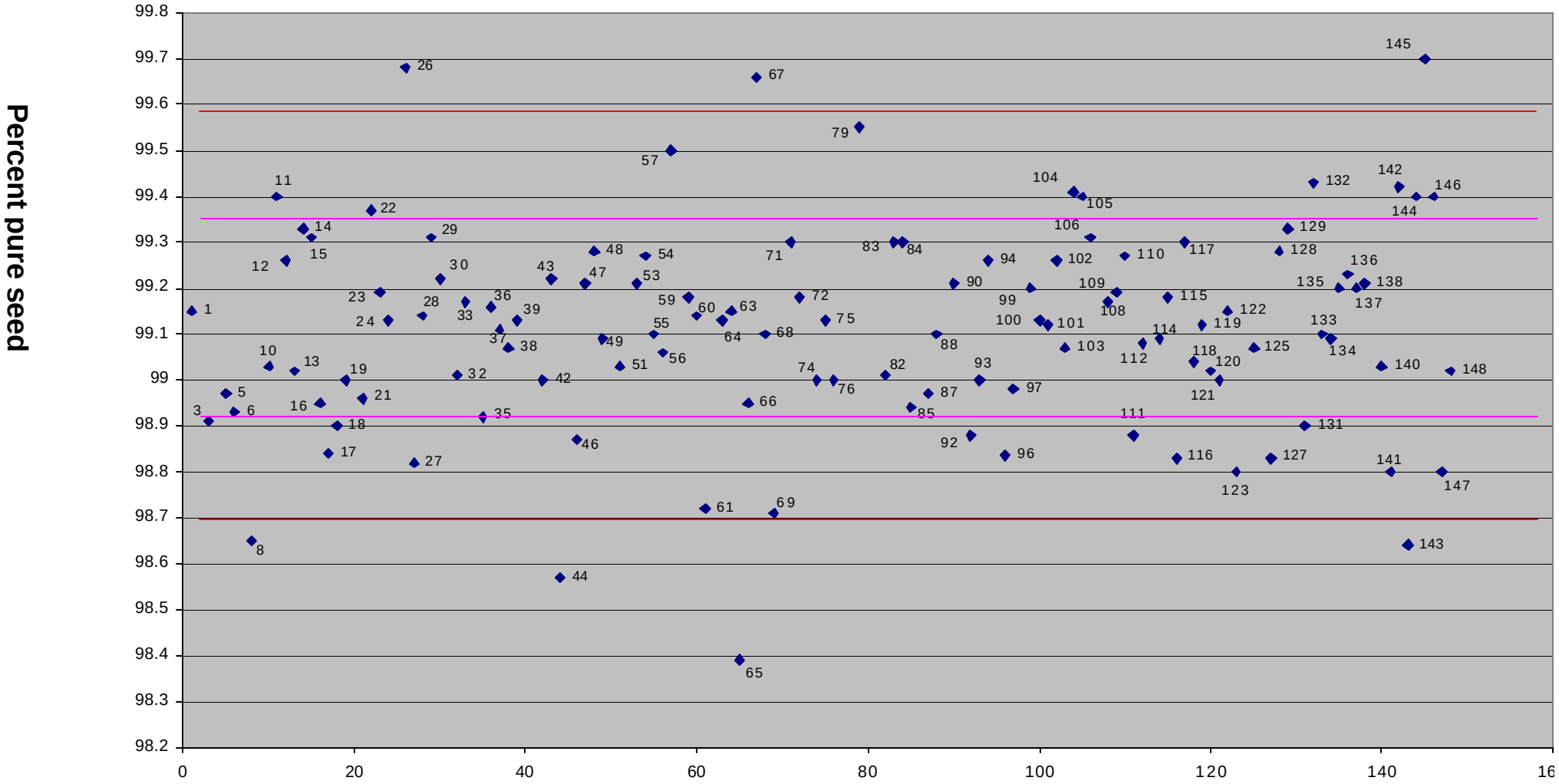
- 99% reported one *Avena fatua*
- 1% did not report *Avena fatua*

*Secale cereale*

- 2% did not report *Secale cereale*
- 3% reported one *Secale cereale*
- 5% reported two *Secale cereale*
- 4% reported three *Secale cereale*
- 14% reported four *Secale cereale*
- 21% reported five *Secale cereale*
- 48% reported six *Secale cereale*
- 1% reported seven *Secale cereale*
- 1% reported eight *Secale cereale*
- 1% reported nine *Secale cereale*

100% of identified seeds were correctly categorized as weed seed or crop seed.

# *Triticum aestivum* Pure Seed Graph



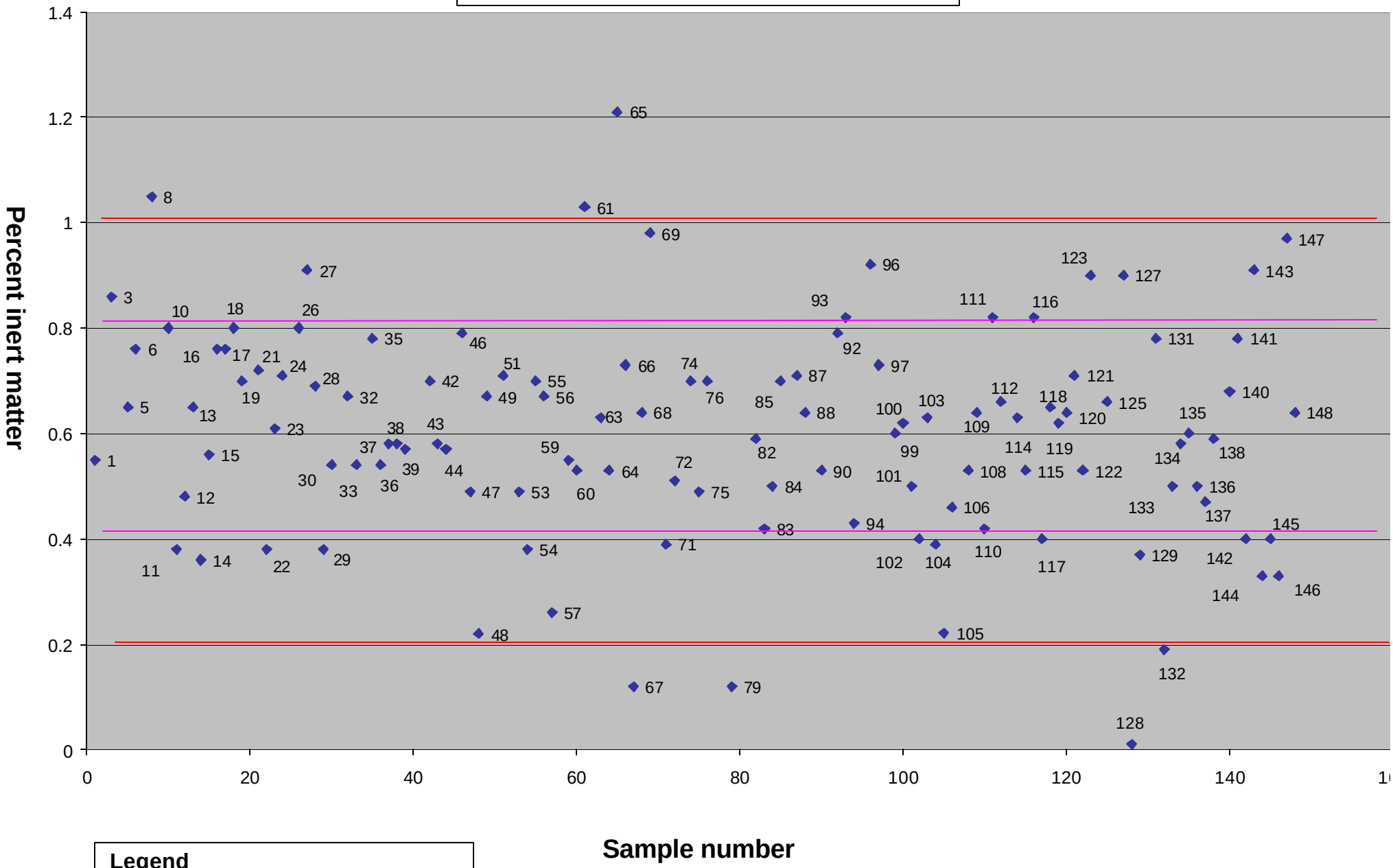

**Legend**

One standard deviation

Two standard deviations

¨ data marker w/sample number

# *Triticum aestivum* Inert Matter Graph



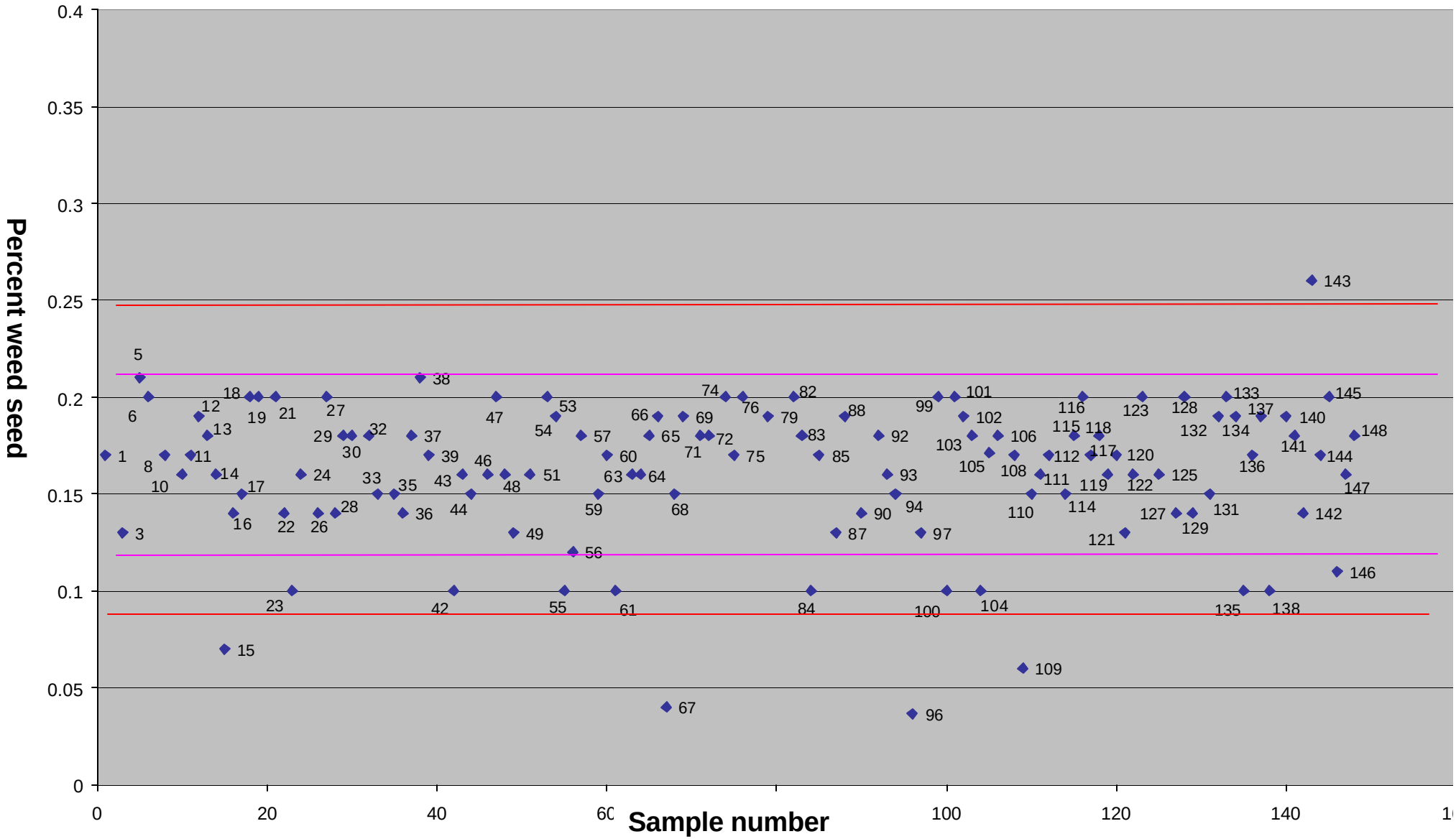

**Legend**

One standard deviation

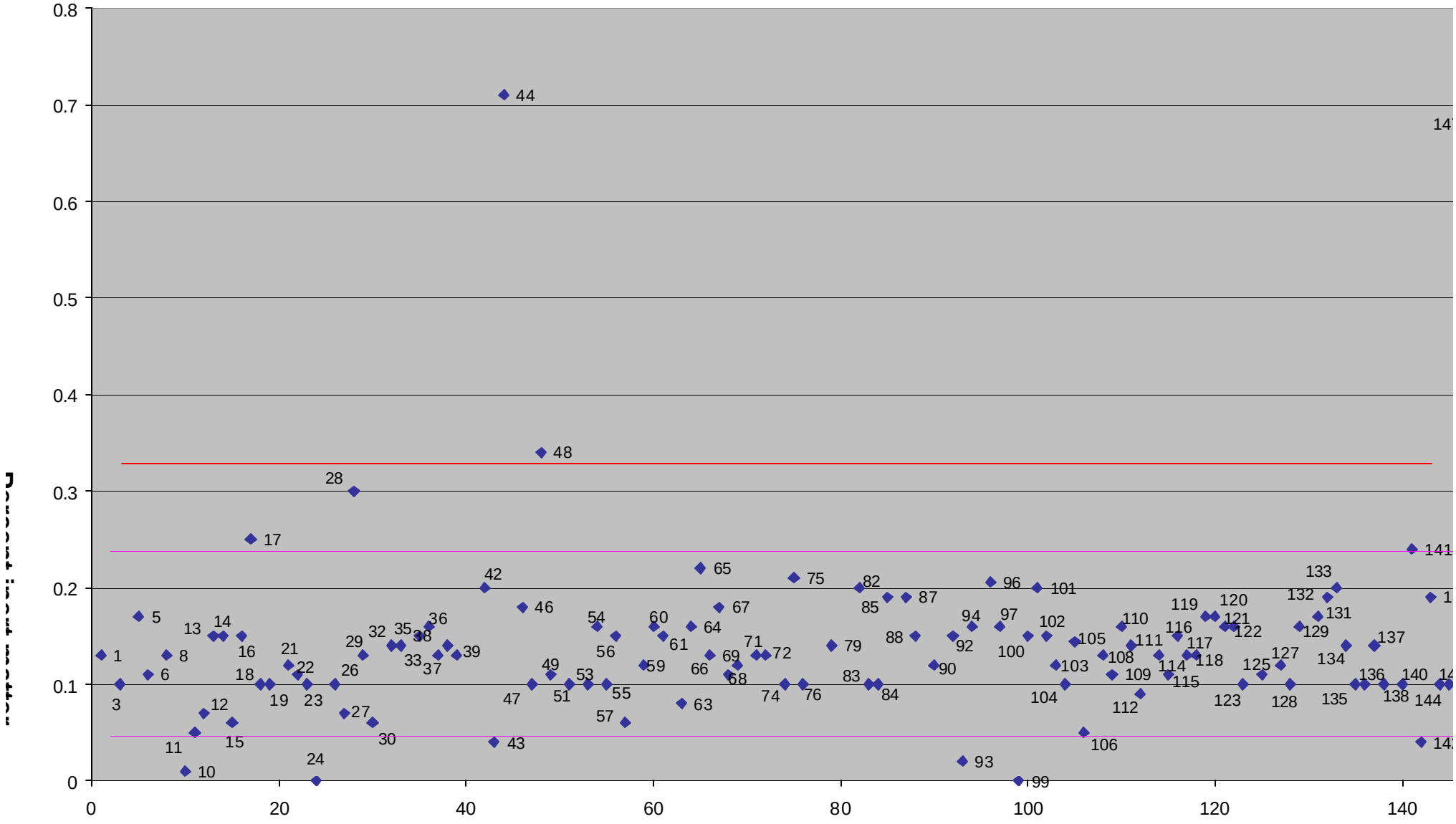
Two standard deviations

¨ data marker w/sample number

# *Triticum aestivum* Weed Seed Graph



# *Triticum aestivum* Crop Seed Graph



Appendix A

Heterogeneity Testing

Cantaloupe germination- 13 samples tested in rolled towels @ 20-30 °C.

| Sample # | Normal seedlings | Abnormal seedlings | Dead seed |
|---|---|---|---|
| 2 | 94 | 1 | 5 |
| 4 | 92 | 1 | 7 |
| 25 | 90 | 1 | 9 |
| 45 | 91 | 2 | 7 |
| 50 | 88 | 1 | 11 |
| 73 | 89 | 2 | 9 |
| 77 | 93 | 1 | 6 |
| 81 | 92 | 1 | 7 |
| 86 | 95 | 1 | 4 |
| 95 | 93 | 2 | 5 |
| 113 | 94 | 0 | 6 |
| 130 | 92 | 1 | 7 |
| 158 | 94 | 1 | 5 |
| Mean | 92.08 | 1.15 | 6.77 |
| Median | 92 | 1 | 7 |

Soybean germination- 13 samples tested in rolled towels @ 25°C.

| Sample # | Normal seedlings | Abnormal seedlings | Dead seed | Hard seed | |
|---|---|---|---|---|---|
| 2 | 83 | 10 | 7 | 0 | |
| 4 | 83 | 10 | 7 | 0 | |
| 25 | 84 | 8 | 8 | 0 | |
| 45 | 83 | 7 | 10 | 0 | |
| 50 | 80 | 10 | 10 | 0 | |
| 73 | 81 | 10 | 9 | 0 | |
| 77 | 82 | 11 | 7 | 0 | |
| 81 | 89 | 7 | 4 | 0 | |
| 86 | 82 | 12 | 6 | 0 | |
| 95 | 84 | 12 | 4 | 0 | |
| 113 | 85 | 11 | 4 | 0 | |
| 130 | 84 | 11 | 5 | 0 | |
| 158 | 82 | 10 | 8 | 0 | |
| Mean | 83.23 | 9.92 | 6.85 | 0 | |
| Median | 83 | 10 | 7 | 0 | |

Wheat germination- 13 samples tested in rolled towels @ 15°C.

| Sample # | Normal seedlings | Abnormal seedlings | Dead seed | |
|---|---|---|---|---|
| 2 | 93 | 5 | 2 | |
| 4 | 95 | 3 | 2 | |
| 25 | 96 | 2 | 2 | |
| 45 | 93 | 5 | 2 | |
| 50 | 96 | 2 | 2 | |
| 73 | 96 | 2 | 2 | |
| 77 | 93 | 4 | 3 | |
| 81 | 97 | 1 | 2 | |
| 86 | 96 | 2 | 2 | |
| 95 | 96 | 2 | 2 | |
| 113 | 97 | 1 | 2 | |
| 130 | 95 | 3 | 2 | |
| 158 | 97 | 2 | 1 | |
| Mean | 95.38 | 2.62 | 2 | |
| Median | 96 | 2 | 2 | |

Wheat purity

| Sample Number: | % Pure Seed | % Inert Matter | % Weed seed | % Crop seed |
|---|---|---|---|---|
| 2 | 99.55 | 0.15 | 0.15 | 0.15 |
| 4 | 99.46 | 0.25 | 0.17 | 0.12 |
| 25 | 99.53 | 0.16 | 0.15 | 0.16 |
| 45 | 99.54 | 0.21 | 0.15 | 0.1 |
| 50 | 99.23 | 0.44 | 0.18 | 0.15 |
| 73 | 99.47 | 0.26 | 0.16 | 0.11 |
| 77 | 99.46 | 0.22 | 0.18 | 0.14 |
| 81 | 99.39 | 0.33 | 0.15 | 0.13 |
| 86 | 99.62 | 0.11 | 0.17 | 0.1 |
| 95 | 99.49 | 0.18 | 0.16 | 0.17 |
| 113 | 99.5 | 0.19 | 0.17 | 0.14 |
| 130 | 99.59 | 0.15 | 0.16 | 0.1 |
| 158 | 99.24 | 0.43 | 0.14 | 0.19 |
| Mean | 99.47 | 0.24 | 0.16 | 0.14 |
| Median | 99.49 | 0.21 | 0.16 | 0.14 |

Contaminants

| Sample Number: | *Aegilops cylindrica* | *Convolvulus arvensis* | *Avena sativa* | *Secale cereale* |
|---|---|---|---|---|
| 2 | 3 | 2 | 1 | 6 |
| 4 | 3 | 2 | 1 | 5 |
| 25 | 3 | 2 | 1 | 6 |
| 45 | 3 | 2 | 1 | 4 |
| 50 | 3 | 2 | 1 | 5 |
| 73 | 3 | 2 | 1 | 5 |
| 77 | 3 | 2 | 1 | 6 |
| 81 | 3 | 2 | 1 | 5 |
| 86 | 3 | 2 | 1 | 4 |
| 95 | 3 | 2 | 1 | 6 |
| 113 | 3 | 2 | 1 | 3 |
| 130 | 3 | 2 | 1 | 5 |
| 158 | 3 | 2 | 1 | 6 |
| Mean | 3 | 2 | 1 | 5.08 |
| Median | 3 | 2 | 1 | 5 |

Incidentals:
*Hordeum vulgare* and *Triticum aestivum ssp*. (white wheat) were reported in two of the samples.

Appendix B

| **Wheat sample preparation** | **Time in hours** |
|---|---|
| Selecting lot for testing | 6 |
| Prep work & contaminant collection | 3 |
| Dividing & admixture preparation - 2 people | (combined time)16 |
| Packaging & shipping samples, misc. | 2 |
| Heterogeneity testing | 9 |
| **Total** | **36** |

| **Soybean sample preparation** | **Time in hours** |
|---|---|
| Selecting lot for testing | 8 |
| Dividing sample- 2 people | (combined time) 12 |
| Packaging & shipping samples | 1 |
| Heterogeneity testing | 6 |
| **Total** | **27** |

| **Canteloupe sample preparation** | **Time in hours** |
|---|---|
| Selecting lot for testing | 6 |
| Dividing sample- 2 people | (combined time) 12 |
| Packaging & shipping samples | 1 |
| Heterogeniety testing | 6 |
| **Total** | **25** |

| **Statistical analysis of results** | **3** |
|---|---|

| **Executive Director** | **Time in hours** |
|---|---|
| Conference Calls (two) | 3 |
| Labeling samples | 2 |
| Packaging samples | 7 |
| Shipping samples | 5 |
| Recording results | 12 |
| Requesting results | 2 |
| Reporting & analysis of results | 15 |
| **Total** | **46** |