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The ISTA Proficiency Test Programme

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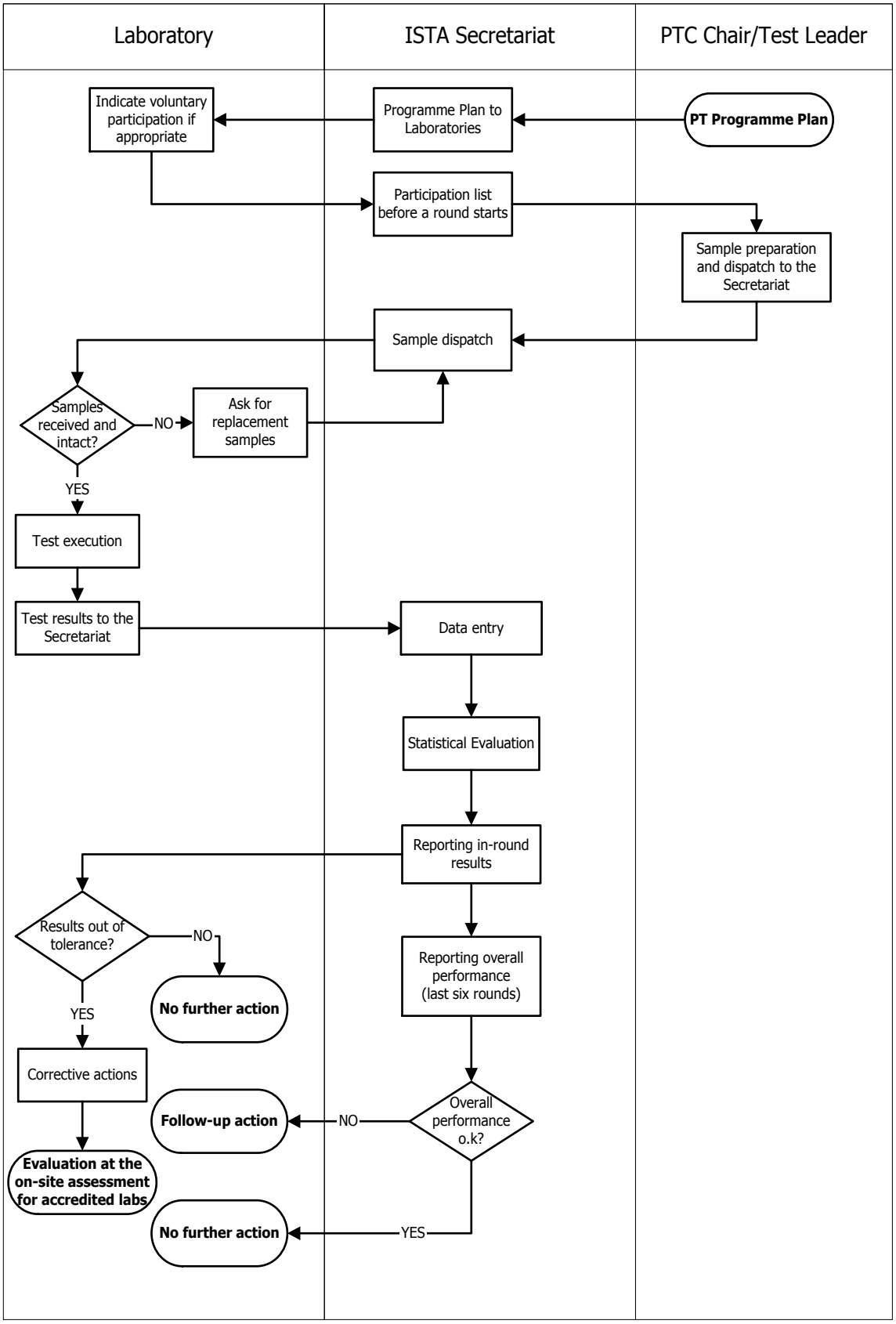
The ISTA Proficiency Test Programme

The scope of this document is to define the ISTA Proficiency Test (PT) Programme, formerly referred to as ISTA Referee Test Programme and to explain the single steps and framework in which it is operated.



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1 Scope of the ISTA Proficiency Test Programme

All ISTA member laboratories are eligible to participate in all PT rounds of the ISTA PT Programme. It is mandatory for ISTA accredited member laboratories (depending on their scope of accreditation) and voluntary for non-accredited laboratories who want to benchmark themselves with accredited laboratories and prepare themselves for accreditation in the future. The goal is not to identify the best seed testing laboratory in the world, but to identify those laboratories that do not meet the minimum standard of performance that is reasonably expected from an ISTA accredited laboratory and to determine if such laboratories are taking reasonable corrective action to bring their performance standard to at least the minimal level.

Non-members of ISTA may participate in the ISTA PT Programme for a flat fee determined and published by the Association. Participation comprises shipment of samples, statistical analysis and reporting to the participating laboratory. Non-members who wish to participate should contact the ISTA Secretariat.

2 Related Documents

ISTA Laboratory Accreditation Standard

Acc-D-01-Procedures for Termination, Suspension and Withdrawal of ISTA Accreditation

PT-G-02-Proficiency Test Sample Preparation Instruction

Acc-D-07-Scope of Accreditation Policy

3 Schedule

Regular PT rounds are performed three times per year. Normally, a test round starts 1st of February, June and October each year with the shipment of the samples as indicated in the Programme Plan. Each round is made up of three samples for each test (or group of tests) that are analysed for purity, other seed determination (OSD), germination, moisture, and/or tetrazolium as applicable. PTs for tests other than those mentioned may be organised by the Technical Committee, but are, for the time being, not yet part of the rating.

4 Programme Plan

The ISTA Proficiency Test Committee (PTC), comprising the Chairman and the PT Leaders, select the particular species to be used for the programme over a three year time span between two ISTA Congresses. The species to be used are chosen to represent a size and germination type group and are intended to be generic in representing a crop group. They are species listed in the ISTA Rules Table 2A Part I and III. All species of Table 2A may be part of a laboratory's scope of accreditation. If a laboratory is accredited for one or several of the species mentioned in a crop group, participation in a test round which tests another species of the same crop group is mandatory. A representative species for each crop group (Appendix I Crop group list) should be chosen at least once within six rounds.

At the beginning of each PT period, generally after an ISTA Congress, the laboratory will receive the Programme Plan (Appendix II ISTA Proficiency Test Programme Plan). New member laboratories will receive the Programme Plan together with the membership confirmation letter. Non-accredited laboratories that wish to participate as volunteers will be requested to indicate in which test rounds they wish to participate by returning the completed form to the ISTA Secretariat. Accredited laboratories whose scope does not oblige them to participate in every test round may also indicate the rounds in which they wish to participate as volunteers. Results of voluntary test rounds will be excluded from the accredited laboratory's overall rating.

Test rounds are identified by a unique numbering system that is as follows: last two numbers of the year in which the test is performed, a number indicating the round of that year plus an abbreviation of the species tested. Hence, 07-2 M.sat means that it is the second round of year 2007 and the species tested is *Medicago sativa*. This number is applied and referred to in communication to quickly identify the test round concerned.

5 Participants

Before a round starts, the list of participants is generated on the basis of the data available in the Secretariat's data base. This list is made up of laboratories obliged to participate due to their specific scope of accreditation and laboratories having indicated their interest. The mandatory status of every laboratory is determined on the basis of the approved scope of accreditation. The scope of accreditation is defined as described in the document Acc-D-07-Scope of Accreditation Policy.

6 Sample Preparation and Dispatch to the Secretariat

A PT Leader volunteers to prepare the material for a test round. The ISTA Secretariat informs the PT Leader of the number of participants to determine the number of samples needed. The PT Leader prepares the samples according to the PT Sample Preparation Instruction provided by the ISTA Secretariat. The PT Leader prepares 130–160 sub-samples from each of the three separate bulk samples of seed of the selected species that has purity and germination levels that meet

normal international marketing requirements. Ten randomly selected sub-samples are subjected to a heterogeneity test to ensure the lots chosen are suitable for a PT. The sub-samples are sent together with a phytosanitary certificate to the ISTA Secretariat for distribution, test results reporting and tracking, data entry and results distribution plus communication with the participating laboratories. Samples are randomly assigned to the participating laboratories and the allocated random number is used to maintain the anonymity of the laboratory when reporting the results to the Association or the PT Leader.

7 Sample Dispatch

Samples are dispatched from the ISTA Secretariat at the beginning of February, June, and October every year. Where needed a phytosanitary certificate is enclosed. Laboratories are notified by email upon sample dispatch. Laboratories not having received the samples within three weeks after dispatch date, are required to contact the Secretariat and ask for replacement samples.

Every sample package is accompanied by an instruction letter and result forms where results are reported. Deadline for reporting of results is 90 calendar days after the PT round package has been dispatched from the ISTA Secretariat. Analysis results from participating laboratories have to be with the Secretariat by that time or they will not be included in the analysis and final report for the round. Laboratories not having reported the results two weeks prior to the deadline will receive a reminder advising that the deadline for reporting of results is close. This is especially important for mandatory participants since they will be scored with a BMP (Below Minimum Performance) if results are not received by the due date. Laboratories having persisting problems with delivery of the sample packages will be required to take immediate action to correct the situation. The Secretariat may provide additional documents such as proforma invoices and/or explanation letters on the purpose of the PT if needed.

8 Test Execution

Participants are expected to initiate the tests required for a round as soon as possible after the samples have been received, preferably within three weeks of their receipt. If the laboratory receives samples that are not acceptable (e.g. insufficient sample weight, opened seed packets, leakage of seeds, etc.), the ISTA Secretariat must be informed and asked for replacement samples. Any complaints pertaining to inadequate sample status may not be considered once the ISTA Secretariat has processed the data and reported the results.

The laboratory tests the samples using the ISTA method it usually uses when testing seed for ISTA Certificate purposes. The participants are responsible for the correctness of all results/information reported and no results can be corrected after the round reporting period has been terminated. The seed remaining after the test(s) must be carefully stored for possible required follow up action.

9 Reporting of Results

The laboratory may send the raw data and the means of the test results as they would be reported on an ISTA Certificate, together with the information requested to the ISTA Secretariat on the provided forms either by mail, fax or email. Data report forms will be provided by email and on the ISTA website for download and computerized data entry purposes. For some test rounds the laboratory will be asked to also report the results on an ISTA Certificate which will be provided.

Laboratories not having sent the results to the ISTA Secretariat two weeks before the deadline will receive a reminder. Laboratories that have any delay in reporting the results must inform the ISTA Secretariat before the deadline together with reasons for the delay, and an indication of when

results will be reported. It will be decided on a case by case basis whether delayed results may be included or not.

10 Data Entry

The ISTA Secretariat staff verify whether the results are reported correctly and if the proper reporting procedures have been followed. Deviations may lead to a reduced rating for this round (Appendix III Examples for basic reporting errors). The reported data are then entered in the data base for analysis and report generation.

11 Statistical Evaluation

The purity, germination, moisture, and tetrazolium results are statistically analysed using the publicly available and free programme called "R" following the method of Tattersfield (1979) Seed Science and Technology 7, (2), 247-257. The principle of the method is to calculate Z-scores (Z_i) based on determining the true value represented by the estimated mean, after outliers have been eliminated.

First analysis is done to identify the outliers, meaning these results differ considerably and may bias the estimate of the 'true' mean. A second analysis of the results is then made, excluding the outliers to find the new mean and standard deviation. The laboratory's mean (x_i) is correlated with the overall mean (x), the estimated 'true value' of the sample, and the standard deviation (s) derived from the data of the accredited laboratories only, according the given formula:

$$\mathbf{Z_i = (x_i - x)/s}$$

These values are used to generate the tables and graphical presentation on the individual report sheet each of the laboratories obtain to provide them with a standardized comparison of their performance with respect to other laboratories. Details on the interpretation of the report sheets are given in Appendix IV Explanation and interpretation of PT report sheets.

The Z-scores provide a good indication of a laboratory's analytical competence. The probability of a Z-score greater than ±2.0 or ±2.68 for a single test component (example pure seed in the purity test) is less than 5 % or 1 % respectively. Results between ±2.0 or ±2.68 provide an indication to the laboratory that it may have an analytical problem and it should verify its state of readiness to perform the test in question. Individual Z-scores between 2.00 and 2.68 (or –2.00 and –2.68) indicate a possible problem which the laboratory should investigate. Results greater than 2.68 are considered unsatisfactory and the laboratory should actively investigate the cause of the discrepancy. The Z-scores for each component are also averaged over the three samples to further clarify the laboratory's performance represented by its accumulated deviation from the expected mean.

The analysis of performance for **other seed determination** is based on a retrieval and identification rate of the added seeds. The performance in OSD is reported as percentage of retrieved and identified seeds to genus level of seeds added to a round's sample. The relative difficulty of retrieving a species from the sample under test is taken into account as explained below.

12 The Rating System

The laboratory is given an in-round rating for every particular test meaning that the laboratory is given an in-round rating for germination, for purity, for OSD, for moisture, and for tetrazolium

testing. In addition, each test has an overall rating derived from the performance over six rounds. A laboratory may have an overall A for germination but an overall BMP for OSD for instance.

12.1 The In-Round Rating for Purity, Germination, Moisture, and Tetrazolium

The in-round rating system for purity, germination, moisture, and tetrazolium is based on the sum of absolute Z-scores. Only normal seedlings and pure seeds are taken into consideration for germination and purity. Z-scores for abnormal seedlings and ungerminated seeds are also reported but do not affect the in-round rating. A, B, C and BMP ratings are given. The in-round rating system for these tests is shown in Table 1.

Table 1: In-round rating system for purity, germination, moisture, and tetrazolium

Score	Sum of absolute Z-scores
A	Sum of absolute Z-scores $\leq$ 3.5
B	3.5 < Sum of absolute Z-scores $\leq$ 5.3
C	5.3 < Sum of absolute Z-scores ≤ 7.0
BMP	Sum of absolute Z-scores > 7.0

12.2 The In-Round Rating for Other Seed Determination

The performance in OSD is reported as a percentage of retrieved and identified seeds to genus level of seeds added to a round's sample. Identification to species level is expected. The species names must be reported in accordance with the current version of the ISTA List of Stabilized Plant Names. Synonyms will not be accepted. Samples sent to the participants have not been purified before adding the other seed inclusions. Therefore, seeds other than those that were added can also be found but they are not considered in the rating.

The in-round rating is based on the actual retrieval rate of a distinct species. The percentage of retrieved seeds for each species among all participants is calculated (Table 2). Based on the actual retrieval rate, a factor is assigned to each added species to take the relative difficulty into account. This factor is multiplied by the total number of seeds added for this species. Then the factor is multiplied by the number of seeds found by the laboratory. The percentage of retrieved and identified seeds determine the in-round rating.

The thresholds for assigning a factor are given in Table 2.

Table 2: Thresholds defining the factor assigned to each species based on the actual retrieval rate of all seeds added of a distinct species

Retrieval rate [%]	Assigned factor
≥90	3
≥85	2
<85	1

The thresholds for the OSD ratings are given in Table 3.

Table 3: In-round rating for OSD based on retrieval and identification rate

In-round rating	Percentage of retrieved and identified seeds
A	≥ 90.0
B	≥ 80.0
C	≥ 70.0
BMP	< 70.0

An example for this rating system is presented in Table 4.

Table 4: Example laboratory results (Test round 04-1 B.nap, *Brassica napus*)

Species	# of seeds added	Retrieval rate [%]*	Factor	# of seeds found	# of seeds added x factor	# of seeds found x factor
Galeopsis tetrahit	2	88	2	2	4	4
Galium aparine	3	93	3	3	9	9
Sinapis alba	4	83	1	4	4	4
Chenopodium sp.	3	84	1	3	3	3
Polygonum aviculare	3	91	3	3	9	9
Sinapis arvensis	3	61	1	3	3	3
Lotus corniculatus	4	72	1	0	4	0
Raphanus sativus	4	81	1	4	4	4
Thlaspi arvense	2	79	1	0	2	0
Sum	**28**			**22**	**42**	**36**
Percentage						**86**
In-round rating						**B**

* The retrieval rate [%] is the mean for all participants

12.3 The Overall Rating

The determination of the overall rating is the same for all tests to have a uniform system that can be applied for all tests once the in-round rating system is defined. Numerical values are attributed to the different in-round ratings. The values are then added for each test over the last six rounds as given in Table 5.

Table 5: Overall rating for all tests based on the in-round ratings over the last six rounds

In-round rating	Attributed value
A	5
B	4
C	3
BMP	0

Range	Overall rating
28-30	A
21-27	B
16-20	C
below 16	BMP

13 Reporting In-Round Results

Shortly after the deadline for reporting the analysis results, preliminary results are published on the ISTA website. Participants are notified by email that the provisional results have been published.

The results represent the mean of the ten results obtained by the PT leader when testing the seed lots for heterogeneity. Pictures of other seed inclusions and seedlings may also be provided.

The laboratory will receive a report sheet for each test component with graphical print-outs of the computer programme, together with the in-round rating for that particular round. The laboratory will receive provisional results, printed on blue paper. The laboratory is requested to check that the transcriptions of the preliminary test results are correct. In case of any transcription errors, the laboratory shall notify the Secretariat within four weeks after receipt of the results.

14 Reporting Overall Rating

On the report sheets, the overall rating for each test will also be indicated. A laboratory that is given an overall C will receive an alert as the laboratory runs the risk of receiving an overall BMP if the level of performance does not increase. A laboratory that is scored with an overall BMP will be suspended from accreditation for that test, subject to the regulations of the Association.

15 Corrective Action

Based on the performance reported on the report sheet, the laboratory is expected to use all the information provided and carry out self initiated investigations and developing a corrective action plan to remedy any discovered problems. This action plan could include a request for help from the Secretariat or the test leader. The corrective action taken will be assessed by the ISTA auditors at the time of the next audit or earlier if deemed necessary.

16 Appendix I Crop group list

Group	Size	Representative species*	Species**
1 (grasses)	A	*Poa, Dactylis*	*Poa pratensis, Poa trivialis, Dactylis*
	B		*Agrostis, Anthoxanthum, Crambe, Cynodon, Cynosurus, Deschampsia, Eragrostis, Holcus, Phleum, Poa,Schizachyrium*
	C	*Festuca, Lolium*	*Agropyron, Alopecurus, Arrhenatherum, Beckmannia, Bromus, Ehrharta, Elymus, Elytrigia, Festuca, X Festulolium, Koeleria, Lolium, Pascopyrum, Phalaris, Piptatherum, Psathyrostachys, Pseudoroegneria, Trisetum, Zoysia*
	D	*Andropogon*	*Andropogon, Astrebla, Bothriochloa, Bouteloua, Cenchrus, Chloris, Dichanthium, Pennisetum, Sorghastrum*
	E	*Panicum*	*Axonopus, Brachiaria, Digitaria, Echinochloa, Eleusine, Melinis, Panicum, Paspalum, Pennisetum glaucum, Setaria, Urochloa*
2 (cereals)	A	*Avena, Triticum*	*Avena, Hordeum, Secale, Triticosecale, Triticum*
	B	*Zea*	*Oryza, Sorghum, Zea*
3 (small legumes)	A	*Trifolium, Medicago*	*Aeschynomene, Alysicarpus, Anthyllis, Astragalus, Calopagonium, Centrosema, Chamaecrista, Coronilla, Crotalaria, Desmodium, Galega, Hedysarum, Kummerowia , Lespedeza, Leucaena, Lotus, Lotonis, Macroptilium, Macrotyloma, Medicago, Melilotus, Neonotania, Onobrychis, Ornithopus, Securigera, Trifolium, Trigonella*
4 (pulses)	A	*Vicia*	*Vicia (small)*
	B	*Pisum*	*Cajanus, Cicer, Lathyrus, Lens,), Mucuna, Phaseolus coccineus, Pisum, Psophocarpus, Vicia (large)*
	C	*Glycine, Phaseolus*	*Arachis, Cyamopsis, Glycine, Lablab, Lupinus, Phaseolus, Pueraria, Vigna*
5 (other agricultural species)	A	*Beta, Brassica ,Linum*	*Beta, Brassica, Dichondra, Hibiscus, Linum, Plantago, Sinapis,Spergula, Raphanus*
	B	*Helianthus*	*Cannabis, Carthamus, Fagopyrum, Helianthus*
6 (vegetables, including fruits, spices and condiments)	A	*Daucus, Lactuca, Lycopersicon*	*Achillea, Anethum, Anthriscus, Apium, Arctium, Atriplex, Atropa, Camelina, Campanula, Carum, Chrysanthemum, Cichorium, Claytonia, Cuminum, Daucus, Eruca, Fragaria, , Lactuca, Lepidium, Lycopersicon, Lycopersicon hybrids, Marrubium, Matricaria, Melissa, Mentha, Nasturtium, Nicotiana, Ocimum, Oenothera, Origanum, Papaver, Petroselinum, Phacelia, Physalis, Pimpinella, Portulaca, Rheum, Rosmarinus, Rumex, Satureja, Sesamum, Stylosanthes, Taraxacum, Thymus, Valerianella*
	B	*Allium, Capsicum, Raphanus*	*Allium, Asparagus, Capsicum, Corchorus, Coriandrum, Cynara, Foeniculum, , Pastinaca, Raphanus, Sanguisorba, Scorzonera, Solanum, Spinacia, Tragopogon*
	C	*Cucumis, Cucurbita*	*Abelmoschus, Borago, Cucumis, Cucurbita, Cucurbita hybrids, Citrullus, Gossypium, Ipomoea, Lagenaria, Luffa, Momordica, Ricinus, Tetragonia*
7 (forest species)			See Table 2A, Part 2
8 (flower species)			See Table 2A, Part 3

* Representative species = species that represents genera in column 3 or 4 of this table are therefore are likely to be used for the PT.

** Genera represented in the ISTA Rules = genera listed in this column are the genera in the ISTA Rules Table 2A Part I and III that are represented by the species of the genera indicated in column 3.

17 Appendix II ISTA Proficiency Test Programme Plan 2011-2013

Round #	Dispatch Date	Crop group	Species	Test round scope*
11-1 H.ann	February 2011	5	*Helianthus annuus*	P, OSD, G
11-1 L.odo	February 2011	8	*Lathyrus odoratus*	G
11-2 T.aes	June 2011	2	*Triticum aestivum*	P, OSD, G, M, TZ, OIC
11-3 T.pra	October 2011	3	Trifolium *pratense*	P, OSD, G
12-1 S.bic	February 2012	2	*Sorghum bicolor*	P, OSD, G, TZ
12-2 P.pra	June 2012	1	*Phleum pratense*	P, OSD, G, M
12-2 P.sat	June 2012	4	*Pisum sativum*	V
12-3 L.sat	October 2012	6	*Lactuca sativa*	P, OSD, G, OIC
13-1 P.can	February 2013	1	*Phalaris canariensis*	P, OSD, G, M
13-2 P.sat	June 2013	4	*Pisum sativum*	G
13-3 B.nap	October 2013	5	*Brassica napus*	P, OSD, G, M, TZ

* P=Purity, G=Germination, OSD=Other Seed Determination, M=Moisture, TZ=Tetrazolium, OIC=reporting on an Orange International Seed Lot Certificate, V=vigour

18 Appendix III Examples of Basic Reporting Errors

Purity and OSD

- Original working sample weight and/or total weight of components is not reported;
- The sum of the weights of all the components does not correspond to the total weight of the components reported due to calculation or typing error;
- The weighing, calculation and expression of results is not in accordance with the ISTA Rules;
- Name and/or number of seeds of other species found are not reported;
- Mixing up the reporting of components between the three lots, e.g. reporting the weight of other seeds for Lot 1 in the Lot 2 position on the report form;
- Botanical names are misspelled or do not follow the nomenclature of the ISTA List of Stabilized Plant Names;

Germination

- The sum of the percentage of all categories (normal seedlings, abnormal seedlings, etc.) reported is not 100 % per replicate (calculating or reporting error);
- The specifications under “Preferred ISTA Method Used” are not reported;
- The range for the 100 seed replicates exceeds the maximum tolerated range and no re-test is initiated;
- Unexpected occurrence of fresh seeds and/or hard seeds reported in the species;
- No indication that a viability test was carried out as required by the ISTA Rules when 5 % or more fresh seeds are reported;
- Mixing up the reporting of components between the three lots, e.g. reporting the abnormals for Lot 1 in the Lot 2 position;

Moisture

- Mean results are reported to two decimal places instead of one;
- The test results of the two replicates exceed the range of 0.2 % difference and no re-test has been initiated;
- The results of the replicates are not reported;
- Mean results are not reported;

Tetrazolium

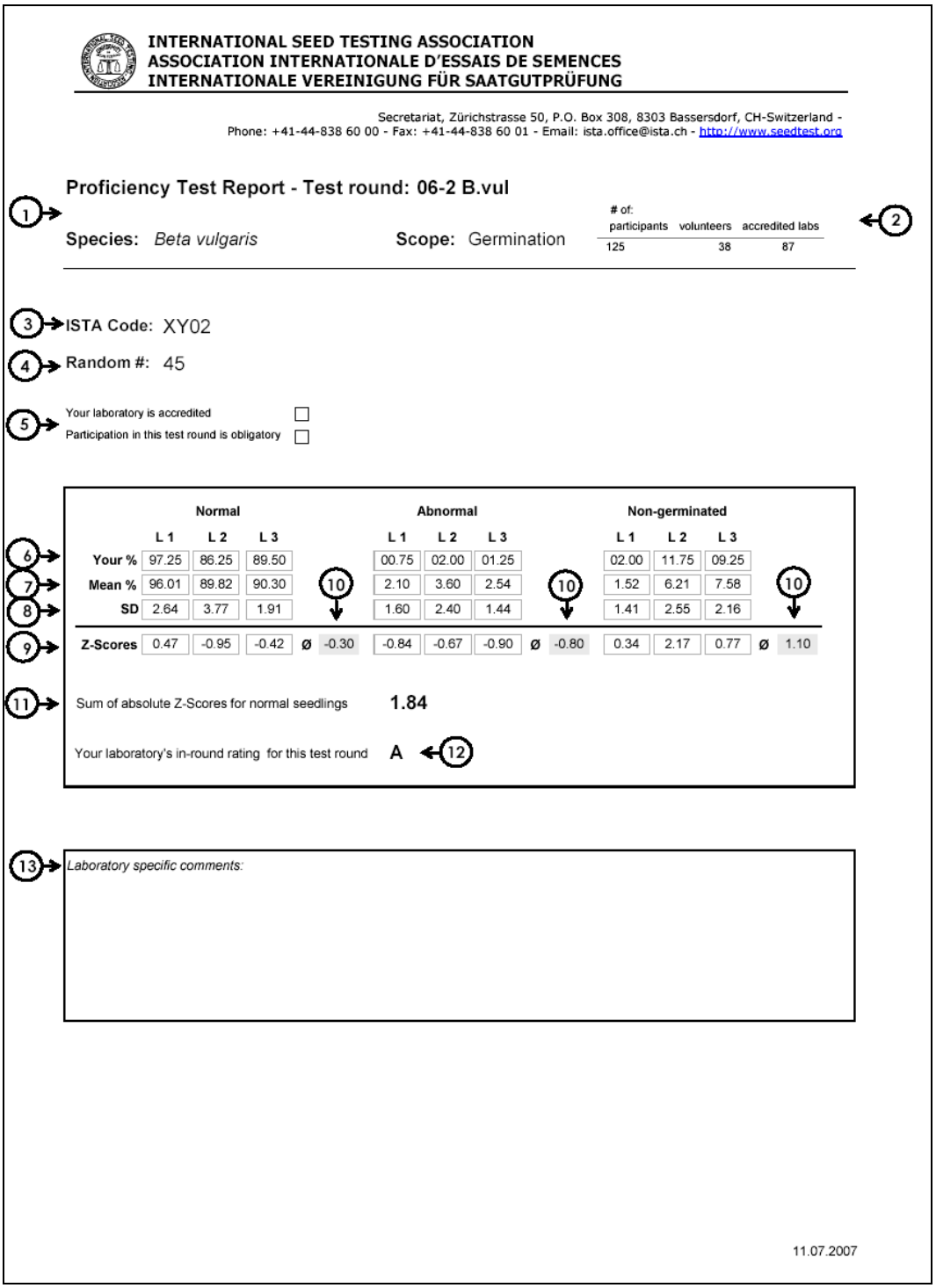
- Reporting of the mean not to the nearest whole number;
- The range for the 100 seed replicates exceeds the maximum tolerated range and no re-test is initiated;
- The specifications regarding the method used are missing.

19 Appendix IV Explanation and Interpretation of PT Report Sheets

(please refer to the explanations corresponding to the numbers)

Examples are given for germination and OSD. This reporting principle is followed in other tests.

19.1 Germination, Purity, Moisture and Tetrazolium



INTERNATIONAL SEED TESTING ASSOCIATION
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Proficiency Test Report - Test round: 06-2 B.vul

(1) **Species:** *Beta vulgaris* **Scope:** Germination

# of: participants	volunteers	accredited labs
125	38	87

(2)

(3) ISTA Code: XY02

(4) Random #: 45

(5) Your laboratory is accredited ☐
Participation in this test round is obligatory ☐

	Normal				Abnormal				Non-germinated			
	L 1	L 2	L 3		L 1	L 2	L 3		L 1	L 2	L 3	
(6) Your %	97.25	86.25	89.50		00.75	02.00	01.25		02.00	11.75	09.25	
(7) Mean %	96.01	89.82	90.30	(10)	2.10	3.60	2.54	(10)	1.52	6.21	7.58	(10)
(8) SD	2.64	3.77	1.91		1.60	2.40	1.44		1.41	2.55	2.16	
(9) Z-Scores	0.47	-0.95	-0.42	Ø -0.30	-0.84	-0.67	-0.90	Ø -0.80	0.34	2.17	0.77	Ø 1.10

(11) Sum of absolute Z-Scores for normal seedlings **1.84**

Your laboratory's in-round rating for this test round **A** (12)

(13) *Laboratory specific comments:*

11.07.2007

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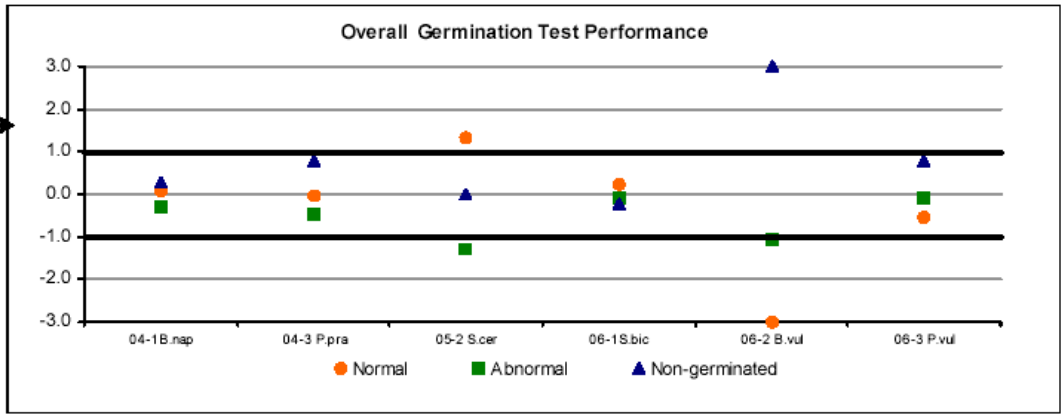
Overview - PT Overall Performance (Germination)

ISTA lab code	PT test round	Accredited?*	Volunteer**	Obligatory	Rating
XY01					
	04-1 B.nap	☐	◉	○	A
	04-3 P.pra	☐	◉	○	A
(14) →	05-2 S.cer	☑	○	◉	B
	06-1 S.bic	☑	○	◉	A
	06-2 B.vul	☑	◉	○	BMP
	06-3 P.vul	☑	○	◉	A

(15) → **Overall rating*****

Total sum of ratings****	14
Number of rounds	3
Overall rating	

(16) →



* Refers to the laboratory's status at the time of sample dispatch.

** Depending on the laboratory's scope of accreditation, participation may be voluntary in spite of existing accreditation

*** An overall rating will only be given after a minimum of six test rounds for which participation was mandatory. Rounds which were not mandatory are not include in the calculation of the overall rating.

**** Values attributed to each in-round score are given in PT-G-01-ISTA Proficiency Test Programme.

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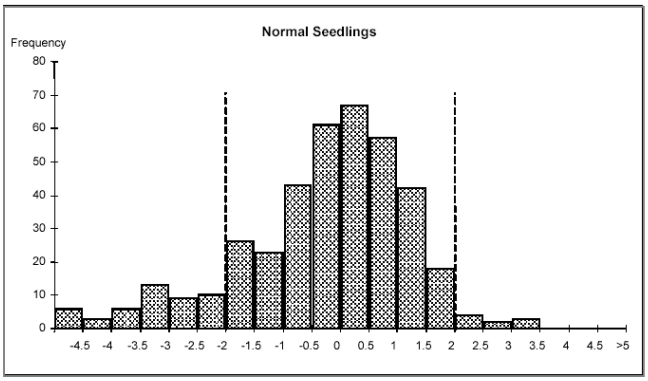
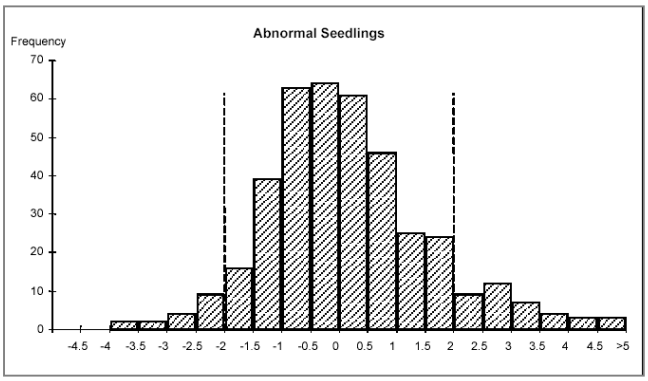
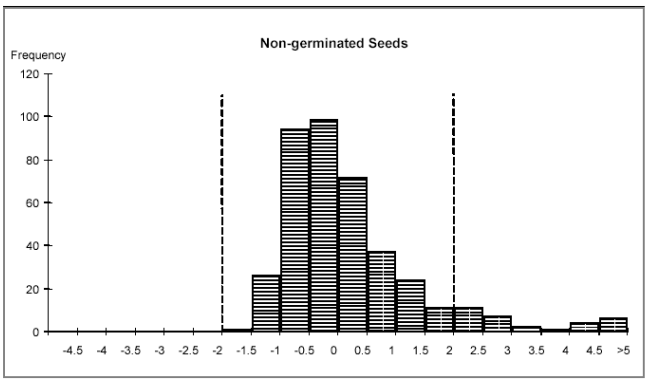
Proficiency Test Report – Test Round 04-2 H.ann

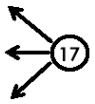
Species: *Helianthus annuus* **Scope:** Germination

The following histograms show the frequency distributions of all participants Z-Scores for the relevant components, i.e. **Normal** and **Abnormal Seedlings** and **Non-germinated Seeds**. The Z-Scores from all three samples are included in each histogram. For further explanations, please refer to Appendix IV of the document 'The ISTA Proficiency Test Programme'.









The numbers in the following explanations refer to the circled numbers on the example report pages. The example is for germination, but the same explanations also apply for other tests.

1. Identifies the PT round being reported.
2. The number of participants having returned results for this round distinguished in total number of participants, number of volunteers, and number of accredited laboratories. Only results from the accredited laboratories are used in calculation of the overall mean and standard deviation (see notes # 7 and 8).

3. The ISTA member laboratory code, identifying the laboratory to which this report applies.
4. The random number assigned to the samples analysed by this laboratory. The laboratory receives three samples for the round, each with the same number. The number has no significance for the laboratory, but the Secretariat is able to use it to track the samples.
5. Indicates whether the laboratory is holding accreditation and whether participation is mandatory because the test is included in the scope of accreditation, or voluntary because the test is not part of the laboratory's scope of accreditation. This is important for the calculation of the laboratory's overall rating.
6. The mean of the results of the replicates submitted by the laboratory for each of the three samples (L1, L2 and L3). There is a result for each attribute in the test, e.g. percentage normal, abnormal seedlings and non-germinated seeds for germination, or percentage pure seeds, inert matter and other seeds for purity. It is important that the laboratory compares these figures with the figures submitted, as a double check against transcription error. Any error noted should be reported immediately to the Secretariat. Note that dead, hard, and fresh seeds are combined into one category 'non-germinated' for this purpose. However, laboratories are requested to report dead, hard and fresh as appropriate to assist in identifying the cause of deviating results.
7. The overall mean, calculated using only the accredited lab results and only after outliers have been excluded. Outliers are results which are significantly different from most other results and if included in the calculations would distort the overall mean and standard deviation.
8. The standard deviation, calculated using data as described under note # 7. The standard deviation is a measure of how widely values are dispersed from the mean. A very low standard deviation indicates most labs reported results quite close to the mean. A large standard deviation indicates more variation among labs.
9. Z-scores, also known as normalized scores. Use of Z-scores allows results from unrelated samples to be combined. They are calculated by subtracting the overall (x) mean from the laboratory's mean (x_i) and dividing by the standard deviation (s), i.e. $Z_i = (x_i – x)/s$. The further a laboratory's result is from the overall mean, the larger the Z-score will be. A Z-score of 0.00 is obtained when the laboratory's result exactly equals the overall mean. A negative Z-score indicates the result was lower than the overall mean while a positive result indicates it was higher. Individual Z-scores between 2.00 and 2.68 (or –2.00 and –2.68) indicate a possible problem which the laboratory should investigate. Results greater than 2.68 are considered unsatisfactory and the laboratory should actively investigate the cause of the discrepancy.
10. The average Z-score for each attribute. This is a measure of bias. An average Z-score of 0.0 indicates no bias. A high positive value indicates a bias towards high results for this attribute while a high negative value indicates a bias towards low results for this attribute. These values are plotted in the chart described in note # 14.
11. The total sum of absolute Z-scores for normal seedlings (or pure seeds) determine the in-round rating.
12. The rating achieved by the laboratory for this round. The rating is calculated using the Z-scores from the normal seedlings when germination is tested and pure seed when purity is tested. There is no linkage between tests, i.e. the rating for a germination test has no effect on the rating of the purity test. The calculation method for in-round ratings is described in Section 12.1 of this document.
13. Comments on items on which the laboratory is requested to pay attention. This will normally be empty if the laboratory did not experience any testing difficulties.
14. The in-round ratings for previous rounds. A missing rating indicates the laboratory did not participate in the indicated round. This might occur, for example, with non-accredited laboratories which do not volunteer to participate in all rounds, or for accredited laboratories when the crop group represented in the round was not in the laboratory's scope of accreditation.

15. The overall rating based on the last six rounds' results for the test being reported. The calculation method for the overall rating is described in Section 12.3 of this document. A rating of 'C' is a warning that there is a potentially serious testing problem which the laboratory should immediately investigate. A rating of 'BMP' is unsatisfactory and the laboratory will be subject to suspension of their accreditation for this test.
16. Chart plotting the average Z-scores for each attribute (see note # 10) over time. Values below -3 and above +3 are represented as ± 3 at the border line of the chart. The test rounds are indicated on the x-axis by the test round code. The average Z-scores are expected to be randomly distributed over time as positive and negative values above and below the zero line. The results should also fall between ± 1 most of the time. If the results are dispersed over a wide range the laboratory should investigate why this is occurring and take corrective action, as it indicates the laboratory may not be in an adequate state of readiness to perform analyses according to ISTA Rules.
17. Histograms of the frequency distribution of Z-scores. For each attribute (e.g. normal seedlings, abnormal seedlings, non-germinated seeds) the three Z-scores for all participants are plotted on one chart. Each laboratory can compare its performance to the overall by noting their Z-scores (see note # 9) and observing their location on the x-axis of the histogram.

19.2 Other Seed Determination

INTERNATIONAL SEED TESTING ASSOCIATION
ASSOCIATION INTERNATIONALE D'ESSAIS DE SEMENCES
INTERNATIONALE VEREINIGUNG FÜR SAATGUTPRÜFUNG

Secretariat, Zürichstrasse 50, P.O. Box 308, 8303 Bassersdorf, CH-Switzerland -
Phone: +41-44-838 60 00 - Fax: +41-44-838 60 01 - Email: ista.office@ista.ch - http://www.seedtest.org

(1) **Proficiency Test Report - Test round: 06-2 B.vul**

Species: *Beta vulgaris* **Scope:** Other Seed Determination

(2) **ISTA Code:** **Random #:** 151

This laboratory is accredited ☑
Participation in this test round is obligatory ☑

(3)

Lot #	Species name	# seeds added	Retrieval rate [%]	Factor	# seeds found	# seeds added x factor	# seeds found x factor	Misspelled?	Correct Species?	Correct Genus?	Different Species?
Lot 1											
	Helianthus annuus	4	92.7	3	4	12	12	◉	◉	○	○
	Triticum aestivum	3	98.3	3	3	9	9	○	○	○	◉
	Medicago sativa	2	85.4	2	0	4	0	○	○	○	○
Lot 2											
	Avena sativa	4	96.0	3	4	12	12	○	◉	○	○
	Polygonum convolvulus	3	76.4	1	3	3	3	○	◉	○	○
	Convolvulus arvensis	2	91.7	3	1	6	3	○	◉	○	○
Lot 3											
	Daucus carota	4	89.4	2	4	8	8	○	◉	○	○
	Hordeum vulgare	3	98.1	3	3	9	9	◉	◉	○	○
	Cichorium intybus	2	87.5	2	2	4	4	○	○	○	◉

(4) **Sum 27** **24** **67** **60** **Percentage 89.6%**

(5) **In-round rating: B**

Additional seeds found and reported by the laboratory

(6)

Lot #	Species name	# of seeds	Misspelled?
Lot 1			
	Trifolium spp.	2	○
Lot 3			
	Beta spp.	3	○
	Calystegia sepium	1	○

(7) Your laboratory's in-round ratings over the last test rounds

03-1 T.inc	03-3 L.esc	04-1 B.nap	05-2 S.cer	06-1 S.bic	06-2 B.vul
B	B	B	BMP	A	B

Your laboratory's overall rating*

Total sum of ratings****	21
Number of rounds	6
Overall rating	B

(8)

* An overall rating will only be given after a minimum of six test rounds for which participation was mandatory. Rounds which were not mandatory are not included in the calculation of the overall rating.

**** Values attributed to each in-round score are given in PT-G-01-ISTA Proficiency Test Programm

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1. Identifies the PT round being reported.
2. The ISTA member laboratory code, identifying the laboratory to which this report applies and the random number assigned to the samples analysed by this laboratory. The laboratory receives three samples for the round, each with the same random number. The number is used by the Secretariat to track the samples. An indication whether the laboratory is accredited and whether participation is obligatory because of the scope of accreditation is given.
3. Names of the species that the test leader added to the seed samples;

   The number of seeds added ('# seeds added') per species, the retrieval rate ('Retrieval rate [%]') based on the total number of seeds found by all participants and the number of seeds reported ('# seeds found') by the laboratory;

   The factor ('Factor') which is multiplied by the number of seeds added and the number of seeds found (i.e. '# seeds added x score' and '# seeds found x score') based on the retrieval rate.

   Misspellings under 'Misspelled?';

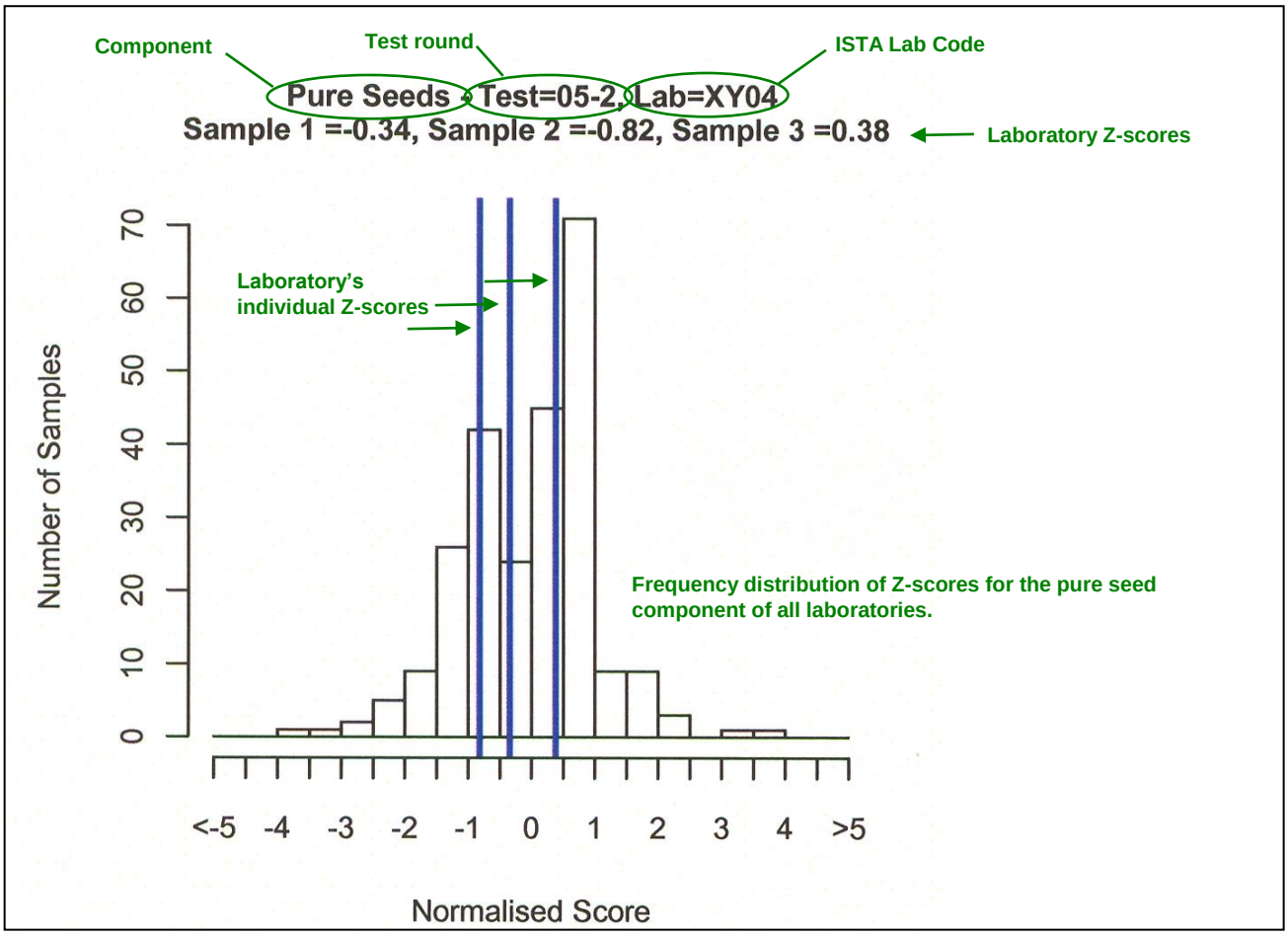
   There are three different levels of identification which are all counted as reported correctly:

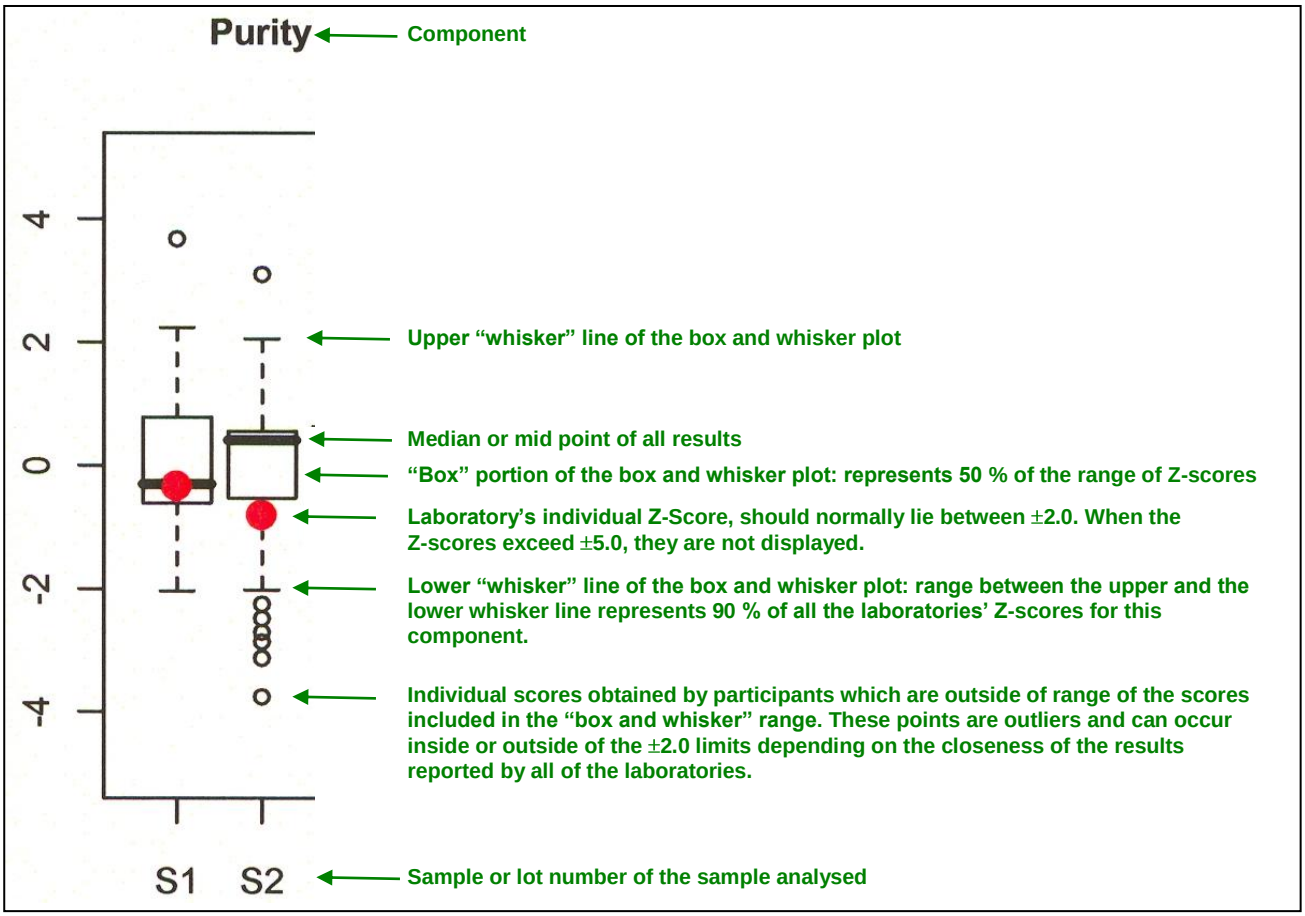
   'Correct species?': Species reported correctly to species level
   'Correct Genus?': Species reported correctly to genus level
   'Different Species?': Correct genus but wrong species.
4. Total sum of seeds added and seeds found;

   The total sum of seeds found and seeds added multiplied by the factor;

   The percentage of '# seeds added x factor' and '# seeds found x factor' are the basis for the in-round rating.
5. The laboratory's in-round rating for this round.
6. Name and number of seeds that were reported but do not belong to the species that were added by the test leader. Additional species may also be species that were added but the number of seeds found exceeds the number of seeds added. Additional seeds found might also be species that were added but misclassified.
7. The laboratory's in-round ratings of previous rounds.
8. The laboratory's overall rating after six test rounds of participation.

19.3 Explanation and Interpretation of Purity Histogram Report Sheets





20 Appendix V Examples for In-round Ratings for Germination

	Normal			Abnormal			Non-germinated		
	L1	**L2**	**L3**	**L1**	**L2**	**L3**	**L1**	**L2**	**L3**
Your %	87.0	78.3	89.5	10.0	17.0	5.75	3.00	4.75	4.75
Mean %	84.7	77.6	89.3	11.0	16.6	7.34	3.93	5.44	3.62
Z-scores	**0.5**	**0.1**	**0.1**	**-0.2**	**0.1**	**-0.5**	**-0.6**	**-0.3**	**0.7**
Σ of absolute Z-scores			**0.7**			**0.8**			**1.6**

✓ **Sum of absolute Z-scores for normal seedlings ≤ 3.5**

⇒ **In-round: A**

	Normal			Abnormal			Non-germinated		
	L1	**L2**	**L3**	**L1**	**L2**	**L3**	**L1**	**L2**	**L3**
Your %	90.75	90.00	86.75	7.75	9.75	11.00	1.5	0.25	2.25
Mean %	93.23	94.46	89.35	4.25	4.76	9.12	2.38	0.83	1.53
Z-scores	**-1.51**	**-2.12**	**-0.87**	**2.34**	**2.58**	**0.63**	**-0.93**	**-0.78**	**1.09**
Σ of absolute Z-scores			**4.5**			**5.55**			**2.80**

✓ **3.5< Sum of absolute Z-scores for normal seedlings ≤ 5.3**

⇒ **In-round: B**

	Normal			Abnormal			Non-germinated		
	L1	**L2**	**L3**	**L1**	**L2**	**L3**	**L1**	**L2**	**L3**
Your %	89.25	89.50	86.75	4.25	4.76	9.12	2.38	0.83	1.53
Mean %	93.23	94.46	89.35	4.25	4.76	9.12	2.38	0.83	1.53
Z-scores	**-2.42**	**-2.36**	**-0.87**	**1.84**	**2.71**	**0.79**	**1.47**	**-0.44**	**0.33**
Σ of absolute Z-scores			**5.65**			**5.34**			**2.24**

✓ **5.3< Sum of absolute Z-scores for normal seedlings ≤7.0**

⇒ **In-round: C**

	Normal			Abnormal			Non-germinated		
	L1	**L2**	**L3**	**L1**	**L2**	**L3**	**L1**	**L2**	**L3**
Your %	85.75	88.00	90.75	12.50	10.25	8.75	2.38	0.83	1.53
Mean %	93.23	94.46	89.35	4.25	4.76	9.12	2.38	0.83	1.53
Z-scores	**-4.55**	**-3.07**	**0.47**	**5.51**	**2.84**	**-0.12**	**-0.67**	**1.24**	**-1.56**
Σ of absolute Z-scores			**8.09**			**8.47**			**3.47**

✓ **Sum of absolute Z-scores for normal seedlings >7.0**

⇒ **In-round: BMP**