Proposal for Amendments to the Criteria for Auto Proportioning Additional Specimens of Total Alkali-insoluble Impurities in Appendix F of IWTO-19 (2024)

By
Henry Wang

Australian Wool Testing Authority Ltd 24 Robertson Street, Kensington, Vic 3031, Australia

INTRODUCTION

The use of the auto proportioning additional specimens is allowed in Appendix F of IWTO-19 for Total Alkaline Insoluble Impurities (TAI) samples no greater than 2.0 g (IWTO-19, 2024). The limit of 2.0g was proposed by NZWTA in 1987 (Austin, D., 1987) and endorsed by S.U.L.'s laboratory, Uruguay in 1987 (Camiou, H., 1987). However, both reports did not provide tested data to support the establishment of the 2.0g limit. It is assumed that both laboratories mainly tested wools of low TAI content at that time. This has left an open question to be answered, which is "can the method of auto proportioning be used for TAI samples greater than 2.0g?"

According to statistical randomness, the larger the quantity of a component within a material mix, the more uniform the distribution of that component throughout the total volume (Axe, 1995). Therefore, the higher the sample TAI content, the more uniform the weight of TAI will be between subsamples. In practice, a high pass rate of the Wool Base range check further supports the similarity among the subsamples.

This report investigates the feasibility of using the auto proportioning method on TAI samples that weigh more than 2g, particularly when using HSI (hyper-spectral imaging) for testing.

MATERIALS AND TRIALS

Three batches of QC data (i.e. using both the manual dissection and the HSI result) were used in this report: two QC trials conducted at AWTA Melbourne laboratory in April 2025 and one at AWTA Fremantle laboratory in May 2025. The limit of TAI mass was set to be 6.0 g. The samples tested at the Melbourne Lab were randomly selected from the seasonal tests, while all daily tests were used at the Fremantle Lab due to lower testing volume there at the time. In total 449 samples were tested by HSI-01 and HSI-02 at the Melbourne Lab and 243 by HSI-03 and HSI 04 at the Fremantle Lab. The ranges of TAI mass, TAI%, VM% (Vegetable Matter), WB% (Wool Base) and VMB% (VM Base) are summarised in Table 1.

A pseudo auto proportioning step was then performed using the criteria established in this report, by using the tested Sub A proportions the additional subsamples, such as Sub B and/or Sub C. IWTO-0 was then used to assess equivalence between the tested versus combined tested Sub A and Auto-Proportioned Subs B/C / (B & C). The data setup is:

Control:	Combined actual tested values for all subsamples – No proportioning
Treatment:	Combined tested Sub A with auto-proportioned subsamples B/C / (B & C).

Table 1. Ranges of QC samples tested at Mel and Fre Labs

Lab	Statistics	TAI Mass (g)	TAI (%)	VM (%)	WB (%)	VMB (%)
Mel	**Mean**	1.073	3.119	2.989	58.348	1.809
	SD	1.172	3.889	3.892	8.348	2.487
	Min	0.061	0.186	0.123	40.290	0.083
	Max	5.978	18.042	18.042	70.390	12.168
Fre	**Mean**	1.112	3.340	3.187	54.055	1.805
	SD	0.725	2.207	2.213	4.612	1.199
	Min	0.119	0.345	0.228	40.74	0.152
	Max	4.278	16.815	16.71	65.06	8.755

Note: Mel is short for Melbourne Laboratory and Fre for Fremantle Laboratory

Because the HSI QC trials were mainly focused on Grower lots which used two subsamples and had a mass limit set, the data in August 2025 were downloaded to complement the analysis. The data contained 15,937 tests, of which 2,074 were Bulkclassed or Interlots that required three subsamples to be tested. This extra batch of data was also used for analysing the mass equivalence among the subs in a much broader range.

RESULTS AND DISCUSSIONS

Establishment of pre-conditions for auto-proportioning

Equivalence in TAI mass among the subsamples

Based on the requirement for subsamples, TAI mass of all subsamples should be equivalent prior to the auto-proportioning. Equivalence of the TAI mass between the subsamples was checked using IWTO-0 method for the August 2025 data. The data setup is:

Control: TAI mass of Sub A

Treatment: TAI mass of Sub B or Sub C

Figure 1 shows the results for Grower lots for Sub A vs Sub B. Figure 2 & Figure 3 show the results of Bulkclassed and Interlots, respectively for Sub A vs Sub B and Sub A vs Sub C.

IWTO-0 Analysis

Description TAI mass: Sub B vs Sub A

A: Test for Overall Relative Bias & Paired t-test.

	Overall Bias		Paired t-test	
	Control	Treatment		
Number	13863	13863	13863	
Average	1.7413	1.7527	0.0114	SDDV
SD	2.1281	2.1329	0.3538	20.32
SE	0.0181	0.0181	0.0030	
t value	96.3402	96.7555	3.8045	
p value	0.0000	0.0000	0.0001	
Significance			***	

Print Results

B: Test for Correlation.

Number	13863
DF	13861
R	0.9862
t-value	701.7305
p-value	0.0000
Significance	***

Legend : Statistical Significance

GOOD
WORSE

- NS Not Significant
- * Significant at 5% level
- ** Significant at 1% level
- *** Significant at 0.1% level

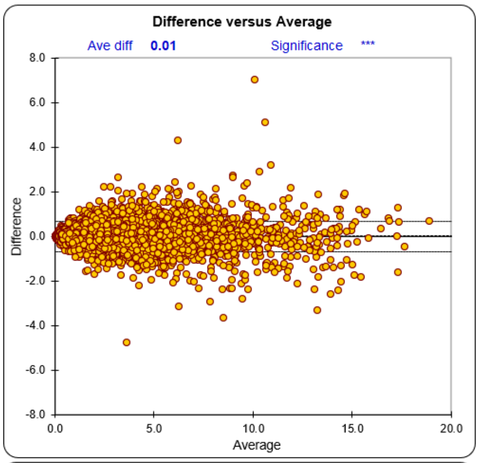
C: Test for Level Dependent "Bias".

Regression	Slope	Significance	SE of Slope	t-Value	p-value	Rsq
GM	1.0022	NS	0.0014	1.5936	0.1111	0.9726
DVA	0.0023	NS	0.0014	1.5954	0.1107	
Intercept(GM)	0.0075					STEYX
Intercept(DVA)	0.0075					0.3521

Magnitude of Level Dependant "Bias"

Nominal	Calculated	Avg. "Bias"
0	0.01	0.01
4	4.02	0.02
8	8.03	0.03
12	12.03	0.03
16	16.04	0.04
20	20.05	0.05

Comments



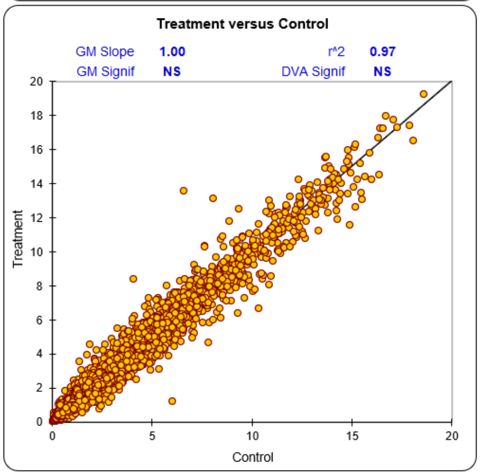


Figure 1. Paired t-test for the TAI mass of Grower lots: Sub A vs Sub B

For grower lots the average difference between Sub A and Sub B was 0.0114g with a s.e. of 0.003g.

IWTO-0 Analysis

Description TAI Mass: Sub A vs Sub B

A: Test for Overall Relative Bias & Paired t-test.

	Overall Bias		Paired t-test	
	Control	Treatment		
Number	2074	2074	2074	
Average	2.5962	2.6337	0.0376	SDDV
SD	2.3003	2.2979	0.5062	19.50
SE	0.0505	0.0505	0.0111	
t value	51.3997	52.1971	3.3796	
p value	0.0000	0.0000	0.0007	
Significance			***	

Print Results

B: Test for Correlation.

Number	2074
DF	2072
R	0.9758
t-value	202.9452
p-value	0.0000
Significance	***

Legend : Statistical Significance

GOOD
NS Not Significant
* Significant at 5% level
** Significant at 1% level
*** Significant at 0.1% level
WORSE

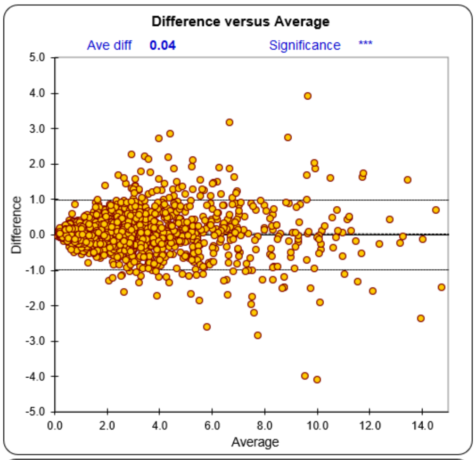
C: Test for Level Dependent "Bias".

Regression	Slope	Significance	SE of Slope	t-Value	p-value	Rsq
GM	0.9990	NS	0.0048	0.2137	0.8308	0.9521
DVA	-0.0010	NS	0.0049	0.2136	0.8309	
Intercept(GM)	0.0402					STEYX
Intercept(DVA)	0.0403					0.5035

Magnitude of Level Dependant "Bias"

Nominal	Calculated	Avg. "Bias"
0	0.04	0.04
3	3.04	0.04
6	6.03	0.03
9	9.03	0.03
12	12.03	0.03
15	15.02	0.02
16	16.02	0.02

Comments



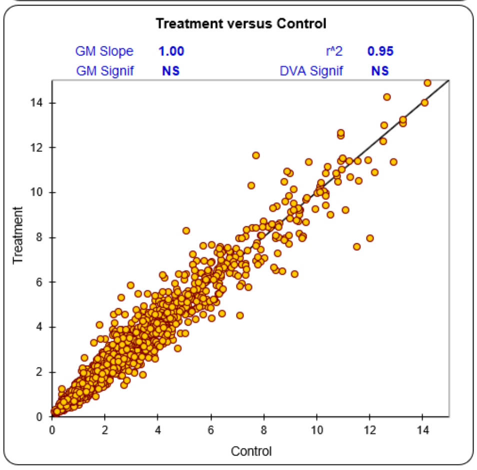


Figure 2. Paired t-test for the TAI mass of Bulkclassed and Interlots: Sub A vs Sub B

For Bulkclassed and Interlots lots the average difference between Sub A and Sub B was 0.0376g with a s.e. of 0.0111g

IWTO-0 Analysis

Description: TAI Mass: Sub A vs Sub C

A: Test for Overall Relative Bias & Paired t-test.

	Overall Bias		Paired	
	Control	Treatment	t-test	
Number	2074	2074	2074	
Average	2.5962	2.6220	**0.0258**	**SDDV**
SD	2.3003	2.3080	0.4734	18.24
SE	0.0505	0.0507	0.0104	
t value	51.3997	51.7374	2.4833	
p value	0.0000	0.0000	0.0131	
Significance			*	

Print Results

B: Test for Correlation.

Number	2074
DF	2072
R	0.9789
t-value	218.0324
p-value	0.0000
Significance	***

Legend : Statistical Significance

GOOD
NS Not Significant
* Significant at 5% level
** Significant at 1% level
*** Significant at 0.1% level
WORSE

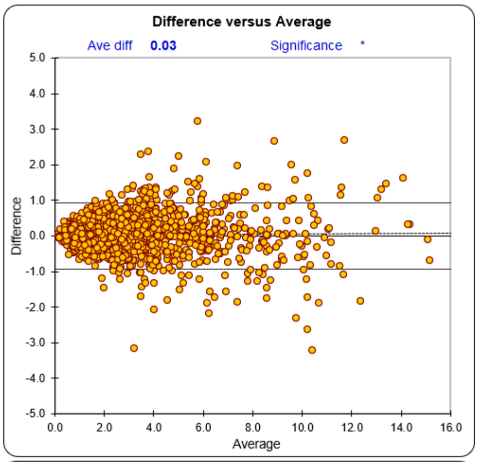
C: Test for Level Dependent "Bias".

Regression	Slope	Significance	SE of Slope	t-Value	p-value	Rsq
GM	**1.0034**	NS	0.0045	0.7443	0.4568	0.9582
DVA	0.0034	NS	0.0045	0.7455	0.4561	
Intercept(GM)	**0.0171**					STEYX
Intercept(DVA)	0.0170					0.4702

Magnitude of Level Dependant "Bias"

Nominal	Calculated	Avg. "Bias"
0	0.02	0.02
3	3.03	0.03
6	6.04	0.04
9	9.05	0.05
12	12.06	0.06
15	15.07	0.07
16	16.07	0.07

Comments



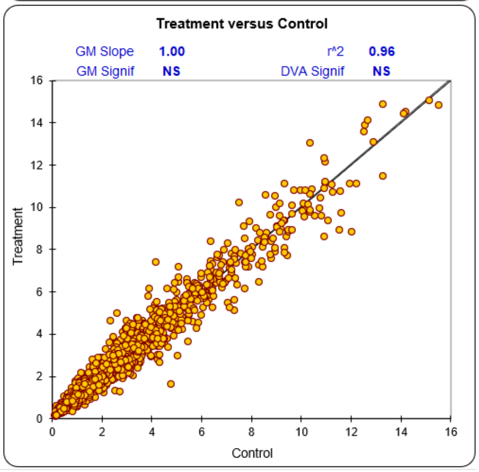


Figure 3. Paired t-test for the TAI mass of bulk and interlots: Sub A vs Sub C

For Bulkclassed and Interlots lots the average difference between Sub A and Sub C was 0.0258g with a s.e. of 0.0104g

The mass differences did not show a level dependence for all types of wools. Based on the standard deviation (SD) of the differences, the 95% confidence limit (95% CL) was ±0.69g for the Grower lots and ±0.99g for the Bulkclassed and Interlots.

Therefore, the auto-proportioning control limit of the difference between Sub A and additional Subs can be conservatively set at **±0.5g** for all types of lots.

Similarity in TAI composition among the subsamples

As required in Appendix F of IWTO-19, TAI composition must be similar prior to the auto-proportioning of any additional Subs. The assessment is done from a visual observation by a trained operator.

In summary, two pre-conditions have been established for the auto-proportioning method in this report:

- The TAI composition must be similar among all subsamples. (current method applied to <=2g TAI weight subsamples as per IWTO Appendix F)
- The difference between the additional Sub TAI mass and the first Sub TAI mass must not exceed ±0.5g.

Equivalence of the WB% and VMB% between the tested and the combined with auto-proportioned values of Grower lots

For the QC-trial data, a pseudo auto-proportion was carried out for additional TAI subs of the tests which met the second and third criteria established. Because the TAI specimens were discarded for all tests, the first criterion, similarity in the composition, was not checked in this report.

Equivalence of WB% and VMB%

A series of IWTO-0 analyses were done to check the equivalence of WB and VMB between the auto-proportioned and the actual HSI or manual tested results against the criteria published in Appendix L of IWTO-19. A summary of the results is listed in Table 2 for overall biases and geometric mean (GM) slopes. The details of the analyses are shown in Appendixes 1 - 5.

Table 2. Overall bias and geometric mean slope for WB and VMB checks

Lab	Certified values	Overall bias			Geometric Mean Slope			Valid tests
		Standard	AutoPro vs HSI Tested	AutoPro vs Manual	Standard	AutoPro vs HSI Tested	AutoPro vs Manual	
Mel: 1st QC trial	WB%	±0.1	0.000	-0.006	0.90-1.10	0.999	0.999	192
	VMB%	±0.1	0.006	0.003	0.90-1.10	1.009	1.016	192
Mel: 2nd QC trial	WB%	±0.1	0.004	0.005	0.90-1.10	1.000	0.998	202
	VMB%	±0.1	-0.010	-0.029	0.90-1.10	1.002	0.995	202
Fre: QC trial	WB%	±0.1	-0.002	-0.048	0.90-1.10	1.001	1.006	217
	VMB%	±0.1	-0.001	0.056	0.90-1.10	1.004	1.031	217
Mel: Tests August 2025	WB%	±0.1	-	-0.001	0.90-1.10	-	1.000	12933
	VMB%	±0.1	-	0.001	0.90-1.10	-	1.001	12933

Note: the 2nd QC trial at the Melbourne Lab used an automate sample spreader. AutoPro: Auto proportion

The overall biases were all much less than ±0.1% and the GM slopes were well within the range 0.90 - 1.10 for both WB% and VMB%, which met the criteria set in Appendix L.

SD of the differences in VMB%

In addition to the overall bias and GM slope, there is a limit required for the SD of the differences at various VMB levels. Table 3 lists the results for the two QC trials at Melbourne,

Table 4 for the trial at Fremantle and Table 5 for the commercial tests in August 2025.

It can be seen from the tables that all SD values met the criteria required, either for comparing to the HSI or to the manual tested values (i.e. reference). As expected, the HSI SD values were much lower than the manual (subjective) values, indicating that the HSI testing system is very reliable and robust for auto proportioning.

Table 3. Standard deviations of differences for QC trials at Melbourne

VMB Range (%)	Maximum Allowable SD of Differences (%)	Mel: 1st QC trial: SD of Differences AutoPro vs			Mel: 2nd QC trial (spreader): SD of Differences AutoPro vs		
		HSI Tested	Manual	Valid tests	HSI Tested	Manual	Valid tests
0.0 - 1.0	0.1	0.045	0.146	88	0.046	0.114	74
1.1 - 4.0	0.2	0.084	0.193	98	0.065	0.181	101
4.1- 8.0	0.3	0.057	0.324	6 (4*)	0.081	0.342	24
>8.0	0.4	NA	NA	NA	0.066	0.346	3

Note: * two outliers excluded in comparison to Manual

Table 4. Standard deviations of differences of VMB for the QC trial at Fremantle

VMB Range (%)	Maximum Allowable SD of Differences (%)	Fre: QC trial: SD of Differences AutoPro vs		
		HSI Tested	Manual	Valid tests
0.0 - 1.0	0.1	0.046	0.135	61
1.1 - 4.0	0.2	0.052	0.195	141
4.1- 8.0	0.3	0.07	0.115	15
>8.0	0.4	NA	NA	NA

Table 5. Standard deviations of differences of VMB for the tests in August at Melbourne

VMB Range (%)	Maximum Allowable SD of Differences (%)	Fre: QC trial: SD of Differences AutoPro vs		
		HSI Tested	Manual	Valid tests
0.0 - 1.0	0.1	-	0.04	4012
1.1 - 4.0	0.2	--	0.08	6324
4.1- 8.0	0.3	-	0.14	1716
>8.0	0.4	-	0.18	881

Equivalence of WB% and VMB% between the tested and the combined with auto-proportioned values of Bulkclassed and Interlots

Similar analyses were carried out for the Bulkclassed and Interlots which used three subsamples. There were 1,401 lots of the 2,074 tests that met the first two criteria for the auto proportioning. The details of IWTO-0 analysis are shown in Appendix 5.

Table 6 shows the equivalence of WB and VMB to the tested values. The overall biases and GM slopes all met the criteria required in Appendix L.

Table 6. Overall bias and geometric mean slope for WB and VMB for Bulk and Interlots

Lab	Certified values	Overall bias		Geometric Mean Slope		Valid tests
		Standard	AutoPro vs Tested	Standard	AutoPro vs Tested	
Mel: Tests August 2025	WB%	±0.1	0.000	0.90-1.10	1.000	1401
	VMB%	±0.1	0.001	0.90-1.10	1.000	1401

Table 7 shows the SD of the differences for VMB. The values were all well in the control limits required.

Table 7. Standard deviations of differences of VMB for Bulkclassed and Interlots

VMB Range (%)	Maximum Allowable SD of Differences (%)	SD of Differences	Valid tests
0.0 - 1.0	0.1	0.065	232
1.1 - 4.0	0.2	0.120	864
4.1- 8.0	0.3	0.175	241
>8.0	0.4	0.121	64

CONCLUSIONS

The IWTO-0 statistical analysis method showed that the using a combination of tested (Sub A) and auto proportioned additional sub(s) produced equivalent WB% and VMB% to those of the actual tested values from either the HSI or the manual method. Therefore, it would have no commercial impact on the issued test results.

Two preconditions have been established in this report to allow auto-proportioning of TAI, with no upper mass limit. That is, the conditions for the auto-proportioning shall be:

1. TAI composition is similar among the subsamples (visual operator check)
2. The difference between the TAI masses do not exceed ±0.5g.

The formula: TAI mass difference (g) = $\text{Sub}_{\text{B or C}}$ - Sub_{A}

RECOMMENDATION

It is recommended that changes be made to the criteria published in Appendix F of IWTO-19 (2024) for the auto proportioning method.

REFERENCES

IWTO, (2024), Appendix F & L: Method for Determining Vegetable Matter Base and Total Alkali-insoluble Impurities of Scoured Subsamples, IWTO-19-2024.

Austin, D. (1987), Appendix 3: Precision of Weight Proportion Assessment of the Components of Total Alkali-insolubles and its Effect on Vegetable Matter Base Percentage of New Zealand Wools, IWTO January 1987, Pairs, Raw Wool Certification Sub-committee.

Camiou, H. (1987), Appendix 4: Differences between the Weighing and Visual Estimation of Alkali-insoluble Components of Uruguayan Wools, IWTO June 1987, Rio De Janeiro.

Axe, D. E. (1995), Factors affecting uniformity of a mix, Animal Feed Science and Technology Volume 53, Issue 2, Pages 211-220.

Appendix 1. Equivalence of WB% for Melbourne QC trials

IWTO-0 Analysis

Description: Mel: HSI_WB% AutoPro v Tested

A: Test for Overall Relative Bias & Paired t-test.

	Overall Bias		Paired	
	Control	Treatment	t-test	
Number	192	192	192	
Average	57.2379	57.2378	-0.0001	SDDV
SD	5.3022	5.2975	0.0760	0.13
SE	0.3827	0.3823	0.0055	
t value	149.5807	149.7143	-0.0190	
p value	0.0000	0.0000	0.9849	
Significance			NS	

Print Results

B: Test for Correlation.

Number	192
DF	190
R	0.9999
t-value	962.9463
p-value	0.0000
Significance	***

Legend : Statistical Significance

GOOD NS Not Significant
* Significant at 5% level
** Significant at 1% level
WORSE *** Significant at 0.1% level

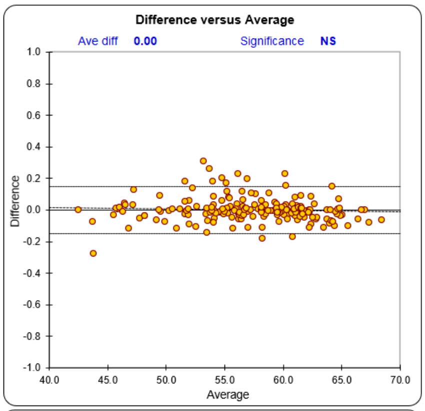
C: Test for Level Dependent "Bias".

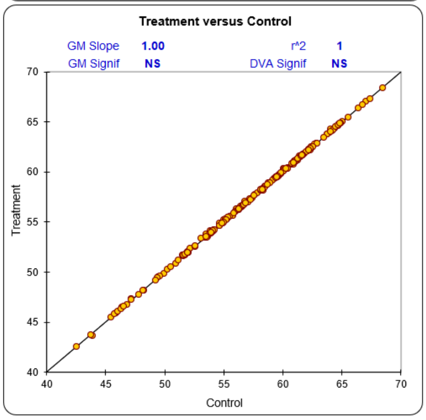
Regression	Slope	Significance	SE of Slope	t-Value	p-value	Rsq
GM	0.9991	NS	0.0010	0.8618	0.3899	0.9998
DVA	-0.0009	NS	0.0010	0.8614	0.3901	
Intercept(GM)	0.0511					STEYX
Intercept(DVA)	0.0511					0.0761

Magnitude of Level Dependant "Bias"

Nominal	Calculated	Avg. "Bias"
42	42.01	0.01
47	47.01	0.01
52	52.00	0.00
57	57.00	0.00
62	62.00	0.00
67	66.99	-0.01
69	68.99	-0.01

Comments





(a) HSI Auto proportioned vs T HSI Tested

IWTO-0 Analysis

Description: Mel: HSI WB% AutoPro v Manual

A: Test for Overall Relative Bias & Paired t-test.

	Overall Bias		Paired	
	Control	Treatment	t-test	
Number	192	192	192	
Average	57.2417	57.2352	-0.0064	SDDV
SD	5.3027	5.2990	0.1141	0.20
SE	0.3827	0.3824	0.0082	
t value	149.5777	149.6640	-0.7811	
p value	0.0000	0.0000	0.4357	
Significance			NS	

Print Results

B: Test for Correlation.

Number	192
DF	190
R	0.9998
t-value	640.5437
p-value	0.0000
Significance	***

Legend : Statistical Significance

GOOD NS Not Significant
* Significant at 5% level
** Significant at 1% level
WORSE *** Significant at 0.1% level

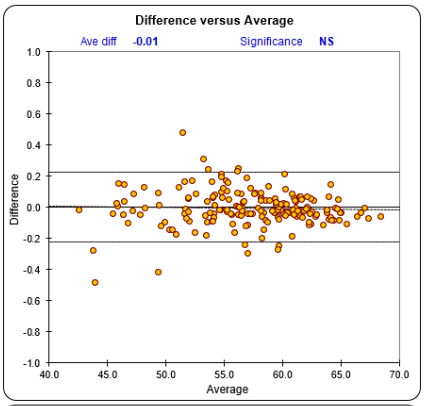
C: Test for Level Dependent "Bias".

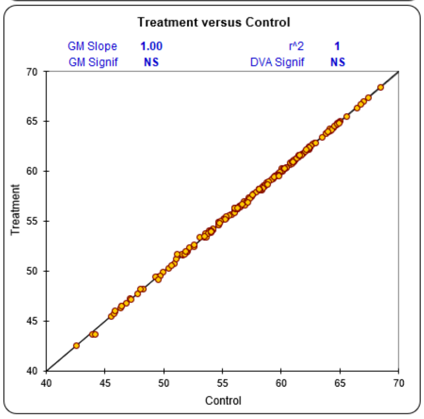
Regression	Slope	Significance	SE of Slope	t-Value	p-value	Rsq
GM	0.9993	NS	0.0016	0.4416	0.6592	0.9995
DVA	-0.0007	NS	0.0016	0.4415	0.6594	
Intercept(GM)	0.0330					STEYX
Intercept(DVA)	0.0330					0.1144

Magnitude of Level Dependant "Bias"

Nominal	Calculated	Avg. "Bias"
42	42.00	0.00
47	47.00	0.00
52	52.00	0.00
57	56.99	-0.01
62	61.99	-0.01
67	66.99	-0.01
69	68.99	-0.01

Comments





(b) HSI Auto proportioned vs Manual tested

IWTO-0 Analysis

Description: Mel HSI-WB%: AutoPro vs Tested (spreader)

A: Test for Overall Relative Bias & Paired t-test

	Overall Bias Control	Overall Bias Treatment	Paired t-test	
Number	202	202	202	
Average	58.4879	58.4920	0.0041	SDDV
SD	6.2006	6.1996	0.0296	0.05
SE	0.4363	0.4362	0.0021	
t value	134.0623	134.0933	1.9918	
p value	0.0000	0.0000	0.0477	
Significance			*	

Print Results

B: Test for Correlation.

Number	202
DF	200
R	1.0000
t-value	2963.7009
p-value	0.0000
Significance	***

Legend : Statistical Significance

GOOD NS Not Significant
* Significant at 5% level
** Significant at 1% level
WORSE *** Significant at 0.1% level

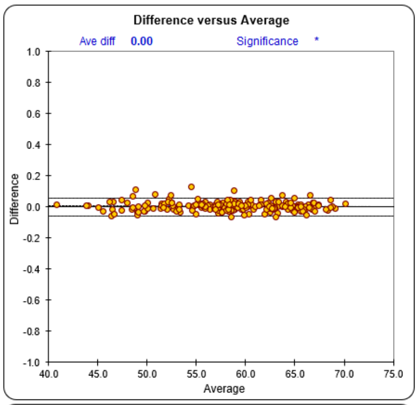
C: Test for Level Dependent "Bias".

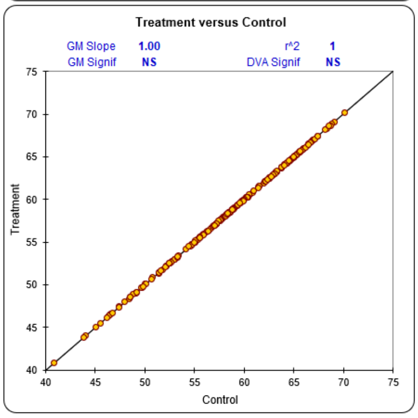
Regression	Slope	Significance	SE of Slope	t-Value	p-value	Rsq
GM	0.9998	NS	0.0003	0.4763	0.6344	1.0000
DVA	-0.0002	NS	0.0003	0.4762	0.6344	
Intercept(GM)	0.0135					STEYX
Intercept(DVA)	0.0135					0.0297

Magnitude of Level Dependant "Bias"

Nominal	Calculated	Avg. "Bias"
40	40.01	0.01
46	46.01	0.01
52	52.01	0.01
58	58.00	0.00
64	64.00	0.00
70	70.00	0.00
71	71.00	0.00

Comments





(c) HSI Auto proportioned vs HSI Tested (using spreader)

IWTO-0 Analysis

Description: Mel: HSI WB%: HSI v Manual (spreader)

A: Test for Overall Relative Bias & Paired t-test

	Overall Bias Control	Overall Bias Treatment	Paired t-test	
Number	202	202	202	
Average	58.4873	58.4920	0.0047	SDDV
SD	6.2134	6.1996	0.1780	0.30
SE	0.4372	0.4362	0.0125	
t value	133.7848	134.0933	0.3724	
p value	0.0000	0.0000	0.7100	
Significance			NS	

Print Results

B: Test for Correlation.

Number	202
DF	200
R	0.9996
t-value	494.5070
p-value	0.0000
Significance	***

Legend : Statistical Significance

GOOD NS Not Significant
* Significant at 5% level
** Significant at 1% level
WORSE *** Significant at 0.1% level

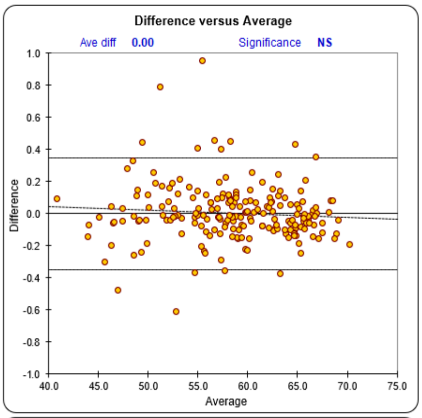
C: Test for Level Dependent "Bias".

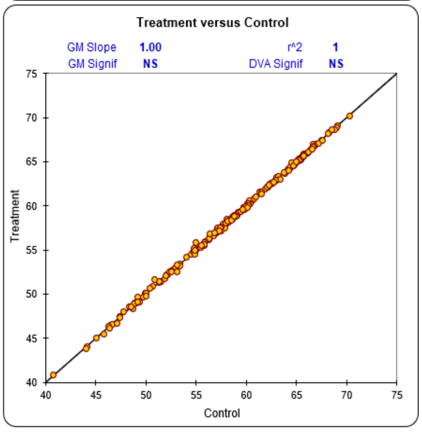
Regression	Slope	Significance	SE of Slope	t-Value	p-value	Rsq
GM	0.9978	NS	0.0020	1.1011	0.2722	0.9992
DVA	-0.0022	NS	0.0020	1.0999	0.2727	
Intercept(GM)	0.1346					STEYX
Intercept(DVA)	0.1347					0.1781

Magnitude of Level Dependant "Bias"

Nominal	Calculated	Avg. "Bias"
40	40.05	0.05
46	46.03	0.03
52	52.02	0.02
58	58.01	0.01
64	63.99	-0.01
70	69.98	-0.02
71	70.98	-0.02

Comments





(d) HSI Auto proportioned vs Manual tested (using spreader)

Appendix 2 Equivalence of WB% for Fremantle QC trial

IWTO-0 Analysis

Description: Fre: HSI_WB% AutoPro vs Tested

A: Test for Overall Relative Bias & Paired t-test.

	Overall Bias: Control	Overall Bias: Treatment	Paired t-test
Number	217	217	217
Average	54.1245	54.1229	**-0.0016**
SD	4.4836	4.4871	0.0237
SE	0.3044	0.3046	0.0016
t value	177.8247	177.6815	-1.0132
p value	0.0000	0.0000	0.3121
Significance			NS

SDDV
0.04

Print Results

B: Test for Correlation.

Number	217
DF	215
R	1.0000
t-value	2811.2776
p-value	0.0000
Significance	***

Legend : Statistical Significance

GOOD NS Not Significant
* Significant at 5% level
** Significant at 1% level
WORSE *** Significant at 0.1% level

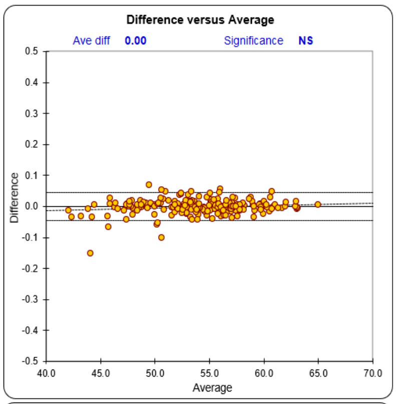
C: Test for Level Dependent "Bias".

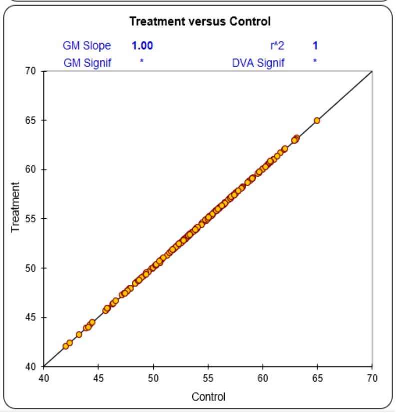
Regression	Slope	Significance	SE of Slope	t-Value	p-value	Rsq
GM	**1.0008**	*	0.0004	2.1791	0.0304	1.0000
DVA	0.0008	*	0.0004	2.1799	0.0303	
Intercept(GM)	**-0.0436**					STEYX
Intercept(DVA)	-0.0436					0.0234

Magnitude of Level Dependant "Bias"

Nominal	Calculated	Avg. "Bias"
42	41.99	-0.01
46	45.99	-0.01
50	50.00	0.00
54	54.00	0.00
58	58.00	0.00
62	62.00	0.00
65	65.01	0.01

Comments





(a) HSI Auto proportioned vs HSI Tested

IWTO-0 Analysis

Description: Fre: HSI_WB% AutoPro vs Maunual

A: Test for Overall Relative Bias & Paired t-test.

	Overall Bias: Control	Overall Bias: Treatment	Paired t-test
Number	217	217	217
Average	54.1713	54.1229	**-0.0484**
SD	4.4623	4.4871	0.1098
SE	0.3029	0.3046	0.0075
t value	178.8317	177.6815	-6.4919
p value	0.0000	0.0000	0.0000
Significance			***

SDDV
0.20

Print Results

B: Test for Correlation.

Number	217
DF	215
R	0.9997
t-value	613.1427
p-value	0.0000
Significance	***

Legend : Statistical Significance

GOOD NS Not Significant
* Significant at 5% level
** Significant at 1% level
WORSE *** Significant at 0.1% level

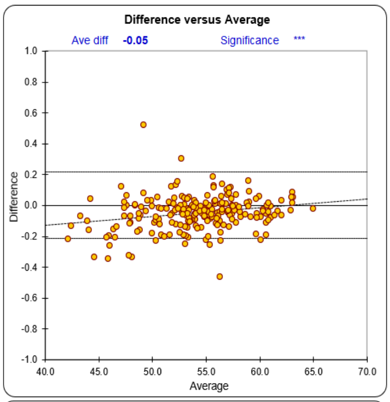
C: Test for Level Dependent "Bias".

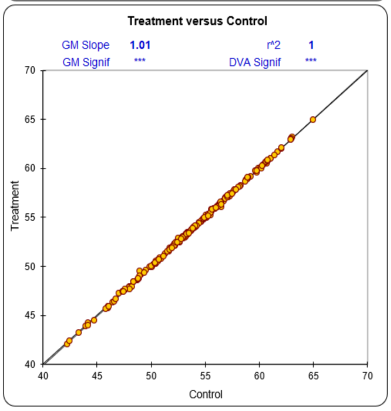
Regression	Slope	Significance	SE of Slope	t-Value	p-value	Rsq
GM	**1.0056**	***	0.0016	3.3997	0.0008	0.9994
DVA	0.0056	***	0.0016	3.4092	0.0008	
Intercept(GM)	**-0.3504**					STEYX
Intercept(DVA)	-0.3494					0.1069

Magnitude of Level Dependant "Bias"

Nominal	Calculated	Avg. "Bias"
42	41.88	-0.12
46	45.91	-0.09
50	49.93	-0.07
54	53.95	-0.05
58	57.97	-0.03
62	62.00	0.00
65	65.01	0.01

Comments





(b) HSI Auto proportioned vs Manual tested

Appendix 3. Equivalence of VMB% for Melbourne QC trials

IWTO-0 Analysis

Description: Mel: HSI-VMB%: AutoPro v Tested

A: Test for Overall Relative Bias & Paired t-test.

	Overall Bias Control	Overall Bias Treatment	Paired t-test	
Number	192	192	192	
Average	1.4151	1.4212	0.0061	SDDV
SD	1.0889	1.0991	0.0685	4.84
SE	0.0786	0.0793	0.0049	
t value	18.0072	17.9164	1.2383	
p value	0.0000	0.0000	0.2171	
Significance			NS	

Print Results

B: Test for Correlation.

Number	192
DF	190
R	0.9981
t-value	222.3935
p-value	0.0000
Significance	***

Legend : Statistical Significance

GOOD NS Not Significant
* Significant at 5% level
** Significant at 1% level
WORSE *** Significant at 0.1% level

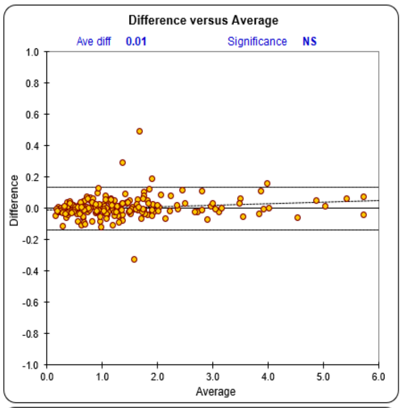
C: Test for Level Dependent "Bias".

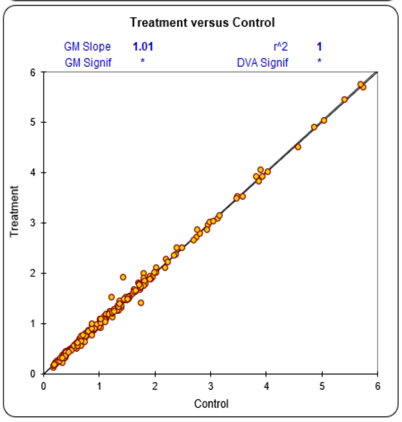
Regression	Slope	Significance	SE of Slope	t-Value	p-value	Rsq
GM	1.0094	*	0.0045	2.0783	0.0390	0.9962
DVA	0.0094	*	0.0045	2.0880	0.0381	
Intercept(GM)	-0.0072					STEYX
Intercept(DVA)	-0.0072					0.0675

Magnitude of Level Dependant "Bias"

Nominal	Calculated	Avg. "Bias"
0	-0.01	-0.01
1	1.00	0.00
2	2.01	0.01
3	3.02	0.02
4	4.03	0.03
5	5.04	0.04
6	6.05	0.05

Comments





(a) HSI Auto proportioned vs HSI Tested

IWTO-0 Analysis

Description: Mel: HSI-VMB%: AutoPro v Ref

A: Test for Overall Relative Bias & Paired t-test.

	Overall Bias Control	Overall Bias Treatment	Paired t-test	
Number	192	192	192	
Average	1.4181	1.4212	0.0031	SDDV
SD	1.0814	1.0991	0.1954	13.78
SE	0.0780	0.0793	0.0141	
t value	18.1705	17.9164	0.2183	
p value	0.0000	0.0000	0.8274	
Significance			NS	

Print Results

B: Test for Correlation.

Number	192
DF	190
R	0.9841
t-value	76.3166
p-value	0.0000
Significance	***

Legend : Statistical Significance

GOOD NS Not Significant
* Significant at 5% level
** Significant at 1% level
WORSE *** Significant at 0.1% level

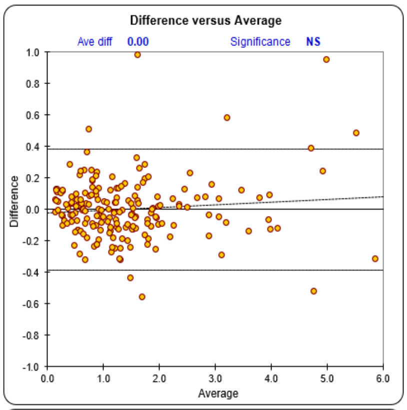
C: Test for Level Dependent "Bias".

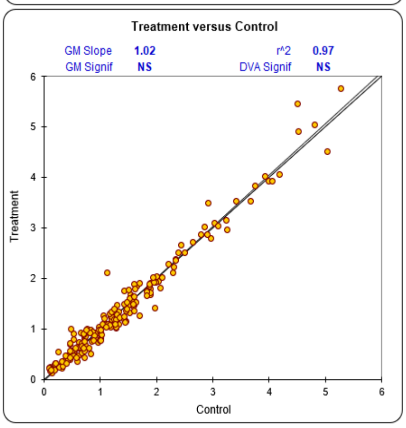
Regression	Slope	Significance	SE of Slope	t-Value	p-value	Rsq
GM	1.0164	NS	0.0131	1.2501	0.2128	0.9684
DVA	0.0164	NS	0.0130	1.2604	0.2091	
Intercept(GM)	-0.0202					STEYX
Intercept(DVA)	-0.0202					0.1927

Magnitude of Level Dependant "Bias"

Nominal	Calculated	Avg. "Bias"
0	-0.02	-0.02
2	2.01	0.01
4	4.05	0.05
6	6.08	0.08
8	8.11	0.11
10	10.14	0.14
7	7.09	0.09

Comments





(b) HSI Auto proportioned vs Manual tested

IWTO-0 Analysis

Description: Mel: HSI VMB%: AutoPro v Tested

A: Test for Overall Relative Bias & Paired t-test.

	Overall Bias Control	Overall Bias Treatment	Paired t-test	SDDV
Number	202	202	202	
Average	2.0195	2.0100	-0.0095	3.04
SD	1.7754	1.7757	0.0613	
SE	0.1249	0.1249	0.0043	
t value	16.1669	16.0883	-2.1980	
p value	0.0000	0.0000	0.0291	
Significance			*	

Print Results

B: Test for Correlation.

Number	202
DF	200
R	0.9994
t-value	409.2261
p-value	0.0000
Significance	***

Legend : Statistical Significance

GOOD NS Not Significant
* Significant at 5% level
** Significant at 1% level
WORSE *** Significant at 0.1% level

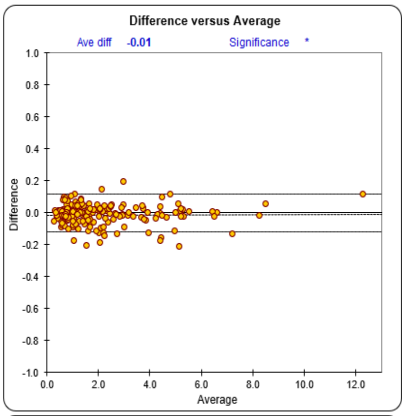
C: Test for Level Dependent "Bias".

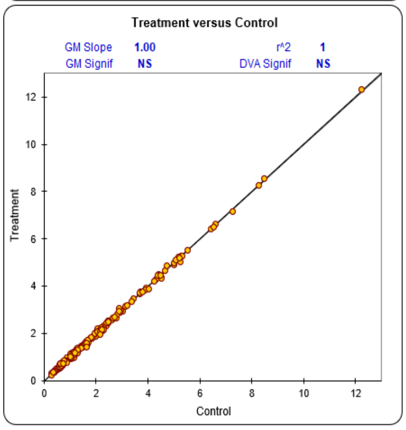
Regression	Slope	Significance	SE of Slope	t-Value	p-value	Rsq
GM	1.0002	NS	0.0024	0.0656	0.9478	0.9988
DVA	0.0002	NS	0.0024	0.0656	0.9477	
Intercept(GM)	-0.0098					STEYX
Intercept(DVA)	-0.0098					0.0615

Magnitude of Level Dependant "Bias"

Nominal	Calculated	Avg. "Bias"
0	-0.01	-0.01
3	2.99	-0.01
6	5.99	-0.01
9	8.99	-0.01
12	11.99	-0.01
15	14.99	-0.01
13	12.99	-0.01

Comments





(c) HSI Auto proportioned vs HSI Tested (using spreader)

IWTO-0 Analysis

Description: Mel HSI VMB%: AutoPro v Manual

A: Test for Overall Relative Bias & Paired t-test.

	Overall Bias Control	Overall Bias Treatment	Paired t-test	SDDV
Number	202	202	202	
Average	2.0390	2.0100	-0.0289	9.85
SD	1.7849	1.7757	0.2009	
SE	0.1256	0.1249	0.0141	
t value	16.2356	16.0883	-2.0461	
p value	0.0000	0.0000	0.0420	
Significance			*	

Print Results

B: Test for Correlation.

Number	202
DF	200
R	0.9936
t-value	124.8384
p-value	0.0000
Significance	***

Legend : Statistical Significance

GOOD NS Not Significant
* Significant at 5% level
** Significant at 1% level
WORSE *** Significant at 0.1% level

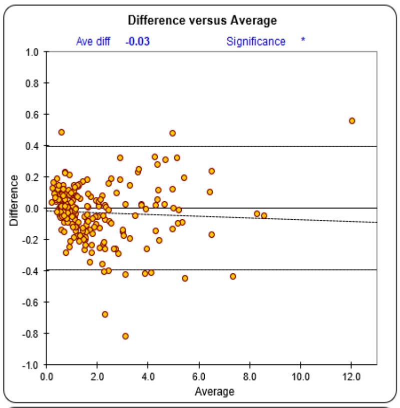
C: Test for Level Dependent "Bias".

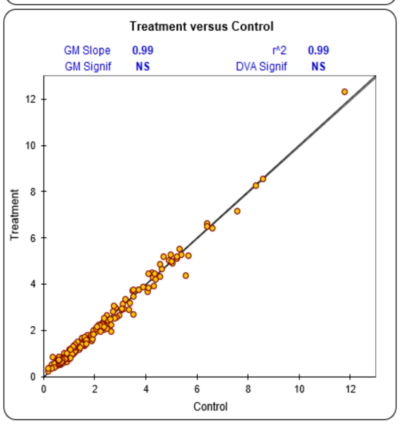
Regression	Slope	Significance	SE of Slope	t-Value	p-value	Rsq
GM	0.9948	NS	0.0079	0.6517	0.5153	0.9873
DVA	-0.0052	NS	0.0080	0.6501	0.5164	
Intercept(GM)	-0.0184					STEYX
Intercept(DVA)	-0.0184					0.2014

Magnitude of Level Dependant "Bias"

Nominal	Calculated	Avg. "Bias"
0	-0.02	-0.02
3	2.97	-0.03
6	5.95	-0.05
9	8.94	-0.06
12	11.92	-0.08
15	14.90	-0.10
13	12.91	-0.09

Comments





(d) HSI Auto proportioned vs Manual Tested (using spreader)

Appendix 4. Equivalence of VMB% for Fremantle QC trial

IWTO-0 Analysis

Description: Fre HSI-VMB%: AutoPro v Tested

A: Test for Overall Relative Bias & Paired t-test.

Print Results

	Overall Bias		Paired	
	Control	Treatment	t-test	
Number	217	217	217	
Average	1.8164	1.8154	-0.0010	SDDV
SD	1.0923	1.0966	0.0519	2.86
SE	0.0741	0.0744	0.0035	
t value	24.4971	24.3876	-0.2851	
p value	0.0000	0.0000	0.7759	
Significance			NS	

B: Test for Correlation.

Number	217
DF	215
R	0.9989
t-value	309.9194
p-value	0.0000
Significance	***

Legend : Statistical Significance

GOOD NS Not Significant
* Significant at 5% level
** Significant at 1% level
WORSE *** Significant at 0.1% level

C: Test for Level Dependent "Bias".

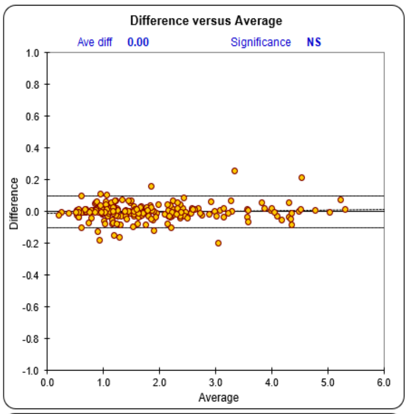
Regression	Slope	Significance	SE of Slope	t-Value	p-value	Rsq
GM	1.0039	NS	0.0032	1.2170	0.2249	0.9978
DVA	0.0039	NS	0.0032	1.2194	0.2240	

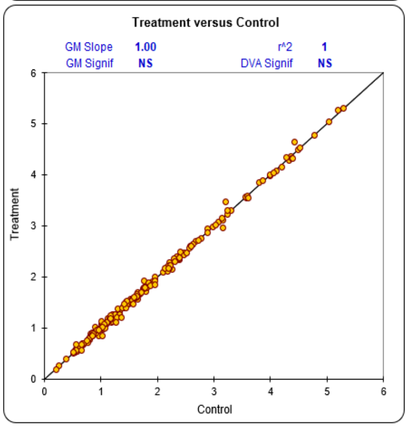
		STEYX
Intercept(GM)	-0.0082	
Intercept(DVA)	-0.0081	0.0517

Magnitude of Level Dependant "Bias"

Nominal	Calculated	Avg. "Bias"
0	-0.01	-0.01
1	1.00	0.00
2	2.00	0.00
3	3.00	0.00
4	4.01	0.01
5	5.01	0.01
6	6.02	0.02

Comments





(a) HSI Auto proportioned vs HSI Tested

IWTO-0 Analysis

Description: Fre HSI-VMB%: AutoPro v Manual

A: Test for Overall Relative Bias & Paired t-test.

Print Results

	Overall Bias		Paired	
	Control	Treatment	t-test	
Number	217	217	217	
Average	1.7591	1.8154	0.0564	SDDV
SD	1.0635	1.0966	0.1769	10.06
SE	0.0722	0.0744	0.0120	
t value	24.3644	24.3876	4.6934	
p value	0.0000	0.0000	0.0000	
Significance			***	

B: Test for Correlation.

Number	217
DF	215
R	0.9870
t-value	90.2117
p-value	0.0000
Significance	***

Legend : Statistical Significance

GOOD NS Not Significant
* Significant at 5% level
** Significant at 1% level
WORSE *** Significant at 0.1% level

C: Test for Level Dependent "Bias".

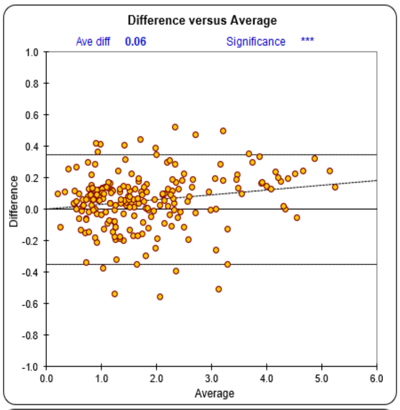
Regression	Slope	Significance	SE of Slope	t-Value	p-value	Rsq
GM	1.0311	**	0.0113	2.7538	0.0064	0.9743
DVA	0.0308	**	0.0110	2.7966	0.0056	

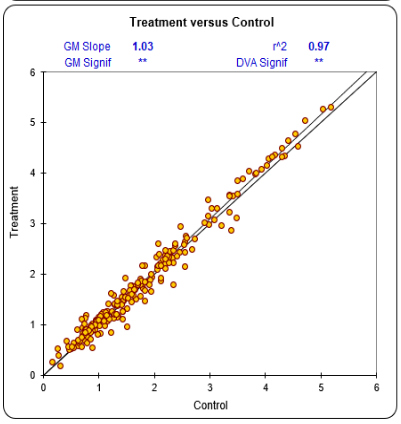
		STEYX
Intercept(GM)	0.0017	
Intercept(DVA)	0.0013	0.1710

Magnitude of Level Dependant "Bias"

Nominal	Calculated	Avg. "Bias"
0	0.00	0.00
1	1.03	0.03
2	2.06	0.06
3	3.09	0.09
4	4.13	0.13
5	5.16	0.16
6	6.19	0.19

Comments





(b) HSI Auto proportioned vs Manual Tested

Appendix 5. Equivalence of WB% and VMB% for the Tests in August 2025

A. Grower lots (two subsamples)

IWTO-0 Analysis

Description: Mel WB of 2 Sub lots: AutoPro vs Tested (August 2025)

A: Test for Overall Relative Bias & Paired t-test.

	Overall Bias		Paired
	Control	Treatment	t-test
Number	12933	12933	12933
Average	55.1949	55.1943	-0.0006
SD	7.2688	7.2702	0.0448
SE	0.0639	0.0639	0.0004
t value	863.5514	863.3701	-1.5349
p value	0.0000	0.0000	0.1248
Significance			NS

SDDV
0.08

Print Results

B: Test for Correlation.

Number	12933
DF	12931
R	1.0000
t-value	18446.8402
p-value	0.0000
Significance	***

Legend : Statistical Significance

GOOD NS Not Significant
* Significant at 5% level
** Significant at 1% level
WORSE *** Significant at 0.1% level

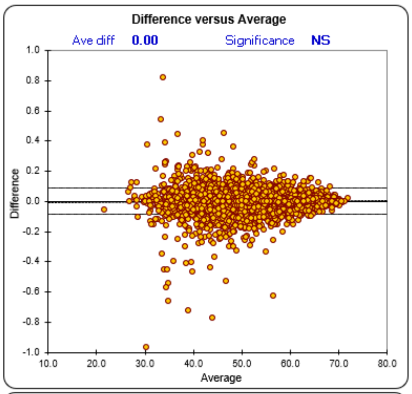
C: Test for Level Dependent "Bias".

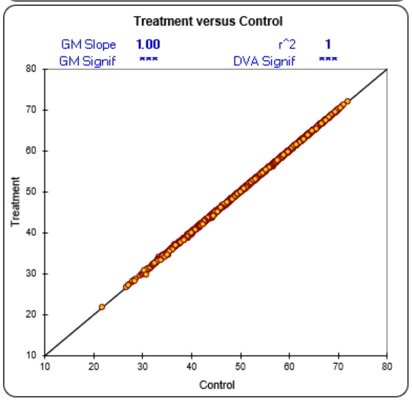
Regression	Slope	Significance	SE of Slope	t-Value	p-value	Rsq
GM	1.0002	***	0.0001	3.6710	0.0002	1.0000
DVA	0.0002	***	0.0001	3.6714	0.0002	
Intercept(GM)	-0.0116					STEYX
Intercept(DVA	-0.0116					0.0448

Magnitude of Level Dependant "Bias"

Nominal	Calculated	Avg. "Bias"
21	20.99	-0.01
30	29.99	-0.01
39	39.00	0.00
48	48.00	0.00
57	57.00	0.00
66	66.00	0.00
72	72.00	0.00

Comments





(a) Auto proportioned vs Tested WB% (manual method)

IWTO-0 Analysis

Description: Mel VMB of 2 Sub lots: AutoPro vs Tested (August 2025)

A: Test for Overall Relative Bias & Paired t-test.

	Overall Bias		Paired
	Control	Treatment	t-test
Number	12933	12933	12933
Average	2.8241	2.8247	0.0006
SD	3.3833	3.3876	0.0924
SE	0.0297	0.0298	0.0008
t value	94.9279	94.8239	0.7010
p value	0.0000	0.0000	0.4833
Significance			NS

SDDV
3.27

Print Results

B: Test for Correlation.

Number	12933
DF	12931
R	0.9996
t-value	4170.3504
p-value	0.0000
Significance	***

Legend : Statistical Significance

GOOD NS Not Significant
* Significant at 5% level
** Significant at 1% level
WORSE *** Significant at 0.1% level

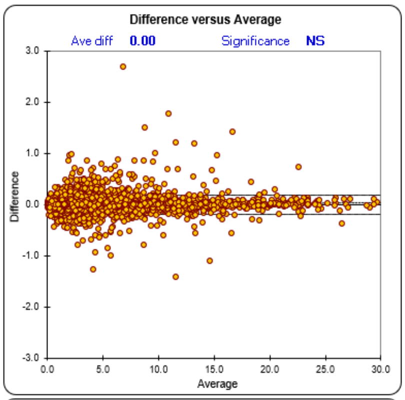
C: Test for Level Dependent "Bias".

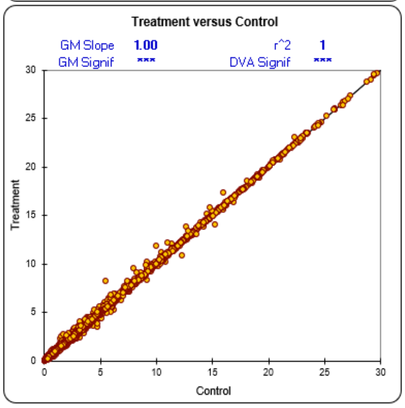
Regression	Slope	Significance	SE of Slope	t-Value	p-value	Rsq
GM	1.0013	***	0.0002	5.4086	0.0000	0.9993
DVA	0.0013	***	0.0002	5.4121	0.0000	
Intercept(GM)	-0.0031					STEYX
Intercept(DVA	-0.0031					0.0922

Magnitude of Level Dependant "Bias"

Nominal	Calculated	Avg. "Bias"
0	0.00	0.00
5	5.00	0.00
10	10.01	0.01
15	15.02	0.02
20	20.02	0.02
25	25.03	0.03
30	30.04	0.04

Comments





(b) Auto proportioned vs manual Tested VMB% (manual method)

Bulk and Interlots (three subsamples)

IWTO-0 Analysis

Description: Mel WB of 3 Sub lots: AutoPro vs Tested (August 2025)

A: Test for Overall Relative Bias & Paired t-test.

	Overall Bias		Paired
	Control	Treatment	t-test
Number	1401	1401	1401
Average	52.8528	52.8533	**0.0004**
SD	6.1746	6.1766	0.0589
SE	0.1650	0.1650	0.0016
t value	320.3881	320.2889	0.2766
p value	0.0000	0.0000	0.7821
Significance			NS

SDDV
0.11

Print Results

B: Test for Correlation.

Number	1401
DF	1399
R	1.0000
t-value	3922.9728
p-value	0.0000
Significance	***

Legend : Statistical Significance

GOOD NS Not Significant
* Significant at 5% level
** Significant at 1% level
WORSE *** Significant at 0.1% level

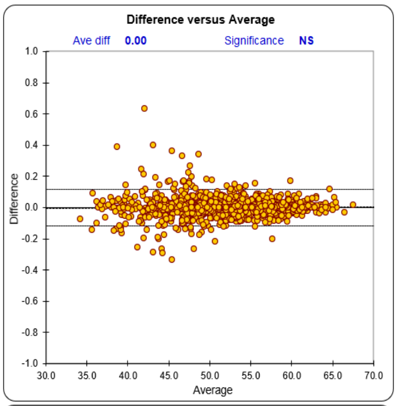
C: Test for Level Dependent "Bias".

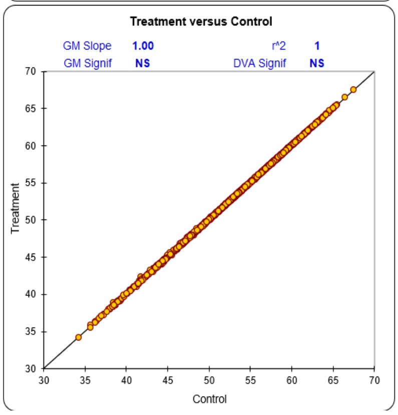
Regression	Slope	Significance	SE of Slope	t-Value	p-value	Rsq
GM	**1.0003**	NS	0.0003	1.2469	0.2126	0.9999
DVA	0.0003	NS	0.0003	1.2471	0.2126	
Intercept(GM)	**-0.0164**					STEYX
Intercept(DVA)	-0.0164					0.0589

Magnitude of Level Dependant "Bias"

Nominal	Calculated	Avg. "Bias"
34	33.99	-0.01
40	40.00	0.00
46	46.00	0.00
52	52.00	0.00
58	58.00	0.00
64	64.00	0.00
68	68.01	0.01

Comments





(a) Auto proportioned vs Tested WB% (manual method)

IWTO-0 Analysis

Description: Mel VMB of 3 Sub lots: AutoPro vs Tested (August 2025)

A: Test for Overall Relative Bias & Paired t-test.

	Overall Bias		Paired
	Control	Treatment	t-test
Number	1401	1401	1401
Average	2.9534	2.9548	**0.0014**
SD	2.5062	2.5143	0.1245
SE	0.0670	0.0672	0.0033
t value	44.1093	43.9880	0.4250
p value	0.0000	0.0000	0.6709
Significance			NS

SDDV
4.21

Print Results

B: Test for Correlation.

Number	1401
DF	1399
R	0.9988
t-value	755.2949
p-value	0.0000
Significance	***

Legend : Statistical Significance

GOOD NS Not Significant
* Significant at 5% level
** Significant at 1% level
WORSE *** Significant at 0.1% level

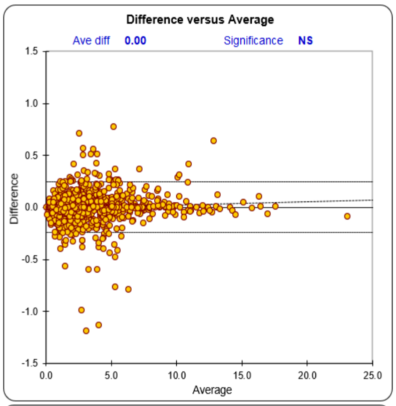
C: Test for Level Dependent "Bias".

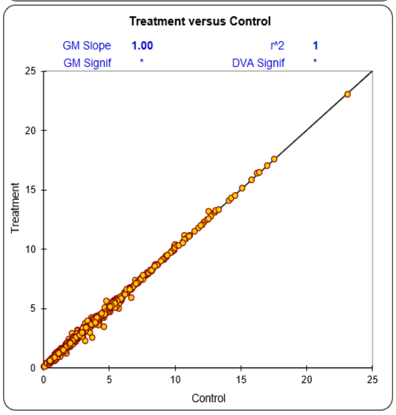
Regression	Slope	Significance	SE of Slope	t-Value	p-value	Rsq
GM	**1.0032**	*	0.0013	2.4399	0.0148	0.9976
DVA	0.0032	*	0.0013	2.4438	0.0147	
Intercept(GM)	**-0.0081**					STEYX
Intercept(DVA)	-0.0081					0.1240

Magnitude of Level Dependant "Bias"

Nominal	Calculated	Avg. "Bias"
0	-0.01	-0.01
4	4.00	0.00
8	8.02	0.02
12	12.03	0.03
16	16.04	0.04
20	20.06	0.06
24	24.07	0.07

Comments





(b) Auto proportioned vs manual Tested VMB% (manual method)