

Data Preservation Through Structured Research Data Management



Gylling Data Management, Inc.



"Data" is Available Everywhere

- Internet
- Popular publications
- Research journals
- Historical experiments that exist in nearly every research organization



Is this Useful Data?





What About "Good Data"?

- Well documented data
- With a full description of assessment parameters
- Includes detailed crop information
- Complete trial site information:
 - Growing conditions (temperature, moisture)
 - Site, soil description and analyses
 - Trial maintenance activities



What About "Good Data"?

- Stored electronically in a readily useable standard format
- Indexed to quickly find relevant trials
- Using standardized terminology
- All values included defined units
- Can be quickly combined with similar trials

Study Management Tools

ARM 2015.6 (GDMdef)

File Edit Format Tools Table Utilities Window Graph Add-Ins Help

Study List

Select study to open

Selected Study

Filter

- Header
- Treatment
- Site Description
 - Site Description - General
 - Site Description - Contacts
 - Site Description - Crop/Pest
 - Site Description - Site and Design
 - Site Description - Soil/Moisture
 - Site Description - Application
- Assessment Data
- Other

Treatment

Treatment Name Type Form Type

Tit Name (condensed) Stage

Site Description - General

Discipline Status

Trial Reliability

Initiation Date Planned Completion Date Completion Date

Trial City Trial Country

Trial State/Prov.

Latitude Longitude

Climate Zone

GLP GEP

Official Trial ID

Guideline

Keywords

Include Exclude OK Range

(All)
 BEL
 DEU
 FRA
 FRG
 HUN
 ROM
 SKR
 USA

All Trials Protocols
 When was it modified?

Filter (Trial Country)

Whole Field
 Start of field
 Empty (Blank) Fields
 Everything Except
 Contains
 Clear Filter for this Field
 Filter For ...

From:

To:

Active Filter (23):
Active Studies
Study Type is 'Trial'
Exclude Latitude is (Blank)

Selected	Study ID	Trial Country	Trial Region	Climate Zone	Coopera	Date	Planned Completion	Completion Date	Keywords
<input type="checkbox"/>	ST-Exam1	DEU			DEU	49.15	9.816	25-Apr-2014	
<input type="checkbox"/>	G-All7_Fung	BEL			BEL	50.5667	4.6833		
<input type="checkbox"/>	G-All7_Fung_CHtest	BEL			BEL	50.5667	4.6833	01-Oct-2014	08-Oct-2014
<input type="checkbox"/>	G-All7_Herb_02	FRA		EPOMED	FRA	45.906143	2.6005554	15-Mar-2014	31-Aug-2014
<input type="checkbox"/>	G-All7_Herb_03	FRA		EPOMED	FRA	43.0105515	9.56222153	15-Mar-2014	31-Aug-2014
<input type="checkbox"/>	G-All7_SDTR_Inoc_001	USA		USWARM	FRA	39.119366	-90.050766	01-Mar-2014	31-Oct-2014
<input type="checkbox"/>	G-All7_SDTR_Inoc_002	USA		USWARM	FRA	39.219364	-90.150764	01-Mar-2014	31-Oct-2014
<input type="checkbox"/>	G-Seed7-Broccoli_Var_1	SKR			SKR	34.9094	128.0667	20-May-2015	30-Oct-2015
<input type="checkbox"/>	Heterogeneity Example	USA			USA	44.3	-96.8	26-Mar-2014	24-Oct-2014
<input type="checkbox"/>	Seed_Var_Strip_01	USA		USWARM	FRA	47.296112	5.062719	01-Mar-2014	19-Aug-2014
<input type="checkbox"/>	Seed_Var_Strip_02	USA		USWARM	FRA	47.296112	5.062719	01-Mar-2014	19-Aug-2014
<input type="checkbox"/>	Seed_Var_Strip_03	USA		USWARM	FRA	47.296112	5.062719	01-Mar-2014	19-Aug-2014
<input type="checkbox"/>	ST-Exam2	FRA			FRA	43.35383	0.809	30-Apr-2014	30-Nov-2014
<input type="checkbox"/>	ST-Exam3	FRA			FRA	47.6166	-1.3666	28-Apr-2014	30-Nov-2014
<input type="checkbox"/>	ST-Exam5	HUN			HUN	46.35597	18.70382	25-Apr-2014	30-Nov-2014
<input type="checkbox"/>	ST-Exam6	ROM			ROM	44.1666	28.4833	25-Apr-2014	30-Nov-2014

Selected Study

Study ID: G-All7_Fung_Temp

Parent Protocol: G-All7_Fung

Project ID:

Title: An assessment of the efficacy

Treatment Name:

Tit Name (condensed):

Discipline: F

Trial Reliability: HIGH

Initiation Date: Planned

Trial City: GEMBLOUX

Trial State/Prov.: NAMUR

Latitude: 50.5667 Longitude:

Climate Zone:

GLP: N GEP: N

Select All Clear All Remove Filter

Include archived studies Tutorial

Browse... Rebuild Clipboard OK Help

Study Management Tools

- Track progress of studies
- Search current and historical trials
- Extract information for mapping, etc.





Trial Management Steps

1. Prepare treatment/entry list
2. Plan required number of replicates by either: best guess, consult statistician, or perform power analysis
3. Create randomization
4. Define plot size
5. Calculate treatment quantity to apply



Trial Management Steps

6. Establish trial

- Plant
- Apply treatments
- Record site location and other information

7. Make assessments

8. Review and analyze assessments

9. Prepare key graphs

10. Print final reports



Trial Management Steps

These steps are the same whether using:

- Paper
- Office/general purpose software
- Project management software
- ARM
 - Provides automations, and
 - Improves efficiency, quality, and consistency



Overview of Trial Management Software Requirements

- General Requirements:
 - Structure so trials are entered consistently
 - Dictionaries to standardize vocabulary
 - Enter information only once
- Resulting Benefits:
 - Portability across languages and platforms
 - Automation of routine tasks
 - Efficiency and accuracy



Protocol Components no. 1

- Clearly-defined treatments with formulation and rate details

Trt Line	Trt No.	Type	Treatment Name	Form Conc	Form Unit	Form Type	Rate	Rate Unit	Other Rate	Other Rate Unit	Appl Code	Appl Description
1	1	CHK	Untreated Check									
2	2	FUNG	TUB	250	G/L	EC	0.5	L/ha	125	g A/ha	A	pre-emergence
3	3	FUNG	TUB	250	G/L	EC	1	L/ha	250	g A/ha	A	pre-emergence
4	4	FUNG	TILT 250	250	G/L	EC	0.5	L/ha	125	g A/ha	B	early post
5	5	FUNG	MICO 60	600	G/L	EC	1.5	L/ha	900	g A/ha	B	early post
6	5	FUNG	FUNGOL	200	G/L	SC	1.25	L/ha	250	g A/ha	B	early post

Protocol Components no. 2

- Description of required assessments

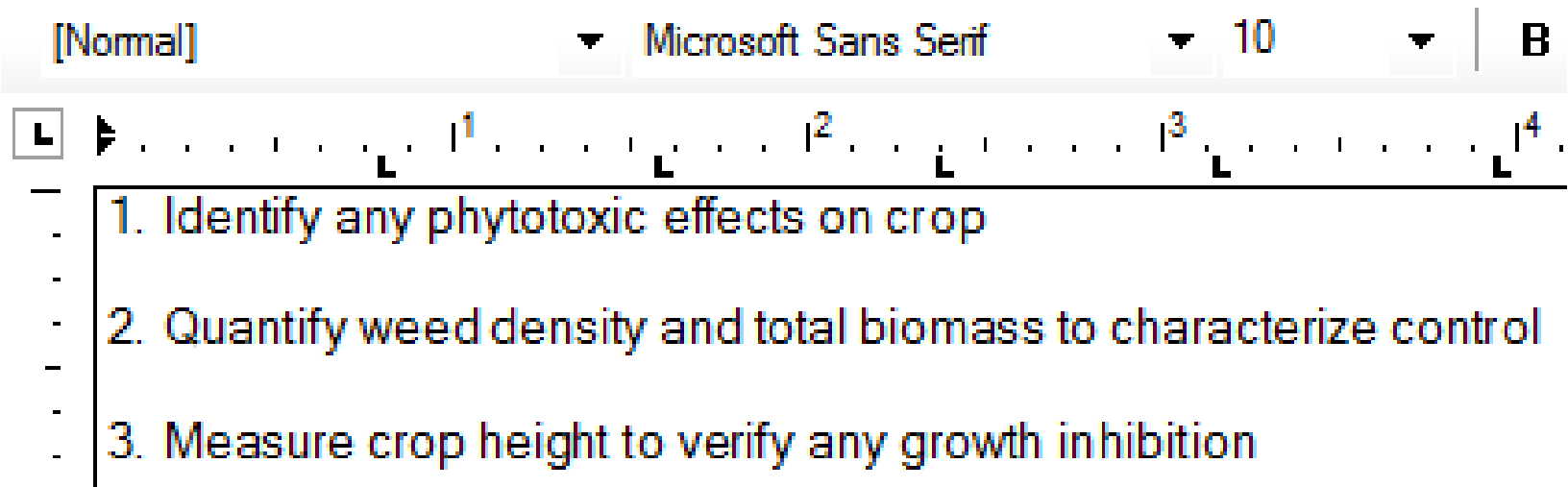
Assessment Data - Line 8								
Column Number	1	2		3		4		
Pest Type				W	Weed	W	Weed	
Pest Name								
Crop Name								
Description	crop injury	crop height		weed density		weed biomass		
Rating Date								
Rating Type	PHYTO	HEIGHT		COUNT		BIOMAS		
Rating Unit	%	cm		PLANT		g		
Sample Size, Unit	1	PLOT	25	PLANT	1	m2	1	m2
Collection Basis, Unit								
Number of Subsamples	1	25		1		1		



Protocol Components no. 3

- Define objectives

Objectives:



[Normal] Microsoft Sans Serif 10 B

1. Identify any phytotoxic effects on crop
2. Quantify weed density and total biomass to characterize control
3. Measure crop height to verify any growth inhibition

Protocol Components no. 4

- Study rules that clearly identify key information to record in each trial created from the protocol

The screenshot shows a software interface with a menu bar (File, Edit, Format, Tools, Table, Utilities, Window, Graph, Ad) and a toolbar. The main window is titled 'Site Description' and has a 'Navigation Bar' on the left. The form contains several input fields: 'City', 'Country', 'State/Prov.', 'Postal Code', 'Climate Zone', 'Latitude of LL Corner °', and 'Longitude of LL Corner °'. Below the form is a 'Study Rules' table.

Rule	Rule ID	Editor	Field
3	Required	Site Description	General Trial - City
4	Required	Site Description	General Trial - Trial State
5	Required	Site Description	General Trial - Postal Code
6	Recommended	Site Description	General Trial - Trial Country
7	Required	Site Description	General Trial - Latitude of LL Corner °



Support for Typical Experimental Designs

- Randomize and appropriately analyze
 - Completely Random Design
 - Randomized Complete Block (RCB)
 - Latin Square
 - Lattice Designs (Incomplete Block)
 - Multi-Factor Designs
 - RCB with Factorial Arrangement of Treatments
 - Split-Plot
 - Strip-Block (Criss-Cross)

Randomize Treatments

The screenshot shows the 'Trial Map' software interface. The main window displays a 4x5 grid of plots, each with a number and a treatment code. The plots are color-coded and patterned according to their treatment. Below the grid is a table with columns for 'Options', 'Movement Arrows', and 'Treatment Description'. To the right of the grid is a 'Properties' panel with radio buttons for 'Color by' (Replicate, Treatment), a checkbox for 'Auto-select for move', and radio buttons for 'Treatment', 'Plot' Experimental Unit, and 'Replicate'. At the bottom right are buttons for 'Settings...', 'Re-Randomize', 'Re-Number Plots', 'Accept Current', and 'Cancel'.

Options	Movement Arrows	Treatment Description
Trt	Trt Code	Trt Description
1	chk	Untreated Check
2	tub.5	TUB 0.5 L/ha
3	tub1	TUB 1 L/ha
4	tilt	TILT 250 0.5 L/ha
5	ref	MICO 60 1.5 L/ha; FUNGOL 1.25 L/ha



Power and Efficiency Planner, Plan Experiments to Have:

- A reasonable chance of distinguishing anticipated treatment differences
- The optimum number of replicates required to meet objectives
- An efficient experimental design and randomization for desired precision
- Cost-effective utilization of the available experimental area



Why is Planning Critical?

- Can reduce costs by selecting optimum number of replicates and samples
- Expected treatment differences are typically $< 10\%$, and frequently $< 5\%$, so small precision gains can help to:
 - Distinguish an actual treatment difference (reject null hypothesis H_0)
 - Strengthen evidence of no treatment diff.) (do not reject null hypothesis H_0)

Power and Efficiency Planner

Protocol Settings

General Design Treatment Application Layout

Randomized Complete Block (RCB)

Factors: 1

Treatments Merge Factor fields to

A: 5 Do not merge

B: Do not merge

C: Do not merge

The Treatment editor Type column (field) uses the factor description entered above as the default entry.

Clear

Power and Efficiency

CV 10.0 Reps 4 Power 80 α SL 5% % Mean Diff 10.0

Lock at

CV	Reps	Power	α SL	% Mean Diff	Error DF	'Plot' EUs
3.83	3	80	5%	10	8	15
4.63	4				12	20
5.3	5				16	25
5.9	6				20	30
6	7				24	35
6.9	8				28	40
8	11				40	55
10	17				64	85
12	24				92	120
14	32				124	160



Power and Efficiency Planner

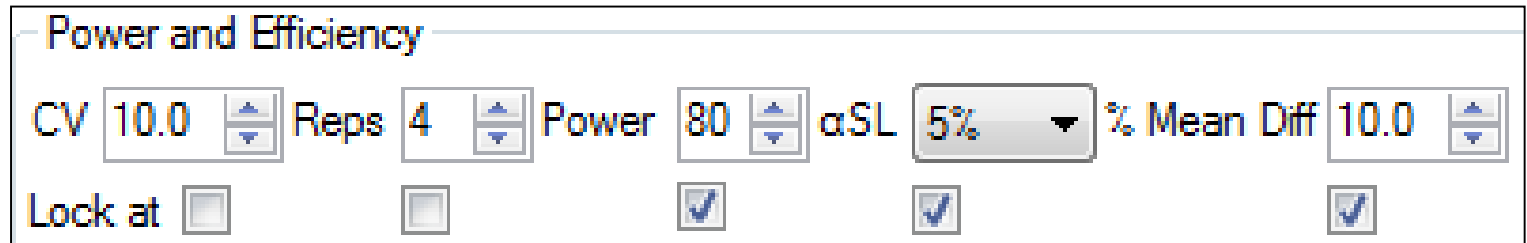
- Help plan experiments that successfully detect expected treatment differences
- Available in both protocols and trials so:
 - Protocol writers can more effectively plan experiments
 - Trialists can verify whether CV expectations are realistic based on local experience for specified crop(s)



Power and Efficiency Planner

- Calculates "power" based on:
 - Estimated CV of key assessment (e.g. yield)
 - Number of replicates
 - Power = Level of certainty to detect "real" treatment effects (80% or 90%)
 - Alpha Significance Level (e.g. 5%, 10%)
 - % Mean Diff = estimated treatment effect, expressed as percentage of overall (grand) mean across treatments of key assessment

Power and Efficiency Planner



Power and Efficiency

CV 10.0 Repts 4 Power 80 αSL 5% % Mean Diff 10.0

Lock at

- "Lock at" to keep 3-4 columns constant
- Calculates table of possible values for "unlocked" columns (e.g. Rep or CV)
- Values entered by protocol writer are carried into trials created from protocol, conveying protocol expectations

Power and Efficiency Planner

Compare effect of significance level on minimum replicates for CV=6% vs. 10%

Power and Efficiency

CV 10.0 Reps 4 Power 80 **αSL 5%** % Mean Diff 10.0

Lock at

CV	Reps
4.37	3
5.05	4
5.64	5
6.2	6
7.14	8
6	6
8	11
10	16
12	23
14	31

Power and Efficiency

CV 10.0 Reps 4 Power 80 **αSL 10%** % Mean Diff 10.0

Lock at

CV	Reps	Power	αSL	% Mean Diff
4.93	3			
5.7	4			
6.36	5			
7	6			
8.04	8			
6	5	80	10%	10
8	8			
10	13			
12	18			
14	25			

Power and Efficiency Planner

- Consider impact of Replicates on precision to detect treatment differences

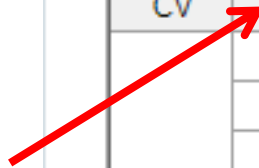
Power and Efficiency

CV 5.0 Reps 4 Power 80 α SL 5% % Mean Diff 5.0

Lock at

CV	Reps	Power	α SL	% Mean Diff	Error DF	'Plot' EUs
5	3	80	5%	13	8	15
	4			10.8	12	20
	5			9.4	16	25
	6			8.5	20	30
	8			7.26	28	40
	9			7	32	45
	12			6	44	60
	17			5	64	85
	26			4	100	130
	45			3	176	225

Click on column heading to sort





Randomization Quality Review

Goal is to improve experiment precision:

1. Arrange replicates as squares, not strips
2. Equalize treatment distribution
 - a. Balance average distance from all other treatments
 - b. Balance "Edge effect" across treatments
3. Randomize all replicates

Trial Map

75%

Properties

- Color by
 - Replicate
 - Treatment
 - Current Treatment
- Auto-select for move
 - Treatment
 - 'Plot' Experimental Unit
 - Replicate

Treatment

Trt	Code	At Edge	Ave Dist.	StDev	Min	Max
1	CHK	3	79	18.6	40.4	121
2		3	96	26.2	40.4	128
3		2	76.5	26.6	19.1	128
4		3	86	24.6	46.8	138
5		2	82	20.0	46.8	117
6		2	69	21.0	38.3	106
7		2	67	13.9	49	102
8		2	68	18.2	27.6	102
9		2	66	25.6	19.1	117
10		2	64.7	23.2	25.5	117
11		2	69	19.2	27.6	104
12		2	66	21.8	25.5	106
13		2	61	22.3	25.5	125
14		2	56	17.6	21.3	89
15		2	67	22.8	32	125
16		2	64.7	22.3	27.6	123
17		2	71.5	24.0	27.6	113
18		2	67	25.0	27.6	110
19		2	60.6	19.2	21.3	102
20		2	63	24.2	27.6	125
21		2	79	27.4	25.5	128
22		2	69	27.0	14.9	121
23		2	70	26.0	14.9	110
24	REF	3	27.7	38.3	138	

Options | Movement Arrows | Treatment Description | Comment | **Quality**

Suggested block size (*=optimum):

Block Size	6	8*	12	24
Rep Width	50.5	67.5	101.5	203.5
Rep Length	103	77	51	25
Surface/Area	0.059	0.056*	0.059	0.090
Trial Width	50.5	67.5	101.5	203.5
Trial Length	415	311	207	103
Unused 'Plot'	0	0	0	0

Replicate shape

Replicate 1 is defined as non-randomized. It is best statistical practice to randomize all replicates.

1

3

a

b

Settings... | Re-Randomize | Re-Number 'Plots' | | Cancel | Help

Arrange Replicates as Squares not Strips

"Optimum" is smallest surface-to-area ratio

Options	Movement Arrows	Treatment Description	Comment	Quality
Suggested block size (*=optimum):		<input type="button" value="Apply"/>		
Block Size	6	8*	12	24
Rep Width	50.5	67.5	101.5	203.5
Rep Length	103	77	51	25
Surface/Area	0.059	0.056*	0.059	0.090
Trial Width	50.5	67.5	101.5	203.5
Trial Length	415	311	207	103

Options	Movement Arrows	Treatment Description	Comment	Quality
Suggested block size (*=optimum):		<input type="button" value="Apply"/>		
Block Size	6	8*	12	24
Rep Width	50.5	67.5	101.5	203.5
Rep Length	103	77	51	25
Surface/Area	0.059	0.056*	0.059	0.090
Trial Width	50.5	67.5	101.5	203.5
Trial Length	415	311	207	103

Options	Movement Arrows	Treatment Description	Comment	Quality
Suggested block size (*=optimum):		<input type="button" value="Apply"/>		
Block Size	6	8*	12	24
Rep Width	50.5	67.5	101.5	203.5
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Surface/Area	0.059	0.056*	0.059	0.090
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Options	Movement Arrows	Treatment Description	Comment	Quality
Suggested block size (*=optimum):		<input type="button" value="Apply"/>		
Block Size	6	8*	12	24
Rep Width	50.5	67.5	101.5	203.5
Rep Length	103	77	51	25
Surface/Area	0.059	0.056*	0.059	0.090
Trial Width	50.5	67.5	101.5	203.5
Trial Length	415	311	207	103

Equalize Treatment Distribution

"Undesirable" layout of 7 treatments and 5 replicates in Randomized Complete Block:

- Trt. 6 in middle 3 columns of all reps
- Trt. 5 in right 2 cols for all but one plot

2e	4e	7e	1e	6e	3e	5e
1d	7d	3d	4d	6d	2d	5d
7c	5c	4c	6c	2c	3c	1c
2b	1b	3b	6b	7b	5b	4b
7a	2a	6a	3a	4a	1a	5a

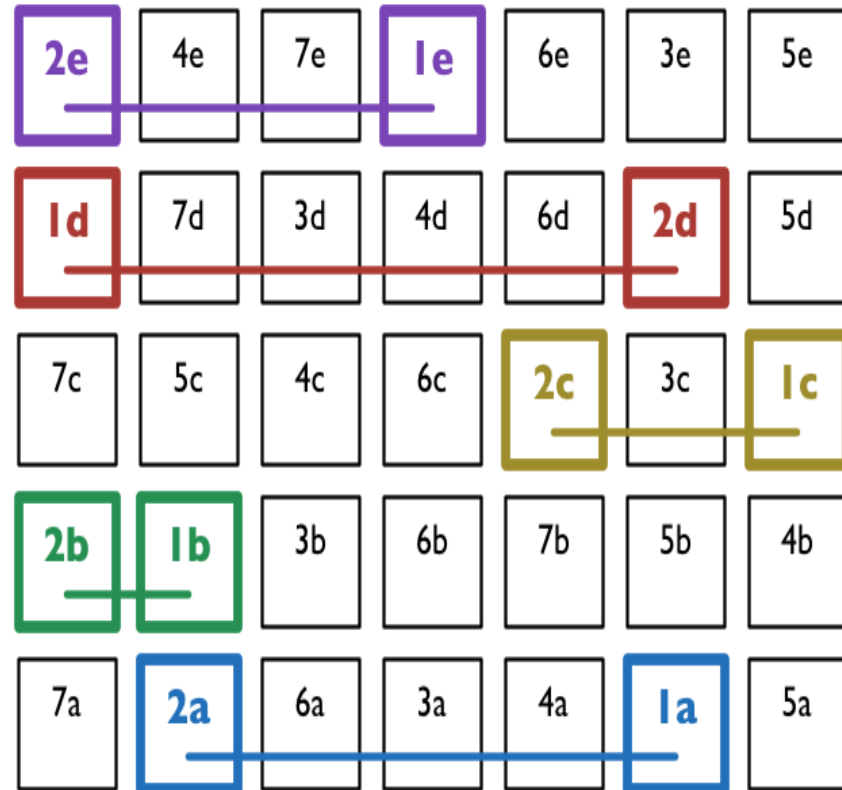


Uses "Average Distance of Treatment" Comparison (ADTC)

- van Es and van Es, "Spatial Nature of Randomization and Its Effect on the Outcome of Field Experiments", *Agronomy Journal*, 85:420-428 (1993).
- Comparison between treatments 1 and 2 is taken from 5 plots for each treatment.
- Measure the plot-to-plot distance for each plot containing treatment 1 to the paired plot within replicate containing treatment 2, for a total of 5 distances.
- ADTC for the treatment pair 1-2 is the average of the 5 distances.

Distances, Treatments 1-2

- Average distance = 3 plots = 24 feet for 8 foot wide plots



Unequal Treatment Distribution

- Average distance from 17.9 to 24.6
- Ranges from 11.9(T3,T6) to 34(T2,T5)
- Error variances for treatments may not be homogeneous



Trt	At Edge	Ave Dist.	StDev	Min	Max
1	4	24.4	6.24	13.6	32.3
2	3	24.6	5.56	17	34
3	2	19.8	5.66	11.9	25.5
4	3	21.3	3.18	17	25.5
5	3	27	5.83	20.4	34
6	2	17.9	3.53	11.9	22
7	3	23.8	4.3	18.7	29

Unbalanced "Edge effect"

- Treatment 1 occurs at edge 4 times, T2 and T3 at edge only 2 times

501 7	502 2	503 6	504 3	505 4	506 1	507 5
401 2	402 1	403 3	404 6	405 7	406 5	407 4
301 7	302 5	303 4	304 6	305 2	306 3	307 1
201 1	202 7	203 3	204 4	205 6	206 2	207 5
101 2	102 4	103 7	104 1	105 6	106 3	107 5

Trt	At Edge	Ave Dist.	StDev	Min	Max
1	4	24.4	6.24	13.6	32.3
2	3	24.6	5.56	17	34
3	2	19.8	5.66	11.9	25.5
4	3	21.3	3.18	17	25.5
5	3	27	5.83	20.4	34
6	2	17.9	3.53	11.9	22
7	3	23.8	4.3	18.7	29

Properties

Color by

Replicate

Treatment

Current Treatment

Auto-select for move

Treatment

'Plot' Experimental Unit

Replicate

Balanced Treatment Distribution and Edge Effect

- Average distance from 21.3 to 24.4
- Distances range from 18.7 to 27.2
- "Edge effect" is balanced



501 3	502 4	503 7	504 6	505 5	506 1	507 2
401 2	402 6	403 4	404 1	405 7	406 3	407 5
301 7	302 1	303 2	304 3	305 4	306 5	307 6
201 4	202 5	203 1	204 7	205 6	206 2	207 3
101 1	102 3	103 6	104 5	105 2	106 4	107 7

Trt	At Edge	Ave Dist.	StDev	Min	Max
1	2	22	2.15	20.4	25.5
2	3	23.8	3.57	18.7	27.2
3	3	24.4	1.76	22	27.2
4	3	22.4	3.47	18.7	25.5
5	3	22	3.4	18.7	27.2
6	3	21.3	2.58	18.7	25.5
7	3	22.7	2.56	18.7	25.5

Randomize All Replicates

- This frame displays when a non-randomized replicate is defined in Settings
- Select "Randomize All Replicates" to follow recommended statistical practice

Suggested block size (*=optimum):

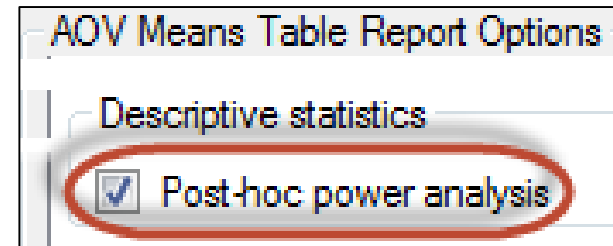
Block Size	6	8*	12	24
Rep Width	50.5	67.5	101.5	203.5
Rep Length	103	77	51	25
Surface/Area	0.059	0.056*	0.059	0.090

Replicate shape

Replicate 1 is defined as non-randomized. It is best statistical practice to randomize all replicates.

Post-hoc Power Analysis

- Optional descriptive statistic on AOV Means Table report
- Lists, for each assessment column, the minimum number of replicates required to statistically separate treatment means based on Treatment P(F) and current significance level
- Use for planning future trials



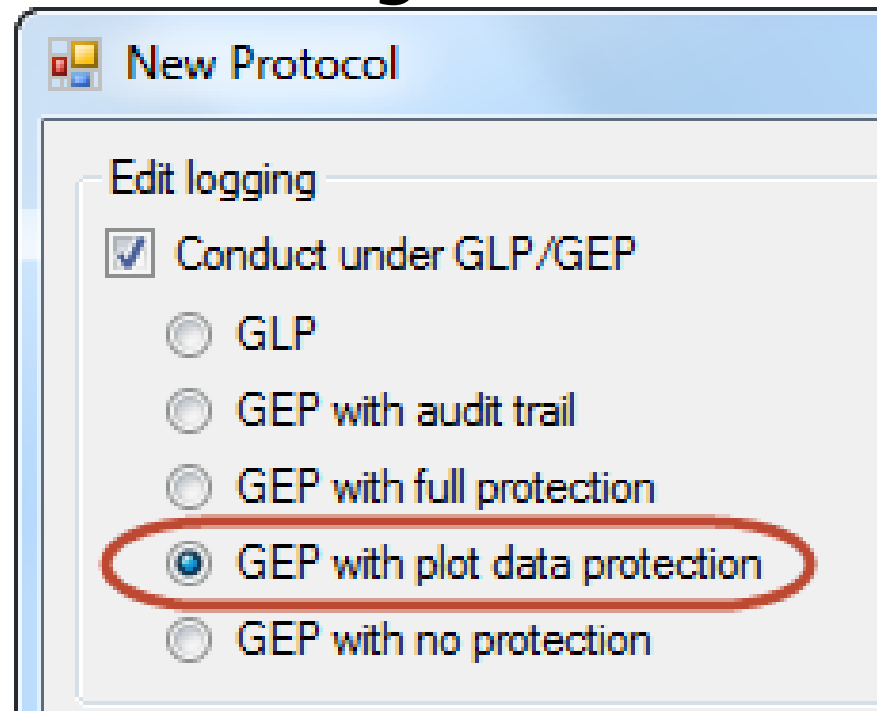
Post-hoc Power Analysis

- In example, LSD can distinguish 25% mean difference (largest existing difference is 18%)
- Current AOV Trt P(F) is 0.2979, so use 0.30+ significance level to separate treatment means
- Need 8+ replicates to reject null hypothesis at 0.05 significance

Crop Variety	CEZANNE
Trt No.	24
	2 85.33 a
	3 81.67 a
	4 98.00 a
	5 95.33 a
LSD P=.05 (% mean diff)	21.808 (25%)
Standard Deviation	10.915
CV	12.12
Grand Mean	90.083
Minimum Replicates (power = 80)	8
Largest Mean Difference (% mean diff)	16.333 (18%)
Treatment F	1.541
Treatment Prob(F)	0.2979

Data Protection

- Offer a protection that allows only trial owners to change assessment data



The screenshot shows a dialog box titled "New Protocol". Under the "Edit logging" section, there is a checked checkbox for "Conduct under GLP/GEP". Below this, there are five radio button options: "GLP", "GEP with audit trail", "GEP with full protection", "GEP with plot data protection" (which is circled in red), and "GEP with no protection".



Robust Data Collection Tools

- Enter data only once to avoid transcription errors
- Employ appropriate range checking for assessed values
- Perform data quality checks before leaving trial site (analyze, graph)
- Include photographs that illustrate or support measurements & observations

ARM Tablet Data Collector

Win 8.1
Pro
tablet
+
ARM
+
special
ARM
tablet
features

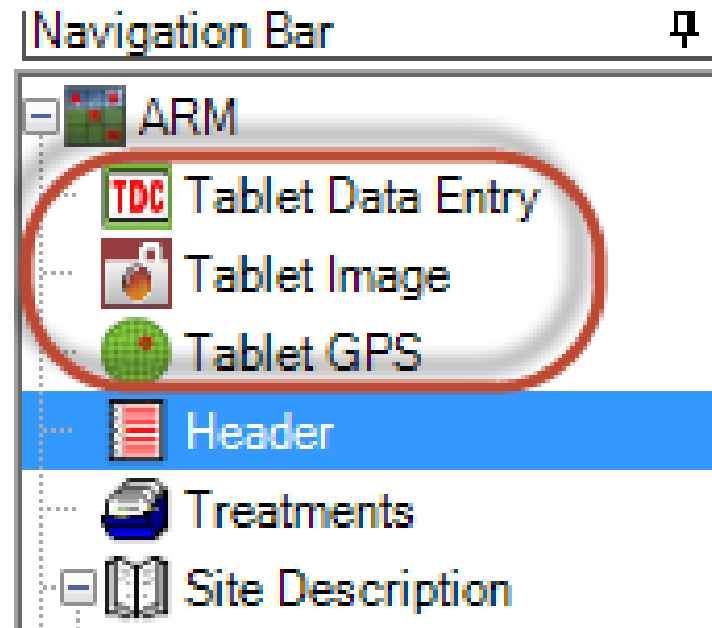
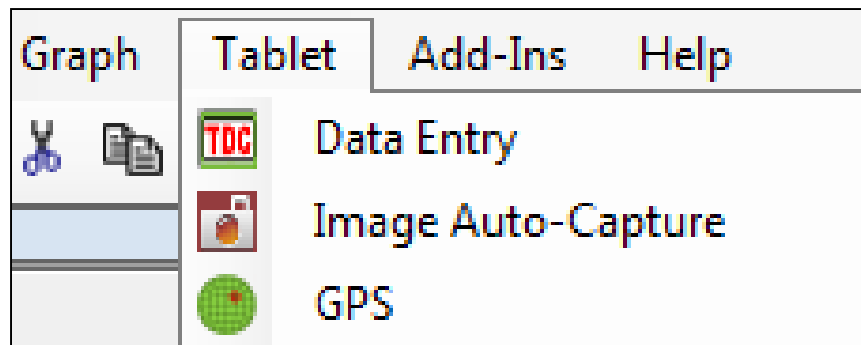
The screenshot displays the ARM Tablet Data Collector software interface. The main window is titled "Assessment Data - Line 1" and contains a table with the following data:

Sub	Plot	20	21
1	101		
1	102		
1	103		
1	104		
1	105		
1	205		
1	204		
1	203		
1	202		
1	201		
1	301		
1	302		
1	303		
1	304		

The interface also includes a menu bar (File, Edit, Format, Tools, Table, Utilities, Window, Graph, Tablet, Add-Ins, Help), a toolbar, and a Properties panel on the right. The Properties panel shows options for "Exit Tablet", "Data Entry", "Tools", "AOV Means Table", "Box-Whisker", and "Assessment Map". A keypad is visible at the bottom right, and the system tray shows the time as 8:13 PM on 3/22/2013.

Tablet Data Collector Features

- Tablet Data Entry
- Tablet Image Capture
- Tablet GPS



Assessment - Linked Image

Assessment Data - Line 1										
Column Number		7	8	9			Properties			
Pest Type		W <input type="checkbox"/> Weed	W <input type="checkbox"/> Weed	W <input type="checkbox"/> Weed	W <input type="checkbox"/> Weed		Assessment View			
Pest Name		<input type="checkbox"/> Soft wheat	<input type="checkbox"/> Blackgrass	<input type="checkbox"/> Blackgrass	<input type="checkbox"/> Blackgrass		View Options...			
Crop Name		<input type="checkbox"/> Winter rape	<input type="checkbox"/> Winter rape	<input type="checkbox"/> Winter rape	<input type="checkbox"/> Winter rape		Ignore Match			
Description							Refresh			
Rating Date		<input type="checkbox"/> 2008/Apr/11	<input type="checkbox"/> 2008/Apr/24	<input type="checkbox"/> 2008/Apr/24	<input type="checkbox"/> 2008/Apr/24		Hidden: Row			
Rating Type		<input type="checkbox"/> GROUND	<input type="checkbox"/> GROUND	<input type="checkbox"/> CONTRO	<input type="checkbox"/> CONTRO		Views			
Rating Unit		<input type="checkbox"/> %	<input type="checkbox"/> %	<input type="checkbox"/> %	<input type="checkbox"/> %		Original			
Sample Size, Unit							All fields			
Collection Basis, Unit							Hidden fields with information			
Number of Subsamples		1	1	1	1		Tools			
Days After First/Last Applic.		0	0	13	13		AOV Means Table			
Trit-Eval Interval		0 DA-A	13 DA-A	13 DA-A	13 DA-A		Box-Whisker			
Days After Emergence							Assessment Map			
ARM Action Codes		<input type="checkbox"/> P ES	<input type="checkbox"/> P ES	<input type="checkbox"/> P	<input type="checkbox"/> P		Treatment			
							<input type="checkbox"/> Display current treatment			
+ Sub	Rp	Bk	Col	Plot Δ	Trit		7	8	9	
<input type="checkbox"/> 1	1	1	1	101	4				75	
1	1	1	2	102	2				60.00	
1	1	1	3	103	5				70.00	
1	1	1	4	104	3				65.00	
1	1	1	5	105	1	8.00	25.00	9.00	0.00	
1	2	2	1	201	5				65.00	
1	2	2	2	202	4				70.00	
1	2	2	3	203	3				70.00	
1	2	2	4	204	1	12.00	18.00	12.00	0.00	
1	2	2	5	205	2				55.00	
1	3	3	1	301	3				65.00	
1	3	3	2	302	2				60.00	
Nov 2015	3	3	3	303	1	10.00	20.00	12.00	0.00	


Assessment (Plot 101, Col 9)

Comment: some plants damaged by animals

Barcode:

GPS:

Damaged

Image: 

Attach Remove Rename

Assessment Review Tools

- Analysis of Data
- Graph of Variability
- Assessment Map (look for site effect)

The screenshot displays a software interface with a data table on the left and a 'Tools' menu on the right. The data table has three rows with values in different colors. The 'Tools' menu contains three buttons: 'AOV Means Table', 'Box-Whisker', and 'Assessment Map'.

	4 (Calculated)
1.00	54
10.00	0.00
1.00	72.00

Tools

- AOV Means Table
- Box-Whisker
- Assessment Map

Analysis of Data

- Duncan's Test at 5%

- Coefficient of Variation

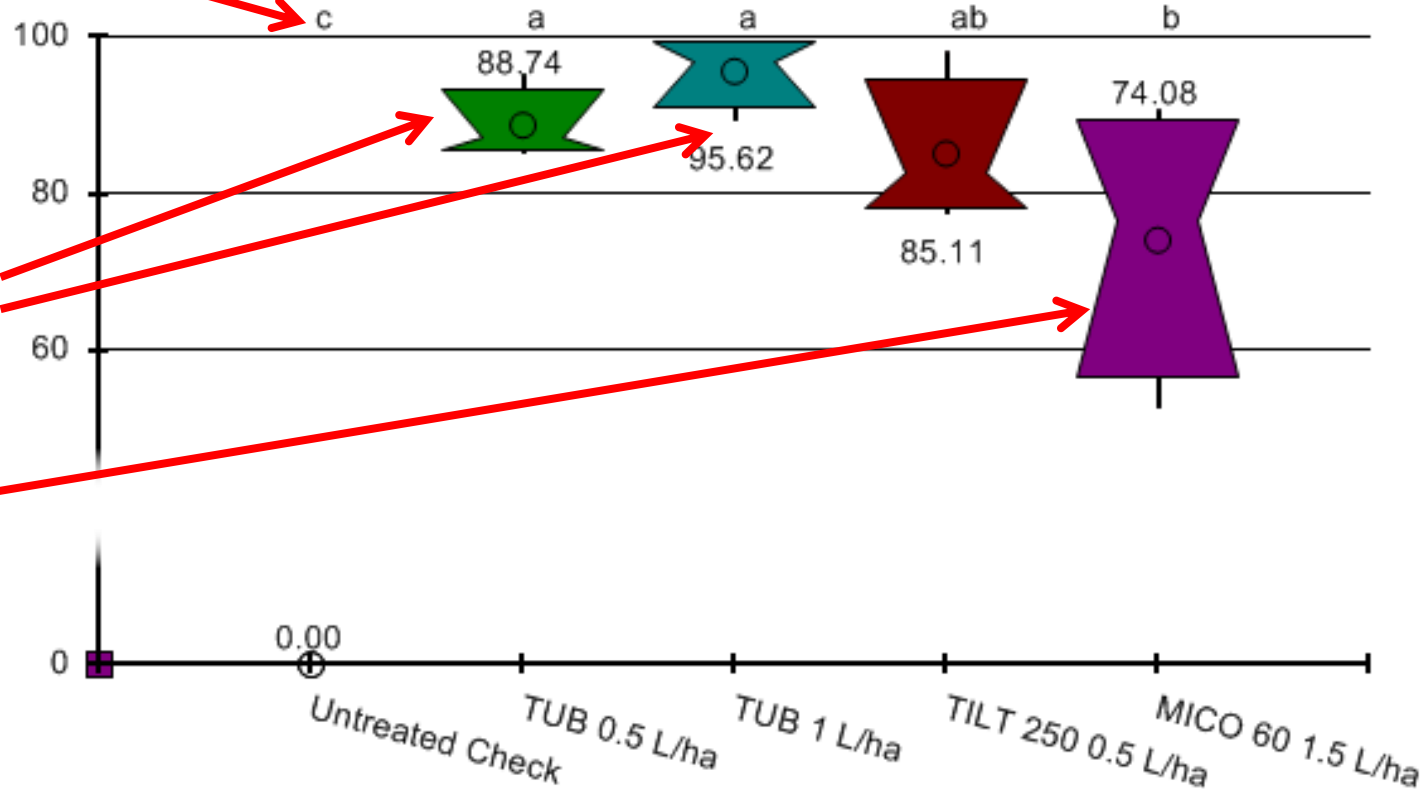
Pest Code	SEPTTR	SEPTTR
Description	severity	control
Rating Date	2/Jul/2008	2/Jul/2008
Rating Type	PESSEV	PESSEV
Rating Unit	%	%UNCK
Sample Size. Unit	10 LEAF	10 LEAF
Trt No.		8
Treatment Name		
Rate		
Appl Unit		
Code		
1 Untreated Check	ABC	15.51 a
2 TUB	0.5 l/ha ABC	1.74 b
3 TUB	1 l/ha ABC	0.83 b
4 TILT 250	0.5 l/ha ABC	2.35 b
5 MICO 60 FUNGOL	1.5 l/ha AB 1.25 l/ha C	3.88 b
LSD (P=.05)	3.146	12.750
Standard Deviation	2.042	8.275
CV	42.01	12.04
Bartlett's X2	10.194	6.963
P(Bartlett's X2)	0.037*	0.073
Skewness	1.7361*	-1.3261*
Kurtosis	2.3213*	0.1148
Replicate F	4.360	2.117
Replicate Prob(F)	0.0270	0.1514
Treatment F	35.175	89.729
Treatment Prob(F)	0.0001	0.0001

Variability Graph (Box-Whisker)

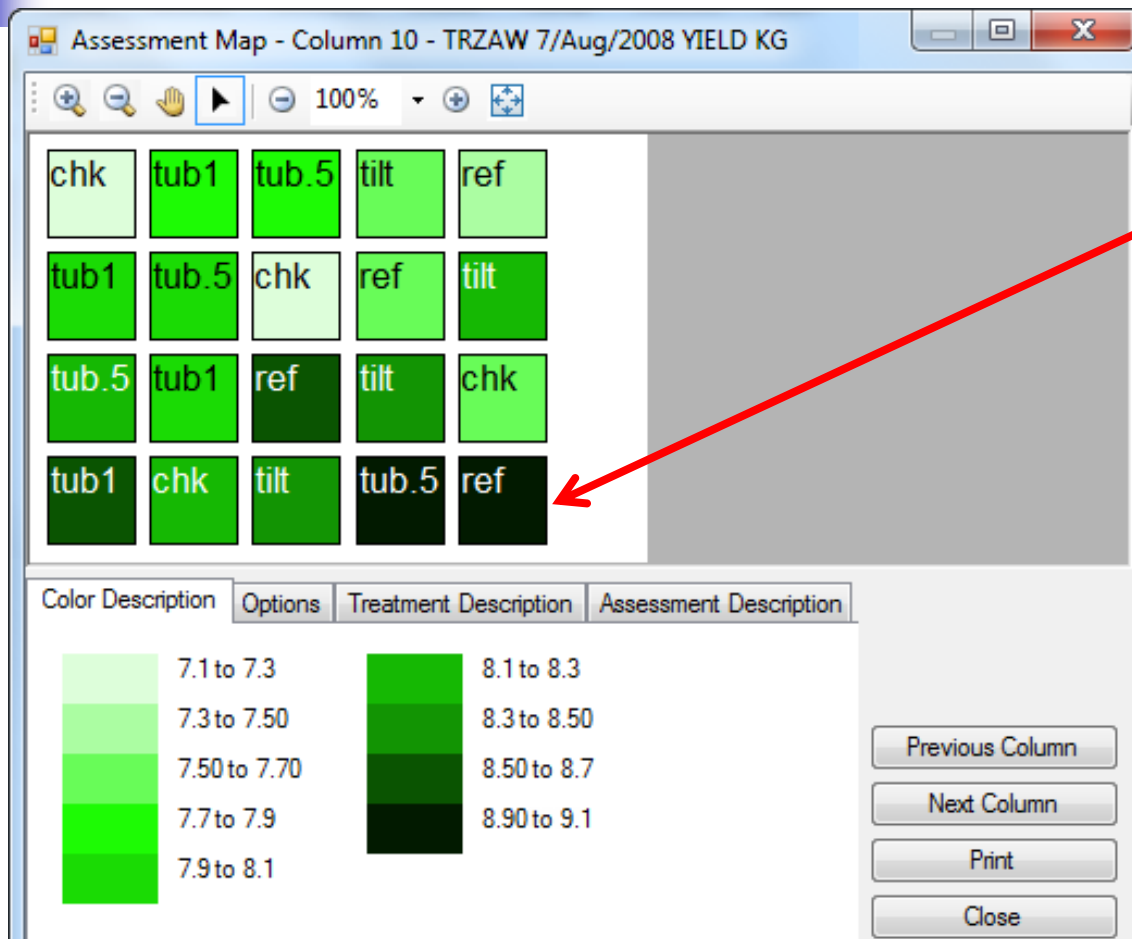
- Duncan's Test at 5%

- Stable across replicates

- More variable across replicates



Assessment Map



Replicate 1 values darker (larger) than other replicates

Site Information no. 1

■ Trial Location

Site Description						
General Trial	Objectives/Conclusions	Contacts	Crop Description	Pest Description	Site and Design	Maintenance
General Trial Information						
Discipline:	<input type="text" value="F"/>	<i>fungicide</i>				
Trial Status:	<input type="text" value="F"/>	<i>one-year/final</i>	Trial Reliability:	<input type="text" value="HIGH"/>		
Initiation Date:	<input type="text" value="2007/Sep/30"/>		Planned Completion Date:	<input type="text"/>		
Completion Date:	<input type="text" value="2008/Aug/7"/>					
Trial Location						
City:	<input type="text" value="GEMBLOUX"/>		Country:	<input type="text" value="BEL"/> <i>Belgium</i>		
State/Prov.:	<input type="text" value="NAMUR"/>					
Postal Code:	<input type="text" value="5030"/>		Climate Zone:	<input type="text" value="EPOMAR"/> <i>EPPO Maritime</i>		
Latitude of LL Corner °:	<input type="text" value="50.5667"/>	<input type="text" value="N"/>				
Longitude of LL Corner °:	<input type="text" value="4.6833"/>	<input type="text" value="E"/>				

Site Information no. 2

■ People

Site Description						
General Trial	Objectives/Conclusions	Contacts	Crop Description	Pest Description	Site and Design	Mainte
Contacts						
Study Director:	<input type="text" value="R.E. Cearch"/>	Title:	<input type="text" value="Study Leader"/>			
Organization:	<input type="text"/>					
Investigator:	<input type="text" value="I. M. Assist"/>	Title:	<input type="text" value="Site Manager"/>			
Organization:	<input type="text"/>					
Postal Code:	<input type="text"/>	E-mail:	<input type="text"/>			
Country:	<input type="text"/>					
Cooperator/Landowner						
Cooperator:	<input type="text" value="NORTH FARM"/>	Role:	<input type="text"/>			
Organization:	<input type="text"/>					
Address 1:	<input type="text"/>					
City:	<input type="text" value="GEMBLOUX"/>	Phone No.:	<input type="text" value="04 73 23 62 89"/>			
State/Prov:	<input type="text" value="NAMUR"/>	Fax No.:	<input type="text"/>			
Postal Code:	<input type="text" value="5030"/>	Mobile No.:	<input type="text"/>			
Country:	<input type="text" value="BLG"/> <i>Belgium</i>	E-mail:	<input type="text"/>			

Site Information no. 3

■ Site and Design

Site Description							
General Trial	Objectives/Conclusions	Contacts	Crop Description	Pest Description	Site and Design	Maintenance	Soil
Site and Design							
<i>Treated Plot Width:</i>	2.5	m			Site Type:	FIELD	field
<i>Treated Plot Length:</i>	10	m			Experimental Unit:	1	PLOT plot
<i>Treated Plot Area:</i>	25	m ²	<i>Treatments:</i>	5	Tillage Type:	CONTIL	conventional-till
Replications:	<input type="text" value="4"/>				<i>Study Design:</i>	RACOBL	Randomized Complete Block (RCB)
% Slope:	<input type="text" value="1.0"/>						
Untreated Arrangement:	<input type="text" value="INCLUDED"/>						single control randomized in each block

Site Information no. 4

■ Soil

Site Description			
Crop Description	Pest Description	Site and Design	Soil
Soil Description			
% Sand:	<input type="text" value="34"/>	% OM:	<input type="text" value="3.5"/>
% Silt:	<input type="text" value="45"/>	pH:	<input type="text" value="6.8"/>
% Clay:	<input type="text" value="21"/>	CEC:	<input type="text"/>
		Texture:	<input type="text" value="SIL"/> <i>silt loam</i>
		Soil Name:	<input type="text" value="Vienna silt loam"/>
		Fert. Level:	<input type="text"/>
		Soil Drainage:	<input type="text" value="G"/> <i>good</i>

Site Information no. 5

- Application

Site Description			
Contacts Crop Description Pest Description Site and Design Maintenance			
Application Description			
	A	B	C
Application Date:	2008/Apr/15 <input type="text"/>	2008/Jun/3 <input type="text"/>	2008/Jul/8 <input type="text"/>
Appl. Start Time:	14:30	10:00	11:15
Appl. Stop Time:			
Application Method:	SPRAY <input type="text"/>	SPRAY <input type="text"/>	SPRAY <input type="text"/>
Application Timing:	POSPOS <input type="text"/>	POSPOS <input type="text"/>	POSPOS <input type="text"/>
Application Placement:	BROFOL <input type="text"/>	BROFOL <input type="text"/>	BROFOL <input type="text"/>
Applied By:	<input type="text"/>	<input type="text"/>	<input type="text"/>
Air Temperature, Unit:	17 C <input type="text"/>	17 C <input type="text"/>	19.5 C <input type="text"/>
% Relative Humidity:	<input type="text"/>	<input type="text"/>	<input type="text"/>
Wind Velocity, Unit:	<input type="text"/>	<input type="text"/>	<input type="text"/>
Wind Direction:	<input type="text"/>	<input type="text"/>	<input type="text"/>
Dew Presence (Y/N):	<input type="text"/>	<input type="text"/>	<input type="text"/>
Soil Temperature, Unit:	10 C <input type="text"/>	13 C <input type="text"/>	16 C <input type="text"/>
Soil Moisture:	MOIST <input type="text"/>	DRY <input type="text"/>	MOIST <input type="text"/>
% Cloud Cover:	50	20	10

Site Information no. 6

■ Application Equipment

Site Description													
Site and Design		Maintenance		Soil		Moisture		Application		Crop Stage at Appl.		Pest Stage	
<p>Application Equipment</p> <p>Some information is copied from Application tab of Settings</p> <p>Use Application Description tab to insert or delete Applications</p>													
	A			B			C						
Appl. Equipment:	AZO <input type="checkbox"/>			AZO <input type="checkbox"/>			AZO <input type="checkbox"/>						
Operation Pressure, Unit:	2.6 BAR <input type="checkbox"/>			2.6 BAR <input type="checkbox"/>			2.6 BAR <input type="checkbox"/>						
Nozzle Type:	TEJ110 <input type="checkbox"/>			TEJ110 <input type="checkbox"/>			TEJ110 <input type="checkbox"/>						
Nozzle Size:	02			02			02						
Nozzle Spacing, Unit:	50 CM <input type="checkbox"/>			50 CM <input type="checkbox"/>			50 CM <input type="checkbox"/>						
Boom Length, Unit:	3 M <input type="checkbox"/>			3 M <input type="checkbox"/>			3 M <input type="checkbox"/>						
Spray Volume, Unit:	250 L/HA <input type="checkbox"/>			250 L/HA <input type="checkbox"/>			250 L/HA <input type="checkbox"/>						
Mix Size, Unit:	2.65 Liters <input type="checkbox"/>			2.65 Liters <input type="checkbox"/>			2.65 Liters <input type="checkbox"/>						



Site Information no. 7

- Other site information as appropriate
 - Trial objectives and conclusions
 - Crop and pest details
 - Rainfall and irrigation
 - Notes and deviations from protocol

- [-] [book icon] Site Description
 - ... General Trial
 - ... Objectives/Conclusions
 - ... Contacts
 - ... Crop Description
 - ... Pest Description
 - ... Site and Design
 - ... Maintenance
 - ... Soil
 - ... Moisture
 - ... Application
 - ... Crop Stage at Appl.
 - ... Pest Stage at Appl.
 - ... Appl. Equipment
 - ... Treatment Appl. Comments
 - ... Notes
 - ... Deviations
 - ... Protocol Comments



Management Reports

- Trial Map
- Applications: spray or seeding plan
- Plot Signs
- Site Information
- Labels: container, plot, seed, harvest
- Field Tour Sheet
- List of Treatments
- Statistical analysis of assessments



Label Reports

- Labels for:
 - Pre-measured quantity of products for each application, placed in small containers

----- Container -----

Container 1/Trt. Line

Brief Container 1/Trt. Line

Brief Cont. Spray Volume, 1/trt line

Brief Cont., Material ID, SpVol, 1/trt line

Experimental Cont. 1/Line

Container 1/Trt. Line + Title

Container 1/Trt. Line + Appl

Container 1/Treatment

Container 1/Treatment + Title

Cont. Multi-Row Trt. 4"x2"

Cont. Multi-Row Lg. Plot #

Cont. Multi-Row Lg.#, File Name

Cont. Multi-Row Lg.#, Mix Size

Cont. Multi-Row Lg.#, Mix Details 99x68mm

Cont. Multi-Row Lg.#, Mix, Rate, Stage 4"x2"

Cont. Weight Audit (1 wide line)

Container Export (1 wide line)



Label Reports

- Labels for:
 - Identifying each plot

----- Plot -----
Plot # Spray Randomization (1/Trt.)
Large Plot # Spray Rand. (1/Trt.)
Plot 1/plot
Brief Plot 1/plot
Plot Soil Core Tube
AgCan Tyvec Plot 6"x3"
AgCan Tear-off Plot 6"x3"
AgCan Tear-off Plot (harvest order)
AgCan Brief Plot
Large Plot # Stake Label
Large Plot # Stake/no Trial ID
Large Bold Plot # Stake Label
Large Plot # Sample Label
Large Plot # Sample, bar code
Large Plot # Sample+Product, bar code
Plot Product Quantity
Plot Seed Tray (in trt. order)
Large Plot # Trt. Mix (Ridgetown)



Label Reports

- Labels for:
 - Identifying packets of seed to plant
 - Identifying small sacks of material harvested from each plot

----- Seed Packet -----

Seed Packet (in trt. order)

Seed Packet (detailed, 1/Plot * Subs)

Seed Packet (detailed, 1/Plot, trt. order)

Seed Packet (detailed, 'n' blank pages)

Seed Packet (brief, 1/Treatment)

Seed Packet (brief, 'n' blank pages)

----- Harvest -----

Plot Harvest (in harvest order)

Plot Harvest+Moisture,Weight fill-in

Plot Harvest+Range/Row, bar code

Harvest Bag (in harvest order)

Harvest Bag, bar code Plot (harvest order)

Harvest Bag (pooled, 1/Trt.)

Brief Harvest Bag (harvest order)

Brief Harvest Bag (pooled, 1/Trt.)

Brief Harvest Bag, bar code Trial,Trt,Plot

Brief Harvest Bag, bar code Trt,Plot

Brief Harvest Bag, bar code Plot

Brief Tear-off Harvest Bag 6.75cm x 5cm

Applications Report

■ Spray/Seeding Plan

Product quantity to measure for each application rate

Trial ID: G-All7 Fung Location: Gembloux Trial Year:

Reps: 4 Appl Code: A Plots: 2.5 by 10 meters
 Spray vol: 200 L/ha Mix size: 2.15 liters (min 2.15)

Trt No.	Treatment Name	Form Conc	Form Unit	Form Type	Rate Rate	Rate Unit	Appl Code	Spray Volume	Volume Unit	Mix Size	Mix Unit	Amt Product to Measure	Rep 1	Rep 2	Rep 3	Rep 4
3	TUB	250	G/L	EC	1	l/ha	ABC					10.75 ml/mx	101	202	301	402
1	Untreated Check						ABC						102	205	303	401
4	TILT 250	250	G/L	EC	0.5	l/ha	ABC					5.375 ml/mx	103	204	305	404
2	TUB	250	G/L	EC	0.5	l/ha	ABC					5.375 ml/mx	104	201	302	403
5	MICO 60	600	G/L	EC	1.5	l/ha	AB	250 L/HA	2.65	Liters		15.9 ml/mx	105	203	304	405

Reps: 4 Appl Code: B Plots: 2.5 by 10 meters
 Spray vol: 200 L/ha Mix size: 2.15 liters (min 2.15)

Trt No.	Treatment Name	Form Conc	Form Unit	Form Type	Rate Rate	Rate Unit	Appl Code	Spray Volume	Volume Unit	Mix Size	Mix Unit	Amt Product to Measure	Rep 1	Rep 2	Rep 3	Rep 4
3	TUB	250	G/L	EC	1	l/ha	ABC					10.75 ml/mx	101	202	301	402
1	Untreated Check						ABC						102	205	303	401
4	TILT 250	250	G/L	EC	0.5	l/ha	ABC					5.375 ml/mx	103	204	305	404
2	TUB	250	G/L	EC	0.5	l/ha	ABC					5.375 ml/mx	104	201	302	403
5	MICO 60	600	G/L	EC	1.5	l/ha	AB	250 L/HA	2.65	Liters		15.9 ml/mx	105	203	304	405

Appl. no. 1

Appl. no. 2



Data Analysis Reports

- Choices of different statistical methods:
 - Assessment Data Summary
 - AOV Means Table
 - Factorial AOV
 - Correlations
 - Dose-Response

Study Management Tools

ARM 9.1.1 (GDMdef)

File Edit Format Tools Table Utilities Window Graph Add-Ins Help

Study List

Select study to open

Selected Study

Filter

- Header
- Site Description
- Site Description - General(1)
- Site Description - General(2)
- Treatment
- Other

Header

Study ID Parent Protocol Study Type

Title

Site Description - General(1)

Location

Keywords

GLP Investigator

GEP Study Director

Project ID

Other Study Director Organization

Site Description - General(2)

Technician

Other Investigator Organization

Trial Location City Trial Location State/Prov.

Trial Postal Code Trial Location Country Latitude Longitude

Status Discipline

Initiation Date Planned Completion Date

Other Trial ID

Study Type

- All/No Filter
- Trials Only
- Protocols Only

When was it modified?

- Don't remember
- Within the last week
- Past month
- Within the past year

Active Filter (46):
Active Studies

Selected	Study ID	Parent Protocol	Project ID	Other Trial ID	Study Type	Discipline	Status	Title
<input type="checkbox"/>	AUDPC7				Trial		F	AUDPC Transformation/Graph Example Tr
<input checked="" type="checkbox"/>	G-AII7_Fung	G-AII7_Fung			Trial	F	F	An assessment of the efficacy of TUB and c
<input type="checkbox"/>	AlphaLattice Tutorial	Alpha-Lattice Design			Trial	SEED	E	Alpha design example, John and Williams
<input type="checkbox"/>	ATD_06HERB-05_01	ATD_06HERB-05	ATD_07HERB-05	DDM06-49H01	Trial	F	F	Herbicidal efficacy of HERB_2203 with a re
<input type="checkbox"/>	ATD_06HERB-05_02	ATD_06HERB-05	ATD_07HERB-05	DDM06-49H02	Trial	F	F	Herbicidal efficacy of HERB_2203 with a re
<input type="checkbox"/>	ATD_06HERB-05_03	ATD_06HERB-05	ATD_07HERB-05	DDM06-49H03	Trial	F	F	Herbicidal efficacy of HERB_2203 with a re
<input type="checkbox"/>	ATD_06HERB-05_04	ATD_06HERB-05	ATD_07HERB-05	DDM06-49H4	Trial	F	F	Herbicidal efficacy of HERB_2203 with a re
<input type="checkbox"/>	ATD_06HERB-05_05	ATD_06HERB-05	ATD_07HERB-05	DDM06-49H05	Trial	F	F	Herbicidal efficacy of HERB_2203 with a re
<input type="checkbox"/>	ATD_06HERB-05_06	ATD_06HERB-05	ATD_07HERB-05	DDM06-49H06	Trial	F	F	Herbicidal efficacy of HERB_2203 with a re
<input type="checkbox"/>	BRO-05-01_01	BRO-05-01			Trial	SEED	F	Screening - Broccoli - 2005 - Central area
<input type="checkbox"/>	CORN_Yield_05_01_01	CORN_Yield_05_01			Trial	SEED	F	Corn North - Yield trials for Product positio
<input type="checkbox"/>	G-AII7_Fung_srg	G-AII7_Fung			Trial	F	F	An assessment of the efficacy of TUB and c
<input type="checkbox"/>	G-AII7_Herb	G-AII7_Herb			Trial	H	F	Determination of the efficacy and lowest eff
<input type="checkbox"/>	G-AII7_Herb	G-AII7_Herb			Trial	H	F	Determination of the efficacy and lowest eff
<input type="checkbox"/>	G-AII7_Herb2	G-AII7_Herb			Trial	H	F	Determination of the efficacy and lowest eff

Selected Study

Study ID G-AII7_Fung Parent Protocol G-AII7_Fu

Title An assessment of the efficacy of TUB and other fungicides for the

Location Gembloux

Keywords

GLP Investigator Your Name

GEP Study Director R.E. Search

Project ID

Other Study Director R.E. Search

Technician

Other Investigator ARM Demonstration

Trial Location City GEMBLOUX

Trial Postal Code 5030 Trial Location Cour

Status F Discipline

Select All Clear All Remove Filter

Nov 2015

Include selected studies Tutorial

Browse... Rebuild... Clipboard OK Help

Study Management Tools

- Track progress of studies
- Search current and historical trials
- Extract information for mapping, etc.



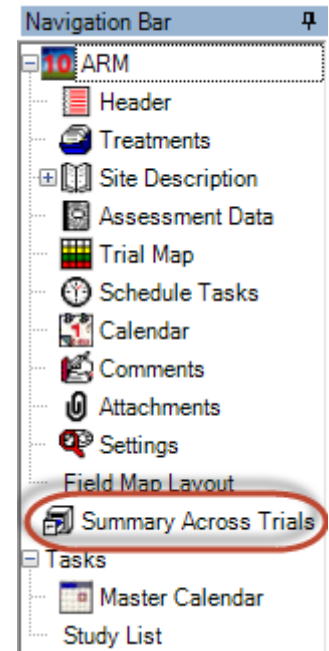


Multi-Trial Summary

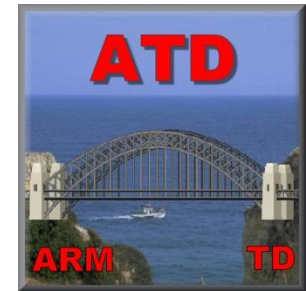
- Tools to analyze experiments over locations and years
- Easy selection of trials, treatments, and assessments to include
- Automated statistical analysis

ARM Summary Across Trials

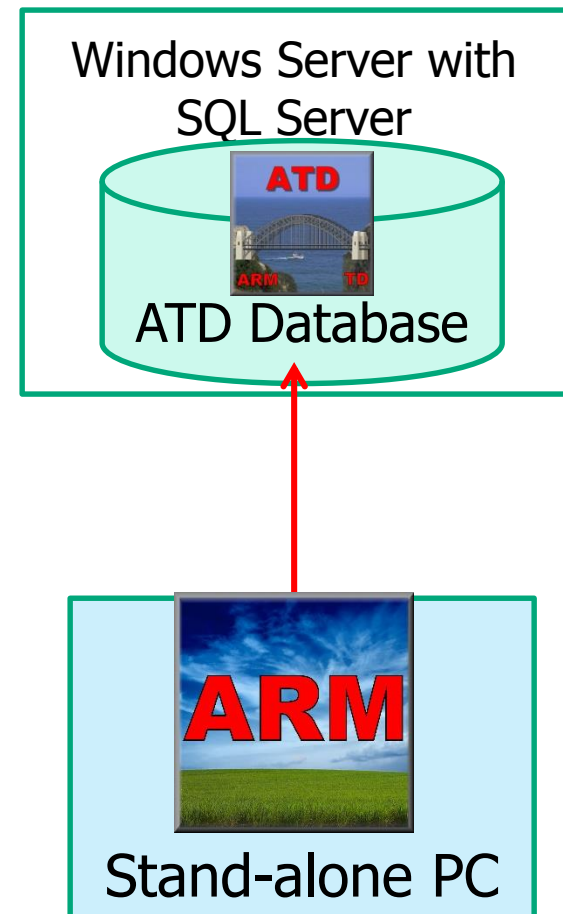
- Optional ARM add-in to summarize a trial series over locations and years
- Summarize selected treatments/entries across a wide range of trials
- View and arrange summary on a grid
- Export the report to Word, Excel, PDF
- Data graphs of across-trial means, trial clusters
- Export raw data to other statistics software



ATD Trial Database

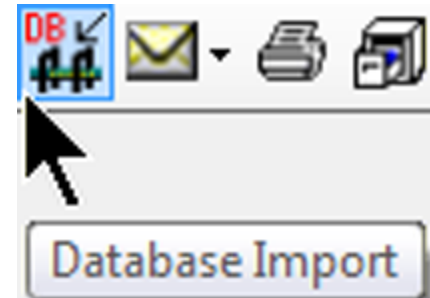


- ARM clients connect to ATD Backend database either directly over a local network, or remotely over VPN
- Authorized ARM clients export trials to SQL Server ATD Backend database that resides on the shared server



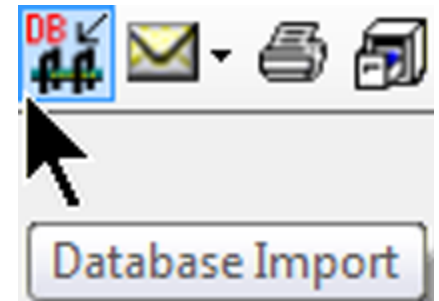
Using ATD with ARM

- Authorized ARM users export trials to ATD database using “Database Export” button on ARM toolbar
- All ARM users who install the ATD connection can import trials from ATD using “Database Import” to select 1 or more trials to import from Backend database (interface is similar to ARM study list)



Using ATD with ARM

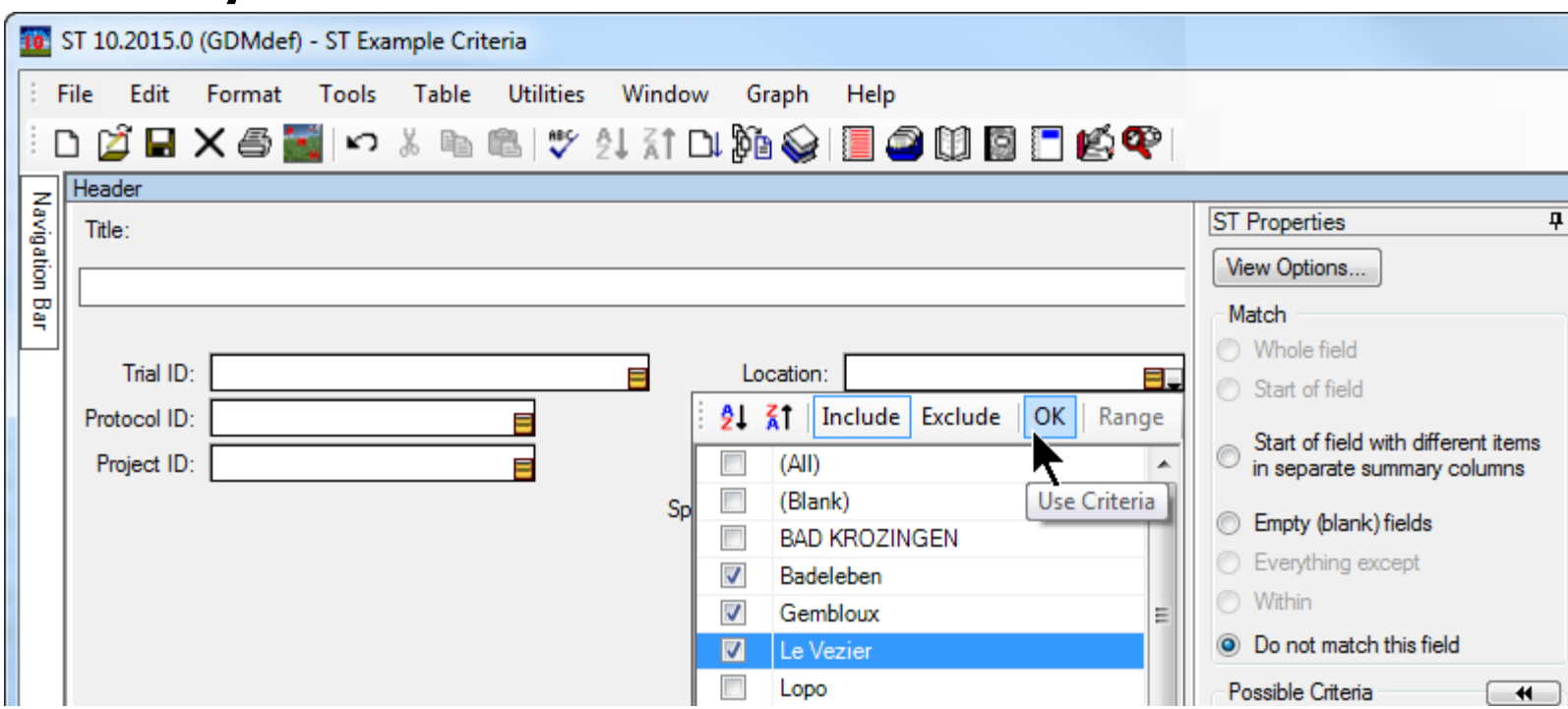
- ARM trials imported from ATD Backend database can be used in ARM like any standard trial: reviewing, graphing, and analyzing assessment data, or printing reports





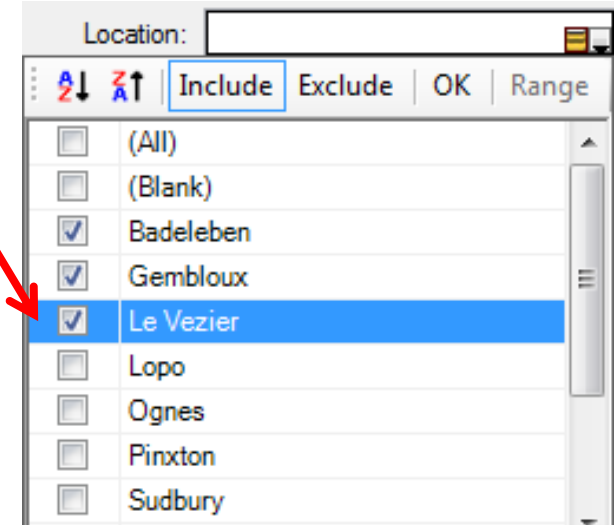
Using ATD with ST

ST criteria/query selection screen connects directly to ATD



Using ATD with ST

- ST is the query and multi-trial summary interface for ATD.
- Select one or more field entries from drop-down lists showing unique field entries in ATD for the current ARM entry field.





Software Must Always “Grow”

- As research methods and objectives change and improve, software must also adapt to support those new research objectives and methods.
- “Unchanging” software:
 - Becomes less useful each year.
 - Can be costly by “losing” (not supporting) information gathered with new technology.