Developing an online toolbox for tree fruit breeding

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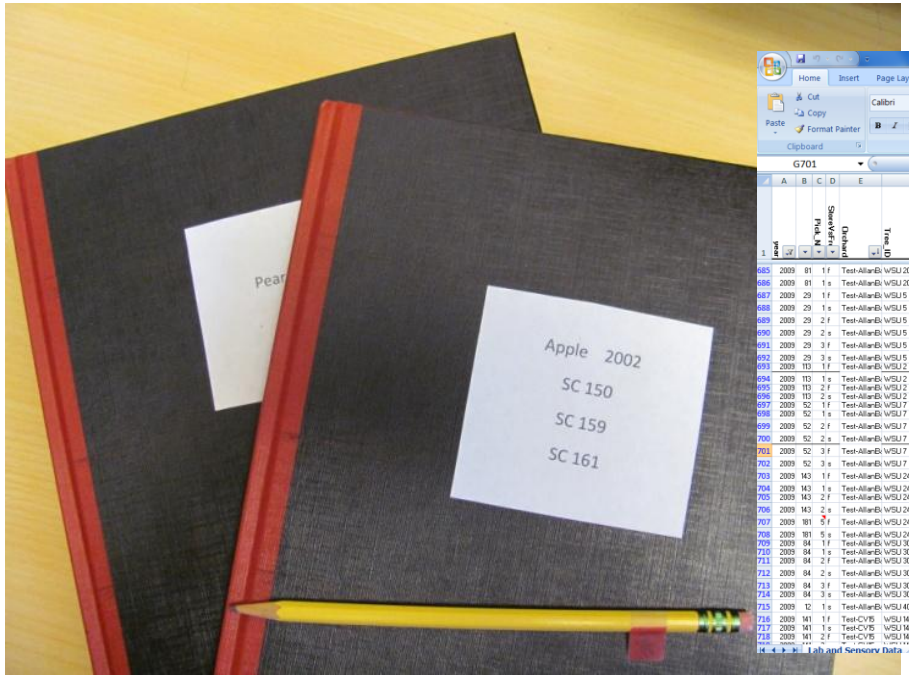
Nnadozie Oraguzie, Cameron Peace
and Dorrie Main

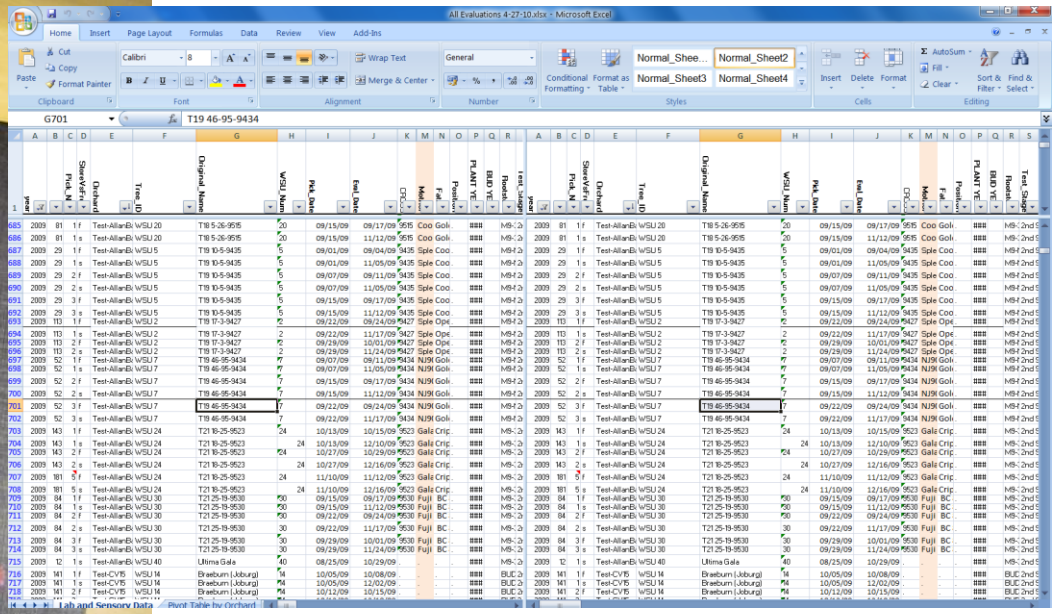
WASHINGTON STATE UNIVERSITY

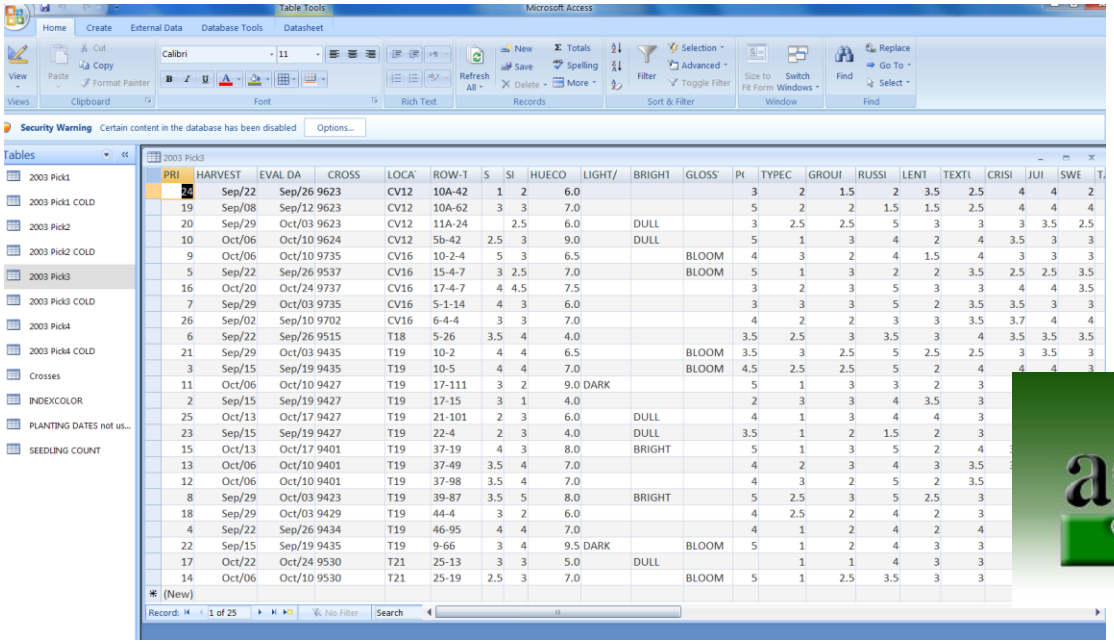
CapeTown RGC5 5th International Rosaceae Genomics Conference 2010

Breeding programs generate a lot of data!

Year after year after year….







PRI	HARVEST	EVAL DA	CROSS	LOCA	ROW-T	S	SI	HUECO	LIGHT/	BRIGHT	GLOSS	PI	TYPEC	GROUI	RUSSI	LENT	TEXTI	CRISI	JUI	SWE
24	Sep/22	Sep/26	9623	CV12	10A-42	1	2	6.0				3	2	1.5	2	3.5	2.5	4	4	2
19	Sep/08	Sep/12	9623	CV12	10A-62	3	3	7.0				5	2	2	1.5	1.5	2.5	4	4	4
20	Sep/29	Oct/03	9623	CV12	11A-24		2.5	6.0		DULL		3	2.5	2.5	5	3	3	3	3.5	2.5
10	Oct/06	Oct/10	9624	CV12	5b-42	2.5	3	9.0		DULL		5	1	3	4	2	4	3.5	3	3
9	Oct/06	Oct/10	9735	CV16	10-2-4	5	3	6.5			BLOOM	4	3	2	4	1.5	4	3	3	3
5	Sep/22	Sep/26	9537	CV16	15-4-7	3	2.5	7.0			BLOOM	5	1	3	2	2	3.5	2.5	2.5	3.5
16	Oct/20	Oct/24	9737	CV16	17-4-7	4	4.5	7.5				3	2	3	5	3	3	4	4	3.5
7	Sep/29	Oct/03	9735	CV16	5-1-14	4	3	6.0				3	3	3	5	2	3.5	3.5	3	3
26	Sep/02	Sep/10	9702	CV16	6-4-4	3	3	7.0				4	2	2	3	3	3.5	3.7	4	4
6	Sep/22	Sep/26	9515	T18	5-26	3.5	4	4.0				3.5	2.5	3	3.5	3	4	3.5	3.5	3.5
21	Sep/29	Oct/03	9435	T19	10-2	4	4	6.5			BLOOM	3.5	3	2.5	5	2.5	2.5	3	3.5	3
3	Sep/15	Sep/19	9435	T19	10-5	4	4	7.0			BLOOM	4.5	2.5	2.5	5	2	4	4	4	3
11	Oct/06	Oct/10	9427	T19	17-111	3	2	9.0	DARK			5	1	3	3	2	3			
2	Sep/15	Sep/19	9427	T19	17-15	3	1	4.0				2	3	3	4	3.5	3			
25	Oct/13	Oct/17	9427	T19	21-101	2	3	6.0		DULL		4	1	3	4	4	3			
23	Sep/15	Sep/19	9427	T19	22-4	2	3	4.0		DULL		3.5	1	2	1.5	2	3			
15	Oct/13	Oct/17	9401	T19	37-19	4	3	8.0		BRIGHT		5	1	3	5	2	4			
13	Oct/06	Oct/10	9401	T19	37-49	3.5	4	7.0				4	2	3	4	3	3.5			
12	Oct/06	Oct/10	9401	T19	37-98	3.5	4	7.0				4	3	2	5	2	3.5			
8	Sep/29	Oct/03	9423	T19	39-87	3.5	5	8.0		BRIGHT		5	2.5	3	5	2.5	3			
18	Sep/29	Oct/03	9429	T19	44-4	3	2	6.0				4	2.5	2	4	2	3			
4	Sep/22	Sep/26	9434	T19	46-95	4	4	7.0				4	1	2	4	2	4			
22	Sep/15	Sep/19	9435	T19	9-66	3	4	9.5	DARK		BLOOM	5	1	2	4	3	3			
17	Oct/22	Oct/24	9530	T21	25-13	3	3	5.0		DULL			1	1	4	3	3			
14	Oct/06	Oct/10	9530	T21	25-19	2.5	3	7.0			BLOOM	5	1	2.5	3.5	3	3			
* (New)																				

agronomix SOFTWARE INC.

Outline

- Washington apple breeding program & database needs
- Specific goals for a breeders toolbox
- Progress report
- Further work

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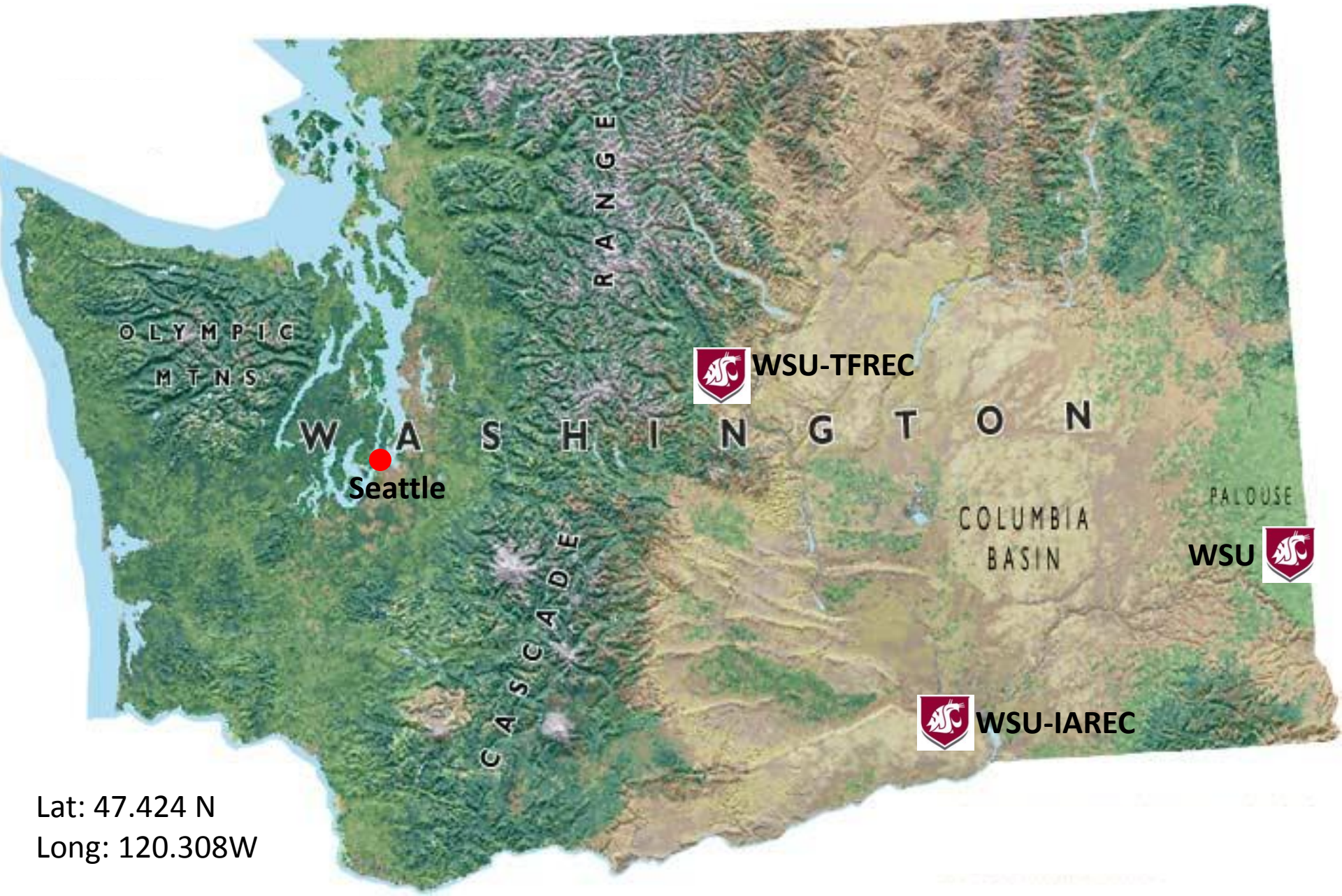
Washington State



Lat: 47.424 N
Long: 120.308W

WSU apple breeding program

Relatively new – started in 1994

Approx 15,000 fruiting seedlings

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Specific goals for a breeders toolbox

- Provide a secure, private database management system
- Fully integrated with GDR to enable use of public marker/trait/genomics data
- Integrated analysis capabilities

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Progress

1. Database schema developed in Chado
2. Excel template for database created

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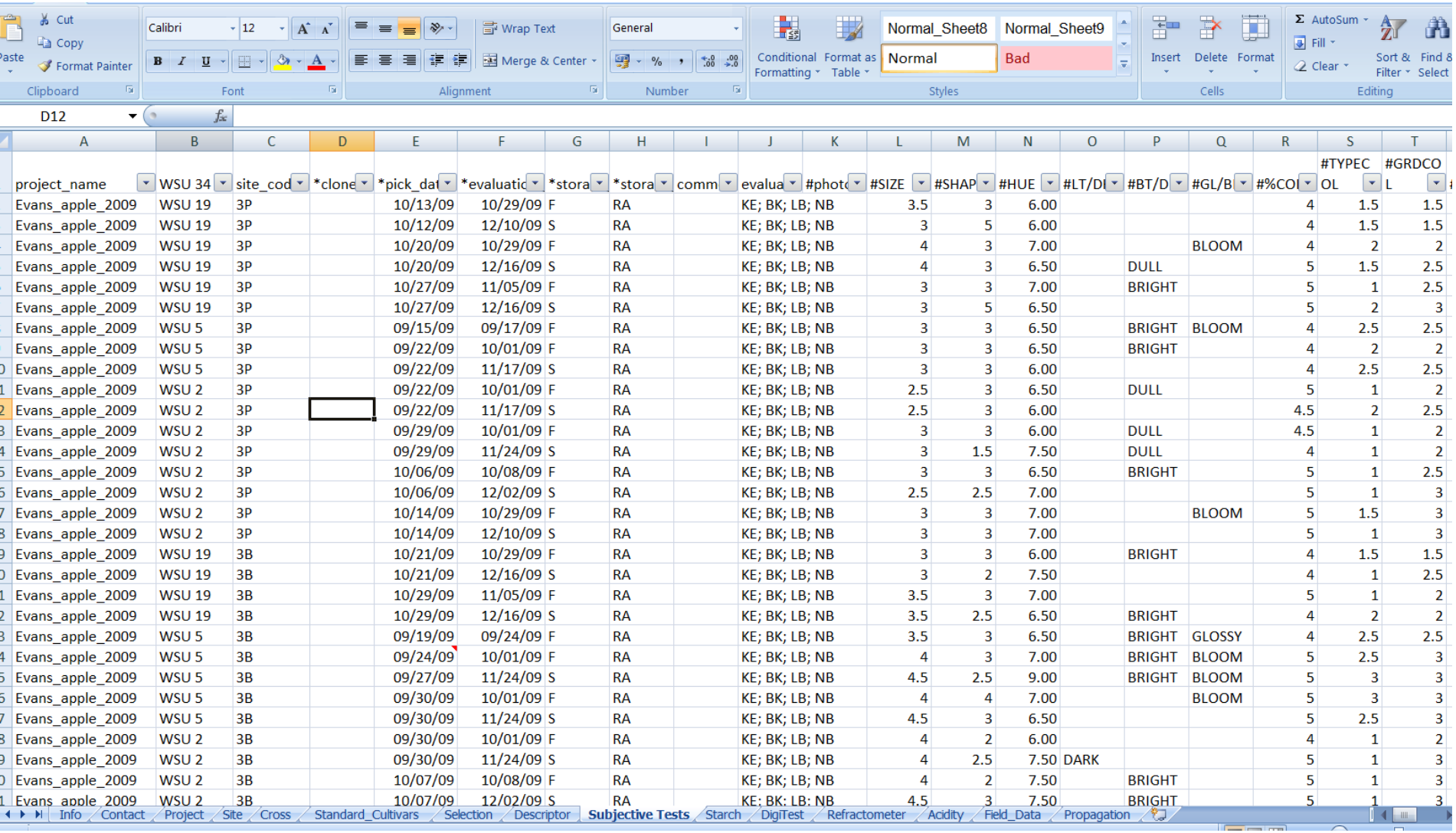

Cut
Copy
Format Painter
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Font
Wrap Text
Merge & Center
Alignment
General
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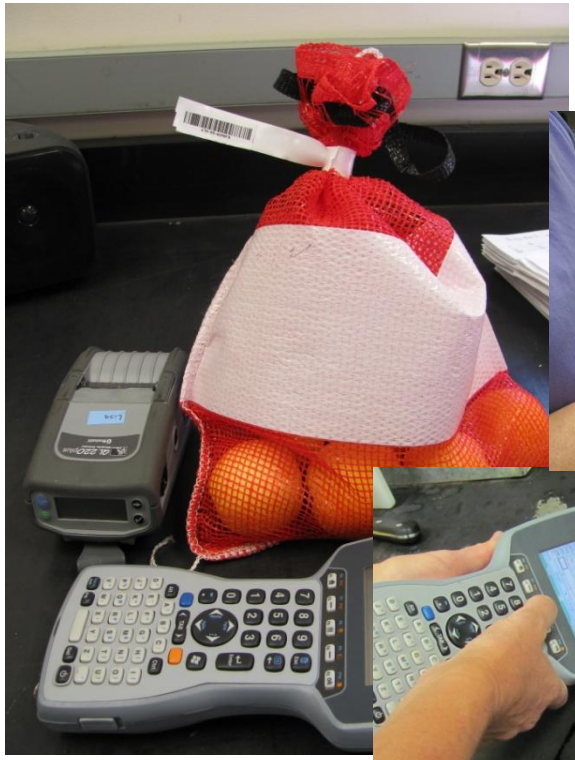
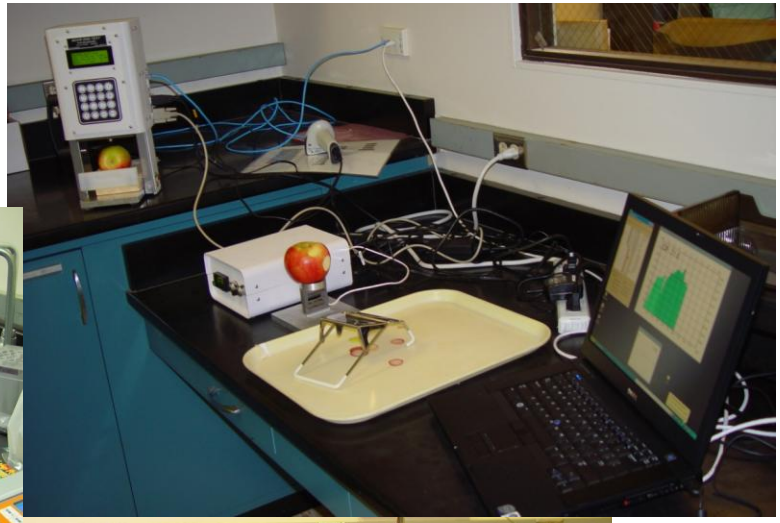
Conditional Formatting
Format as Table
Normal_Sheet8
Normal_Sheet9
Normal
Bad
Styles
Insert
Delete
Format
Cells
AutoSum
Fill
Clear
Sort & Filter
Find & Select
Editing
D12

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T
	project_name	WSU 34	site_cod	*clone	*pick_dat	*evaluatic	*stora	*stora	comm	evalua	#phot	#SIZE	#SHAP	#HUE	#LT/DI	#BT/D	#GL/B	#%COI	#TYPEC OL	#GRDCO L
	Evans_apple_2009	WSU 19	3P		10/13/09	10/29/09	F	RA		KE; BK; LB; NB		3.5	3	6.00				4	1.5	1.5
	Evans_apple_2009	WSU 19	3P		10/12/09	12/10/09	S	RA		KE; BK; LB; NB		3	5	6.00				4	1.5	1.5
	Evans_apple_2009	WSU 19	3P		10/20/09	10/29/09	F	RA		KE; BK; LB; NB		4	3	7.00			BLOOM	4	2	2
	Evans_apple_2009	WSU 19	3P		10/20/09	12/16/09	S	RA		KE; BK; LB; NB		4	3	6.50		DULL		5	1.5	2.5
	Evans_apple_2009	WSU 19	3P		10/27/09	11/05/09	F	RA		KE; BK; LB; NB		3	3	7.00		BRIGHT		5	1	2.5
	Evans_apple_2009	WSU 19	3P		10/27/09	12/16/09	S	RA		KE; BK; LB; NB		3	5	6.50				5	2	3
	Evans_apple_2009	WSU 5	3P		09/15/09	09/17/09	F	RA		KE; BK; LB; NB		3	3	6.50		BRIGHT	BLOOM	4	2.5	2.5
	Evans_apple_2009	WSU 5	3P		09/22/09	10/01/09	F	RA		KE; BK; LB; NB		3	3	6.50		BRIGHT		4	2	2
0	Evans_apple_2009	WSU 5	3P		09/22/09	11/17/09	S	RA		KE; BK; LB; NB		3	3	6.00				4	2.5	2.5
1	Evans_apple_2009	WSU 2	3P		09/22/09	10/01/09	F	RA		KE; BK; LB; NB		2.5	3	6.50		DULL		5	1	2
2	Evans_apple_2009	WSU 2	3P		09/22/09	11/17/09	S	RA		KE; BK; LB; NB		2.5	3	6.00				4.5	2	2.5
3	Evans_apple_2009	WSU 2	3P		09/29/09	10/01/09	F	RA		KE; BK; LB; NB		3	3	6.00		DULL		4.5	1	2
4	Evans_apple_2009	WSU 2	3P		09/29/09	11/24/09	S	RA		KE; BK; LB; NB		3	1.5	7.50		DULL		4	1	2
5	Evans_apple_2009	WSU 2	3P		10/06/09	10/08/09	F	RA		KE; BK; LB; NB		3	3	6.50		BRIGHT		5	1	2.5
6	Evans_apple_2009	WSU 2	3P		10/06/09	12/02/09	S	RA		KE; BK; LB; NB		2.5	2.5	7.00				5	1	3
7	Evans_apple_2009	WSU 2	3P		10/14/09	10/29/09	F	RA		KE; BK; LB; NB		3	3	7.00			BLOOM	5	1.5	3
8	Evans_apple_2009	WSU 2	3P		10/14/09	12/10/09	S	RA		KE; BK; LB; NB		3	3	7.00				5	1	3
9	Evans_apple_2009	WSU 19	3B		10/21/09	10/29/09	F	RA		KE; BK; LB; NB		3	3	6.00		BRIGHT		4	1.5	1.5
0	Evans_apple_2009	WSU 19	3B		10/21/09	12/16/09	S	RA		KE; BK; LB; NB		3	2	7.50				4	1	2.5
1	Evans_apple_2009	WSU 19	3B		10/29/09	11/05/09	F	RA		KE; BK; LB; NB		3.5	3	7.00				5	1	2
2	Evans_apple_2009	WSU 19	3B		10/29/09	12/16/09	S	RA		KE; BK; LB; NB		3.5	2.5	6.50		BRIGHT		4	2	2
3	Evans_apple_2009	WSU 5	3B		09/19/09	09/24/09	F	RA		KE; BK; LB; NB		3.5	3	6.50		BRIGHT	GLOSSY	4	2.5	2.5
4	Evans_apple_2009	WSU 5	3B		09/24/09	10/01/09	F	RA		KE; BK; LB; NB		4	3	7.00		BRIGHT	BLOOM	5	2.5	3
5	Evans_apple_2009	WSU 5	3B		09/27/09	11/24/09	S	RA		KE; BK; LB; NB		4.5	2.5	9.00		BRIGHT	BLOOM	5	3	3
6	Evans_apple_2009	WSU 5	3B		09/30/09	10/01/09	F	RA		KE; BK; LB; NB		4	4	7.00			BLOOM	5	3	3
7	Evans_apple_2009	WSU 5	3B		09/30/09	11/24/09	S	RA		KE; BK; LB; NB		4.5	3	6.50				5	2.5	3
8	Evans_apple_2009	WSU 2	3B		09/30/09	10/01/09	F	RA		KE; BK; LB; NB		4	2	6.00				4	1	2
9	Evans_apple_2009	WSU 2	3B		09/30/09	11/24/09	S	RA		KE; BK; LB; NB		4	2.5	7.50	DARK			5	1	3
0	Evans_apple_2009	WSU 2	3B		10/07/09	10/08/09	F	RA		KE; BK; LB; NB		4	2	7.50		BRIGHT		5	1	3
1	Evans_apple_2009	WSU 2	3B		10/07/09	12/02/09	S	RA		KE; BK; LB; NB		4.5	3	7.50		BRIGHT		5	1	3

Info | Contact | Project | Site | Cross | Standard_Cultivars | Selection | Descriptor | Subjective Tests | Starch | DigiTest | Refractometer | Acidity | Field_Data | Propagation

Collecting lab data





Progress

1. Database schema developed in Chado
2. Excel template for database created
3. Existing data converted into templates
4. Scripts created to upload data in template to Chado
5. Data uploaded to Chado
6. Interfaces for browse, search and data download under development

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search database

search by name | search by evaluation data | search by parentage

name :

start with

OR

upload file :

Browse...

restricted by :

project name: Evans_apple

site name: no site

- subjective test
- analytical test
- field data

search | reset | contact

Go Back to Search Page

Browse projects with sites

Display all the project names with the project type "breeding" and the sites where the stock was planted.

project name	sites		
Evans_apple_2009	Columbia View 04	Columbia View 05	Columbia View 06
	Fullers 04		

Go Back to Browse Page

Washington State University

Funded by the 2009 USDA NIFA Specialty Crop Research Initiative Program

Clemson University

search database

search by name | search by evaluation data | search by parentage

name :

start with

OR

upload file :

Browse...

restricted by :

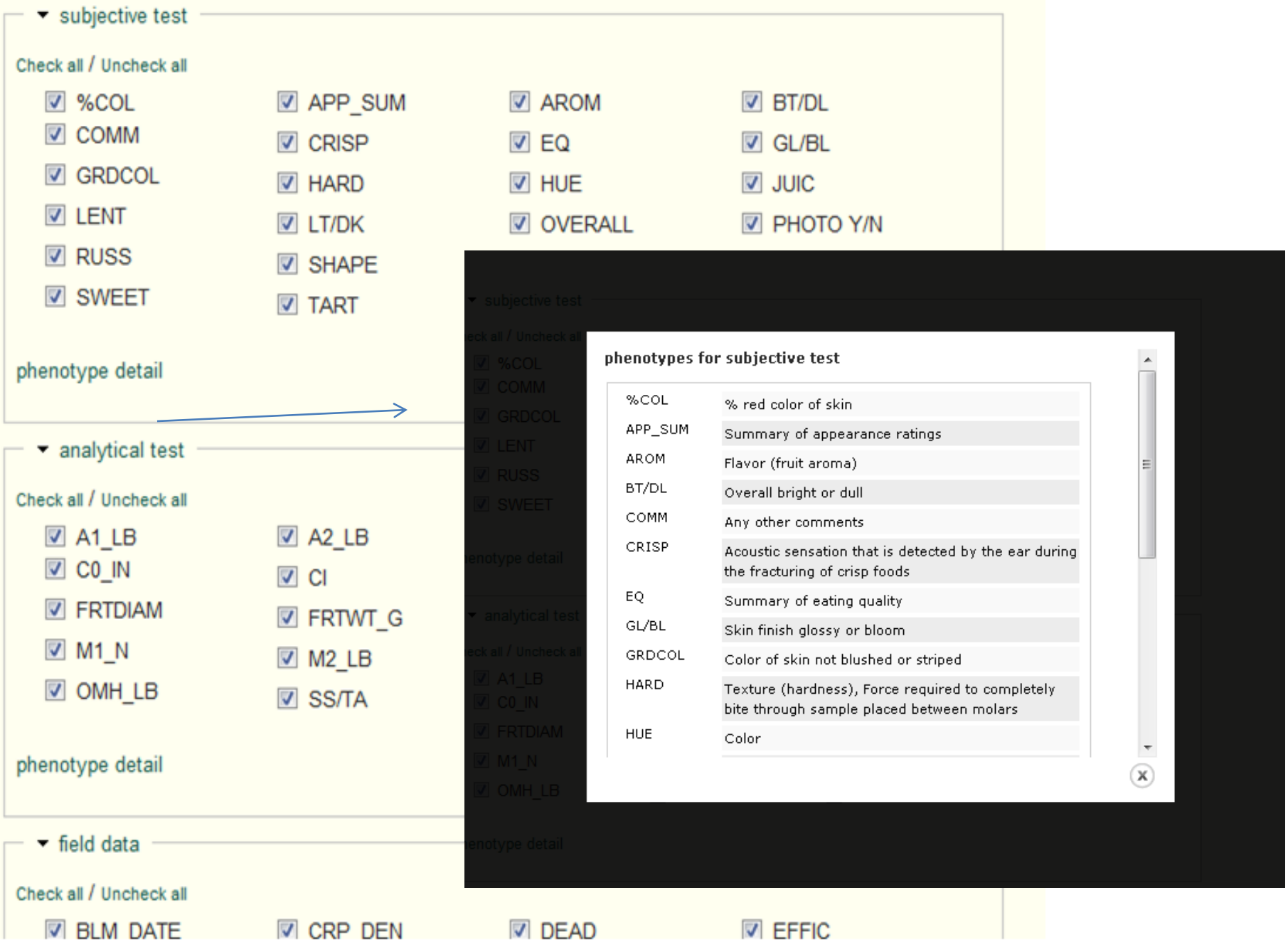
project name: Evans_apple

site name: no site

- subjective test
- analytical test
- field data

search | reset | contact

Go Back to Search Page

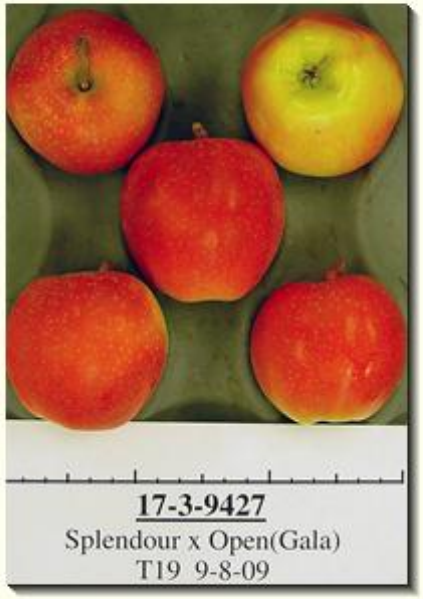

subjective test
Check all / Uncheck all
%COL
APP_SUM
AROM
BT/DL
COMM
CRISP
EQ
GL/BL
GRDCOL
HARD
HUE
JUIC
LENT
LT/DK
OVERALL
PHOTO Y/N
RUSS
SHAPE
SWEET
TART
phenotype detail
analytical test
Check all / Uncheck all
A1_LB
A2_LB
C0_IN
CI
FRTDIAM
FRTWT_G
M1_N
M2_LB
OMH_LB
SS/TA
phenotype detail
field data
Check all / Uncheck all
BLM_DATE
CRP_DEN
DEAD
EFFIC
phenotypes for subjective test
%COL % red color of skin
APP_SUM Summary of appearance ratings
AROM Flavor (fruit aroma)
BT/DL Overall bright or dull
COMM Any other comments
CRISP Acoustic sensation that is detected by the ear during the fracturing of crisp foods
EQ Summary of eating quality
GL/BL Skin finish glossy or bloom
GRDCOL Color of skin not blushed or striped
HARD Texture (hardness), Force required to completely bite through sample placed between molars
HUE Color

germplasm information

Information about *T19-17-3-9427*

alias	WSU 2, 917-3-9427, 2-F04-01, 2
cross number	9427
mother	Splendour
father	Gala

Download evaluation data in Excel file



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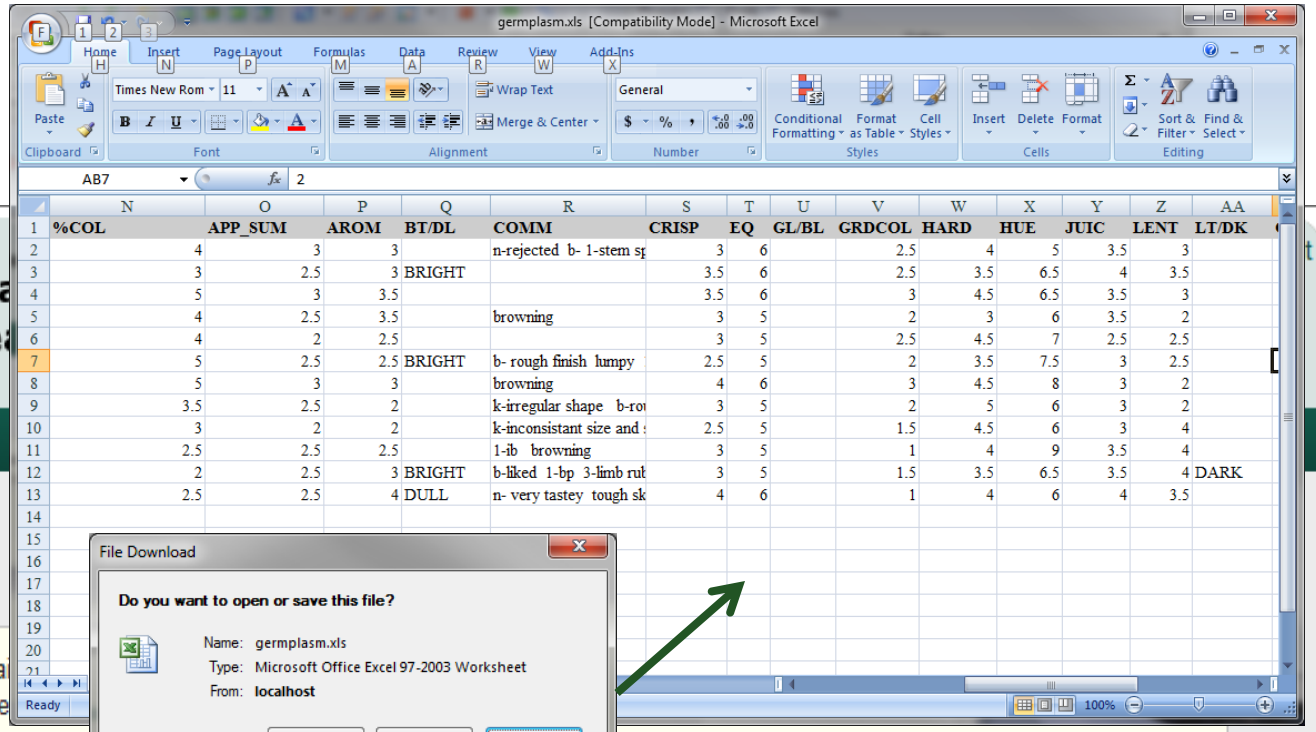

GDR | Genome Da for Rosace

Breeders Toolbox | admin

Browse germplasm

Evaluation data from 3 germplasm are ava
Click the germplasm name below for more

Go Back to Browse projects with sites

T19-10-5-9435	T19-17-3-9427	T19-46-95-9434		

download the results in this page in Excel 2003
download the results in this page in Excel 2007
download all the results in Excel 2003
download all the results in Excel 2007

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Breeders Toolbox | admin

search database

search by name | search by evaluation data | search by parentage

analytical test

A1_LB		≤ A1_LB ≤			
A2_LB		≤ A2_LB ≤			
A3_LB		≤ A3_LB ≤			
BRIX		≤ BRIX ≤			
C0_IN		≤ C0_IN ≤			
CI		≤ CI ≤			
CN		≤ CN ≤			
E2_LB		≤ E2_LB ≤			
FRTDIAM		≤ FRTDIAM ≤			
FRTWT_G		≤ FRTWT_G ≤			
FRTWT_LB		≤ FRTWT_LB ≤			
M1_LB		≤ M1_LB ≤			
M1_N		≤ M1_N ≤			
M2_LB		≤ M2_LB ≤			
M3_LB		≤ M3_LB ≤			
OAH_LB		≤ OAH_LB ≤			
OMH_LB		≤ OMH_LB ≤			
SS/TA		≤ SS/TA ≤			
TA		≤ TA ≤			

subjective test

SIZE	select value	LENT	select value
APP_SUM	1: ugly	%COL	select value
AROM	select value	CRISP	select value
EQ	4: poor	GRDCOL	select value
HARD	select value	HUE	select value
JUIC	select value	OVERALL	select value
RUSS	select value	SHAPE	select value
STARCH	≤ STARCH ≤	SWEET	select value
TART	select value	TYPECOL	select value

EQ options: select value; 2: yuck; 4: poor; 6: average, OK; 8: good; 10: outstanding

search | reset | contact

search database

search by name | search by evaluation data | search by parentage

mother: MN1702

father: BC-8S-27-2

search | reset | contact

Go Back to Search Page

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5. Data uploaded to Chado
6. Interfaces for browse, search and data download under development
7. Private web management system created for breeding programs

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Home Page of WSU Apple Breeding Program

View | Edit

Page *Home Page of WSU Apple Breeding Program* has been updated.

Breeding Program Outline

The Washington State University apple breeding program began in 1994 to develop new varieties suitable to the unique climate of central Washington. Washington is the leading apple producing state with over 50% of U.S. production. Unfortunately, many of the new varieties developed in the world are not well adapted to growing conditions in central Washington or available to the majority of Washington growers.

The goal is to produce apples of a high eating quality with particular factors of outstanding flavor, texture and juiciness. The breeding program is a traditional breeding program, hybridizing parents with desirable traits. Promising seedlings are selected from large populations and their fruit is evaluated in the laboratory for eating quality and suitability for long-term storage. This program is one of the 12 core US breeding programs of the SCRI RosBREED project, enabling the application of marker-assisted breeding within the 4 years of the project.

The first release from the program, 'WA 2', was offered to Washington State growers for evaluation in December 2009. Several other elite selections have been planted in commercial grower trials in central Washington.

Screenshot

Groups: Kate's Apple Breeder Group

Kate's Apple Breeder Group

- Create Calendar Event
- Create Group Document
- 6 members
- Manager: cho
- My membership

Washington State University

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Clemson University

Further work

1. More web interface
2. Development of online data uploading system
3. Integrate with GDR and GRIN
4. Integrate with breeding analysis tools such as PBA

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Acknowledgements

Funding sources:

United States Department of Agriculture
National Institute of Food and Agriculture

WASHINGTON TREE FRUIT RESEARCH COMMISSION

WASHINGTON STATE UNIVERSITY

Main lab bioinformatics members

Ilhyung Cho
Ping Zheng
Stephen Ficklin

WA breeding program lab members

Lisa Brutcher
Bonnie Konishi
Nancy Buchanan

Rosaceae community

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