



CSU Wheat Breeding and Genetics Program Update

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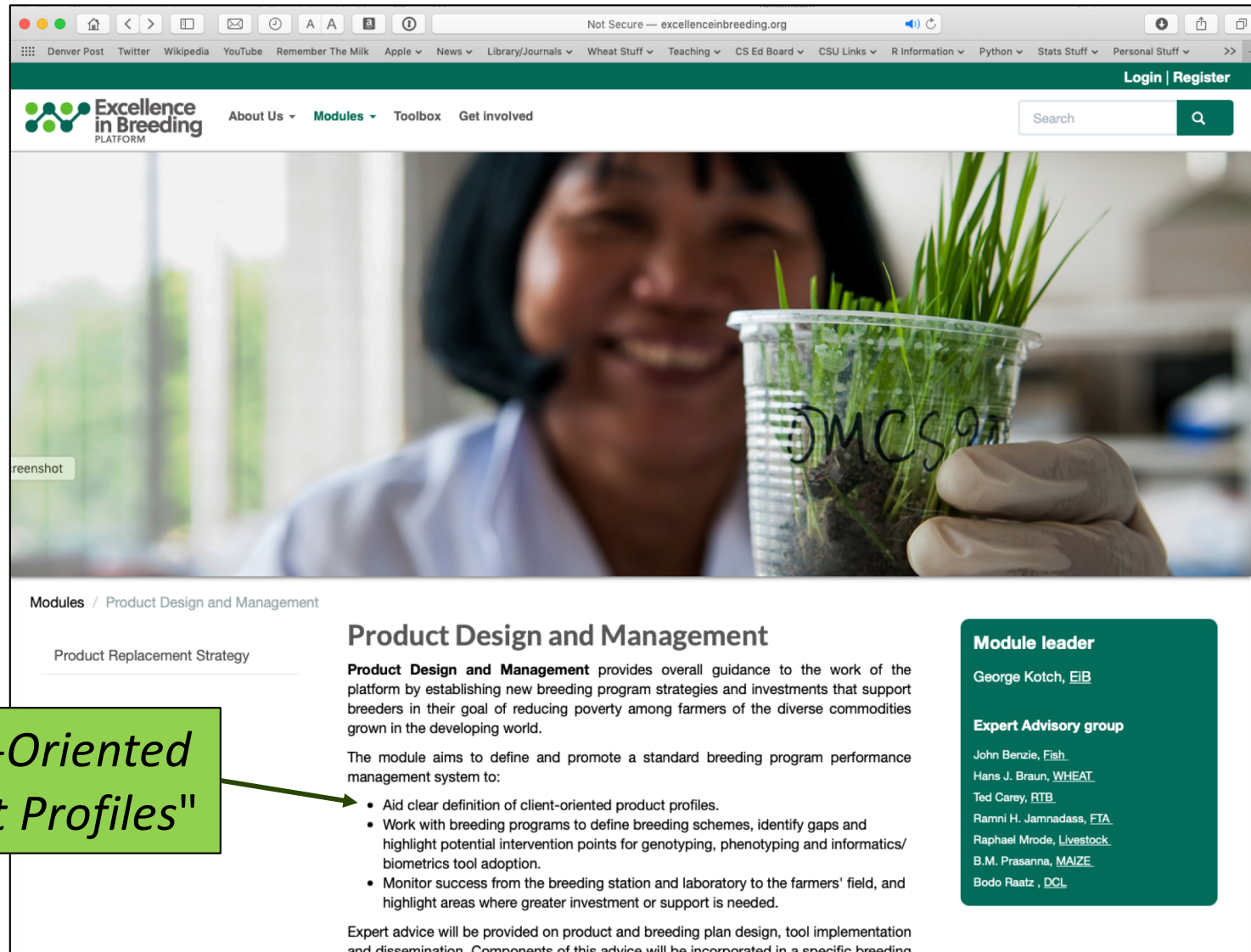
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SOIL AND CROP SCIENCES
COLORADO STATE UNIVERSITY

Excellence in Breeding Platform

Gates-Funded Program with CGIAR Centers



The screenshot shows a web browser displaying the Excellence in Breeding Platform website. The browser's address bar shows "Not Secure — excellenceinbreeding.org". The website has a green header with the logo and navigation links: "About Us", "Modules", "Toolbox", and "Get involved". A search bar is on the right. The main content area features a large image of a smiling woman holding a cup of green grass. Below the image, the breadcrumb "Modules / Product Design and Management" is visible. The "Product Replacement Strategy" link is highlighted. The main heading is "Product Design and Management". The text describes the module's purpose: "Product Design and Management provides overall guidance to the work of the product breeders in their goal of reducing poverty among farmers of the diverse commodities grown in the developing world. The module aims to define and promote a standard breeding program performance management system to:". A list of bullet points follows: "• Aid clear definition of client-oriented product profiles.", "• Work with breeding programs to define breeding schemes, identify gaps and highlight potential intervention points for genotyping, phenotyping and informatics/ biometrics tool adoption.", "• Monitor success from the breeding station and laboratory to the farmers' field, and highlight areas where greater investment or support is needed." Below the list, it states: "Expert advice will be provided on product and breeding plan design, tool implementation and dissemination. Components of this advice will be incorporated in a specific breeding". On the right, a green box contains the "Module leader" George Kotch, EIB, and the "Expert Advisory group" members: John Benzie, Eish; Hans J. Braun, WHEAT; Ted Carey, RTB; Ramni H. Jaminadass, FTA; Raphael Mrode, Livestock; B.M. Prasanna, MAIZE; and Bodo Raatz, DCL.

Product Replacement Strategy

Product Design and Management

Product Design and Management provides overall guidance to the work of the product breeders in their goal of reducing poverty among farmers of the diverse commodities grown in the developing world. The module aims to define and promote a standard breeding program performance management system to:

- Aid clear definition of client-oriented product profiles.
- Work with breeding programs to define breeding schemes, identify gaps and highlight potential intervention points for genotyping, phenotyping and informatics/ biometrics tool adoption.
- Monitor success from the breeding station and laboratory to the farmers' field, and highlight areas where greater investment or support is needed.

Expert advice will be provided on product and breeding plan design, tool implementation and dissemination. Components of this advice will be incorporated in a specific breeding

Module leader
George Kotch, [EIB](#)

Expert Advisory group
[John Benzie, Eish](#)
[Hans J. Braun, WHEAT](#)
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[Bodo Raatz, DCL](#)

"Client-Oriented Product Profiles"

Client-Oriented Breeding



Available online at www.sciencedirect.com



Field Crops Research 100 (2007) 107–116

**Field
Crops
Research**

www.elsevier.com/locate/fcr

Highly **client-oriented breeding**, using local preferences and selection,
produces widely adapted rice varieties

K.D. Joshi ^a, A.M. Musa ^b, C. Johansen ^c, S. Gyawali ^d, D. Harris ^e, J.R. Witcombe ^{e,*}



Contents lists available at ScienceDirect

Field Crops Research

journal homepage: www.elsevier.com/locate/fcr



Review

How much evidence is needed before **client-oriented breeding (COB)** is
institutionalised? Evidence from rice and maize in India



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Excellence in Breeding Platform

A Current Call for Proposals – <http://bit.ly/2UoMLgl>

- Project objectives
 - Establish projects, focused on crop varieties, which will deliver a quantification of the **relative importance of trait improvements**
 - Identify groups of **users with different patterns of trait priorities** and gain an understanding of socio-demographic or **systematic drivers of trait priorities** between groups
 - **Establish product profiles** (a set of **trait weightings**) for programs
- Expected outcomes
 - **Greater user engagement and buy-in** to the process of developing new varieties (products) for farmers and stakeholders
 - An **understanding of the relative importance of traits** for future plant development and selection programs and any market segmentation
 - **Increased adoption of new varieties through transparency of approach** and the use of quantifiable preference data in variety development

CSU Wheat Breeding - The Big Picture

- We are a public sector program that develops products for the public good.
- Product types – improved varieties and germplasm
 - Hard red winter wheat (HRW)
 - Hard white winter wheat (HWW)
 - (teaching, student training, original research)
- Complexities
 - Dryland vs irrigated systems
 - Conventional vs no-till systems
 - Red wheat vs white wheat
 - *CoAXium* vs *Clearfield*
 - (Conventional vs organic wheat)
 - Invasiveness – stripe rust evolution, wheat stem sawfly
 - Producer profitability – yield, yield, and more yield
 - Enhanced profitability – disease/insect resistance, quality
- We must be on the same page with regard to our program objectives!

CSU Wheat Varieties Released

Hard Red				Hard White		Clearfield*	
Baca	1973	Prairie Red	1998	Avalanche	2001	Above	2001
Lindon	1975	Prowers 99	1999	Snowmass	2009	AP502 CL	2001
Vona	1976	Ankor	2002	Antero	2012	Bond CL	2004
Wings	1977	Hatcher	2004	Sunshine	2014	Protection	2004
Sandy	1981	Ripper	2006	Breck	2017	Thunder CL (HWW)	2008
Duke	1981	Bill Brown	2007	Snowmass 2.0	2018	Brawl CL Plus	2011
Hail	1982	Denali	2011	Monarch	2018	Byrd CL Plus	2018
Carson	1986	Cowboy	2011				
Lamar	1988	LCS Mint	2011			CoAxiom*	
Yuma	1991	Byrd	2011			Incline AX	2017
Jules	1993	Avery	2015			LCS Fusion AX	2017
Akron	1994	Langin	2016			Crescent AX	2018
Halt	1994	Canvas	2018				
Yumar	1997	Whistler	2018				
Prowers	1997						

New Releases Fall 2018

2 new hard reds

2 new hard whites

1 new *Clearfield*

1 new *CoAxiom*

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Hail	1982	Denali	2011	Monarch	2018	Byrd CL Plus	2018
Carson	1986	Cowboy	2011				
Lamar	1988	LCS Mint	2011	Wheat Stem Sawfly		CoAxium*	
Yuma	1991	Byrd	2011	CO15SFD107	2019	Incline AX	2017
Jules	1993	Avery	2015	CO15SFD092	2019	LCS Fusion AX	2017
Akron	1994	Langin	2016			Crescent AX	2018
Halt	1994	Canvas	2018				
Yumar	1997	Whistler	2018				
Prowers	1997	CO13D0787	2019				

New Releases Fall 2019
 2 new HRW – stem sawfly
 1 new HRW – wheat streak mosaic

Wheat Stem Sawfly – Stem Solidness



CO15SFD107
(Byrd/Bearpaw//Byrd)



CO15SFD092
(Byrd/Bearpaw//Byrd)

Entry	2016	2017		2018		Average				
	Yield WSS	Yield Non WSS	Yield WSS	Yield Non WSS	Yield WSS	Yield Non WSS	Yield WSS	Test Weight	Stem Cutting	Solidness
Byrd	57.7	71.9	56.8	53.1	69.8	60.9	61.4	57.3	5.8	6.6
Denali	60.9	62.2	54.8	54.4	65.7	59.2	60.5	57.5	5.6	6.3
CO15SFD092	59.3	64.8	56.6	54.9	68.6	59.7	61.5	57.3	2.4	13.2
CO15SFD107	60.0	64.9	53.9	54.3	67.5	59.7	60.5	58.2	2.3	12.7
Average	57.3	65.3	55.2	67.5	55.2	66.4	55.9	57.4		
Locations	2	9	2	8	2	17	6	23		

Image - Phil Bruckner, MT State



1
hollow

5
solid

sum over 5 internodes
5-25 scale

Semi-Solidness and Stem Cutting



CO15SFD107
Akron Colorado 2018

CO15SFD107 (left) – cutting 20%
Canvas (right) – cutting 85%
New Raymer Colorado 2018



CO13D0787 – Wheat Streak Mosaic Virus Resistance



- *Antero/Snowmass//Byrd* pedigree
- Excellent resistance to wheat streak mosaic virus
 - WCM_{T112} for wheat curl mite resistance (from Byrd)
 - $Wsm2$ for virus resistance (from Snowmass)
- Very good resistance to stripe rust (2), leaf rust (3), and stem rust (2)
- Good test weight (2), grain protein deviation (2), and milling (3) and baking (3) quality

Entry	Burlington Yield	Fort Collins Yield	Haxtun Yield	Average Yield	Average TestWt
CO13D0787	111.7	104.0	97.0	104.2	59.2
Canvas	101.2	108.2	83.2	97.5	57.4
Snowmass 2.0	124.5	103.8	82.9	103.7	58.2
Monarch	127.9	116.5	82.5	109.0	58.6
Langin	114.4	87.8	82.4	94.9	57.9
Whistler	107.1	108.0	81.1	98.7	55.7
Avery	98.0	91.4	79.9	89.8	57.0
Antero	92.7	77.8	79.8	83.4	58.0
Byrd	110.1	96.2	78.8	95.0	58.2
Breck	118.9	94.9	78.0	97.3	59.0
Brawl CL Plus	113.3	83.5	75.4	90.7	58.1
Denali	106.8	105.0	74.6	95.5	58.5
SY Wolf	115.9	102.3	74.1	97.4	57.0
Sunshine	116.1	74.4	74.1	88.2	56.2
SY Sunrise	110.9	94.3	73.1	92.8	58.9
WB4303	108.0	108.2	72.0	96.1	55.4
KanMark	111.6	103.0	68.5	94.4	58.0
Cowboy	109.4	103.7	67.8	93.6	55.1
WB-Grainfield	106.2	78.1	67.1	83.8	58.8
WB4458	99.4	88.0	61.4	82.9	56.3
Larry	110.4	96.0	60.7	89.0	57.1
Thunder CL	109.5	85.8	57.9	84.4	57.6
Average	108.3	95.9	75.7	93.3	57.6
Minimum	92.7	74.4	57.9	82.9	55.1
Maximum	127.9	118.7	97.0	109.0	59.2
LSD (P<0.30)	8.0	5.1	4.2		

2017 Irrigated Variety
Performance Trial

Product Profiles – Hard Red Winter



Canvas



Whistler

Must Haves	Would Like to Have
Dryland yield – drought stress tolerance	Irrigated yield – yield responsiveness
Winterhardiness	Good straw strength
High test weight	Positive grain protein deviation
Durable stripe rust resistance	Wheat streak, soilborne mosaic virus resistance
Good end-use quality	Leaf rust, stem rust resistance
Shattering tolerance	Medium height, medium maturity

Product Profiles – Hard White Winter



Snowmass 2.0
(grower premium)



Monarch
(no grower premium)

Additional Must Haves

Extra-strong dough mixing properties

Good pre-harvest sprouting tolerance

Low polyphenol oxidase activity (PPO)

High water absorption

Bright white grain color

Product Profiles – Herbicide Tolerance



Crescent AX
(CoAXium)



Byrd CL Plus
(Clearfield)

Breeding Priorities

Yield improvement over currently available varieties

2X level of herbicide tolerance

Stripe rust resistance

Good end-use quality

Product Profiles – Wheat Stem Sawfly



CO15SFD107



CO15SFD092

Breeding Priorities

Yield – competitive with hollow stem varieties

Reduced cutting due to solid-stem trait

Reduced cutting without solid-stem trait

Good straw strength, tall plant stature, test weight

Stripe rust resistance

Herbicide tolerance (AX, CL) and class (HRW, HWW) options

And In Closing...

- A look back – *PlainsGold* market share second to none!
 - Improved end-use quality – no longer the "crap wheat state"
 - Drought stress tolerance plus yield responsiveness
 - Identity preserved hard white wheat (HWW)
 - Herbicide tolerance – *Clearfield*, *CoAXium*
 - Response to invasiveness – stripe rust, stem sawfly
 - Implementation of "advanced breeding technologies"
- A look forward – laser focus on producer profitability, in all its forms
 - Increase rate of genetic gain using "advanced breeding technologies"
 - Precision breeding – applied genomics to stack traits
 - Rapid deployment of novel traits – gene editing, others
 - Machine learning – "black box"-based prediction
 - Integration of "big data"



John Stromberger



Emily Hudson-Arns



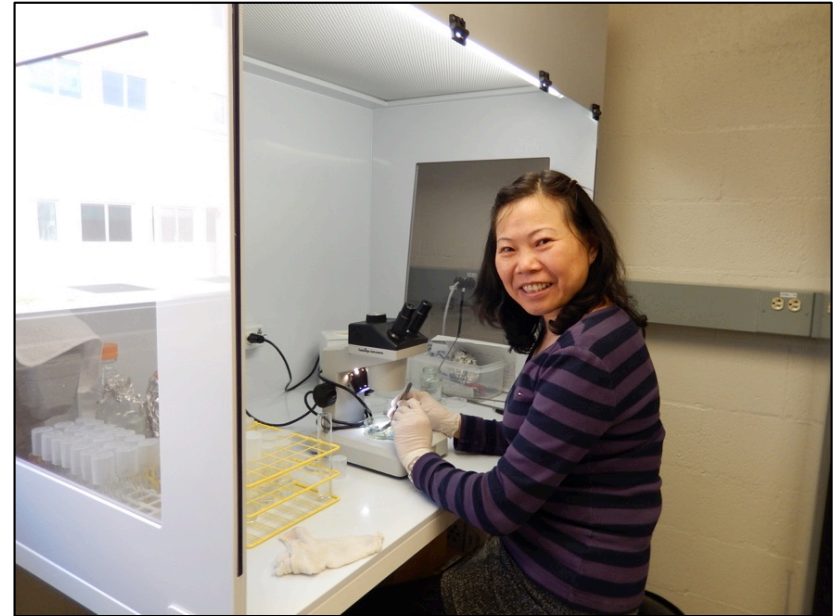
Scott Seifert



Tori
Anderson



Meenakshi Santra



Hong Wang



Zaki
Afshar



Brad
Pakish

Acknowledgements



Colorado Wheat
Administrative Committee



Colorado
State
University



Nourishing what's next.™



Questions?