RosBREED

Enabling marker-assisted breeding in Rosaceae

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Genetic improvement of strawberry fruit quality with the RosBREED approach

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ABSTRACT

Strawberry is one of the five fruit crops included in the USDA-funded multi-institutional and trans-disciplinary project, "RosBREED: Enabling Marker-Assisted Breeding in Rosaceae". Crop reference sets that include genotypes and seedling populations representing the breadth of relevant diversity and encompassing founders used in breeding the domestic strawberry were developed and are being propagated to plant in Oregon, Michigan, Florida and California. Phenotypic traits were identified that will be used to comprehensively characterize this Crop Reference Set including fruit weight, firmness, skin toughness, soluble solids, titratable acidity, pH, external and internal color, flavor, shape, ease of capping, drip loss after freezing and thawing, and total anthocyanins for fruit quality attributes together with remontancy, crop load, disease resistance and plant architecture. Genome-wide genotypic information will also be developed for each member of the Crop Reference Set using single nucleotide polymorphisms. Pedigree Based Analysis will integrate phenotypic and genotypic data using FlexQTL™ software to identify and validate QTLs for important fruit quality traits. Economically valuable genetic tests will then be incorporated into breeding operations via an eight-stage Marker-Assisted Breeding Pipeline. This approach will provide powerful infrastructure for routine applications of marker-assisted breeding in strawberry.

Objective:

To develop the infrastructure for routine applications of marker-assisted breeding in strawberry

APPROACH

Preparation

- Oregon, California and Michigan will be primary sites and pending sufficient propagation success, most or all of the genotypes will also be in New Hampshire & Florida
- Traits to be evaluated have been determined (Table 1)
- Genotypes that will be part of the Crop Reference and Breeders Set have been identified (Table 2)
- European plant material has been imported
- Propagation of genotypes is underway;

Approach

- Each genotype will be grown at each location in a single, two plant plot
- Local standard cultural practices will be used
- Genotypes will be established in August in New Hampshire, Michigan and Oregon and in October in Florida and California
- Phenotypic data will be collected in 2010 and 2011
- Leaf tissue of each genotype is being collected for genotyping
- FlexQTL™ software will be applied to the data to identify and validate QTLs

Table 1. Partial list of phenotypic traits that will be evaluated in each location

Fruit quality traits	
Fruit weight (g, mean of 3 harvests)	Achene position (sunken/even/protruding)
Fruit diameter (mm)	Achene color (white, intermediate, red)
Fruit length (mm)	Cyanidin content
Cap size (mm)	Cyanidin/pelargonidin ratio
Soluble solids (°Brix)	Anthocyanins ,total -spectrophotometrically
Acidity (titration)	***Other important traits***
pH	Period of flowering (evaluated weekly)
% drip loss (after freezing)	Crop estimate (rating 1=no fruit; 9=overcropped)
Appearance (rating; 1= very malformed; 9= symetrical and attractive)	Vigor (rating; 1=dead; 9= extremely vigorous)
Fruit firmness (rating; 1= mush; 9= hard)	Number of runners
% of filled achenes	Leaf diseases powdery mildew (rating 1=severe, 9=no symptoms)
External color (rating; 1= white; 9= Deep red "black")	Leaf diseases leaf spot (rating 1=severe, 9=no symptoms)
Depth of internal color (%)	Leaf diseases leaf scorch ((rating 1=severe, 9=no symptoms)
Ease of capping (rating; 1= does not remove; 9= easily removed)	Powdery mildew on fruit (yes/no)
Flavor (rating; 1= poor flavor; 9= excellent intense flavor)	Verticillium wilt rate if occurs (rating 1=severe, 9=no symptoms)

Table 2. Genotypes, populations and bin sets, grouped by origin, that will be phenotyped and genotyped in California, Florida, Michigan, Oregon, and New Hampshire

Individual genotypes	Individual genotypes (cont.)	Individual genotypes (cont.)	Individual genotypes (cont.)	Individual genotypes (cont.)	Individual genotypes (cont.)	Populations/Bin sets
California	**Evangeline**	***Florida***	**ORUS_740-7**	***Japan***	**MS_34-4**	***Populations***
Aiko	**Fairfax**	**Florida_90**	**OSC_4474**	**Benizuru**	**Sable_Beach_8**	**MSU_9-1**
Albion	**Fairland**	**Florida_Belle**	**OSC_4816**	**Fukuba**	***Wild North American F. chiloensis***	**MSU_9-2**
Aptos	**Geneva**	**Florida_Elyana**	**OSC_4817**	**Harunoka**	**Del_Norte**	**MSU_9-3**
Aromas	**Glooscap**	**Florida_Radiance**	**OSC_4916**	**Hogyoku**	**FRA_34**	**MSU_9-4**
Brighton	**Governor_Simcoe**	**Rosa_Linda**	**Pinnacle**	**Koro103**	**FRA_42**	**MSU_9-5**
Cal_59.39-1	**Guardian**	**Strawberry_Festival**	**Puget_Beauty**	**Kurume103**	**FRA_48**	**MSU_9-6**
Cal_65.65-601	**Holiday**	**Sweet_Charlie**	**Puget_Reliance**	**Nyoho**	**FRA_357**	**MSU_9-7**
Cal_70.3-117	**Honeoye**	**Treasure**	**Puget_Summer**	**Ooishi-shikinari2**	**FRA_368**	**MSU_9-8**
Cal_71.98-605	**Howard_17**	**Winter_Dawn**	**Quinault**	***Miscellaneous***	**FRA_688**	**MSU_9-9**
Camarosa	**Jerseybelle**	***Pacific Northwest North America***	**Rainier**	**Beaver**	**FRA_1267**	**MSU_9-10**
Capitola	**Jewel**	**Benton**	**Redcrest**	**Beaverbelle**	**FRA_1691**	**MSU_9-11**
Chandler	**Joe**	**Bountiful**	**Redgem**	**Capron**	**FRA_1692**	**MSU_9-12**
Cuesta	**Joliette**	**British_Sovereign**	**Shuksan**	**F.vesca_bracteata**	**Yaquina_B**	**MSU_9-13**
Diamante	**Jucunda**	**Cheam**	**Shuswap**	**Fort_Laramie**	***Wild South American F. chiloensis***	**MSU_9-14**
Donner	**Kent**	**Columbia**	**Stolo**	**Guelph_S02**	**FRA_24**	**MSU_9-15**
Douglas	**Klondike**	**Firecracker**	**Streamliner**	**Hawaii4**	**FRA_372**	**MSU_9-16**
Ettersburg_121	**L'Acadie**	**Hood**	**Sumas**	**L1**	**FRA_743**	**MSU_9-17**
Fern	**Lateglow**	**Independence**	**Tillamook**	**LB48**	**FRA_796**	**ORUS_3277**
Irvine	**L'Authentique_Orleans**	**Linn**	**Totem**	**MSU_49**	**FRA_1075**	**ORUS_3278**
Laguna	**Liberation_d'Orleans**	**Nanaimo**	**Tyee**	**MSU_56**	**FRA_1088**	**ORUS_3279**
Lassen	**Marlate**	**Northwest**	**Vale**	**Ogallala**	**FRA_1092**	**ORUS_3304**
Oso_Grande	**Marshall**	**NW_90054-37**	**Valley_Red**	**Pawtuckaway**	**FRA_1100**	**ORUS_3305**
Parker	**Massey**	**Olympus**	**Whonnock**	**Pioneer**	**FRA_1104**	**ORUS_3306**
Seascape	**MDUS_3184**	**ORUS_1083-135**	***Europe***	**y32b**	**FRA_1108**	**ORUS_3307**
Selva	**MDUS_4258**	**ORUS_1239R-21**	**Auchincruive_Climax**	**Yellow_Wonder**	**Huachi(Ambato_NAH)**	**ORUS_3308**
Sequoia	**Mesabi**	**ORUS_1267-236**	**Darselect**	***Wild F. virginiana***	***F. x ananassa reconstruction project***	**ORUS_3314**
Shasta	**Micmac**	**ORUS_1384-3**	**Deutsch_Evern**	**FRA_58**	**FVC_8-1**	**ORUS_3315**
Tioga	**Midland**	**ORUS_1391-1**	**Direktor_Paul_Wallbaum**	**FRA_110**	**FVC_8-2**	**ORUS_3316**
Tufts	**Midway**	**ORUS_1407-76**	**E-30324**	**FRA_338**	**FVC_8-3**	**ORUS_3317**
Ventana	**Narcissa**	**ORUS_1723-3**	**E-30397**	**FRA_982**	**FVC_8-4**	**ORUS_3318**
Eastern North America	**Ourown**	**ORUS_1735-1**	**Elsanta**	**FRA_1408**	**FVC_8-5**	**ORUS_3319**
Aberdeen	**Ozark_Beauty**	**ORUS_1754-2**	**Everest**	**FRA_1414**	**FVC_10-1**	**ORUS_3320**
Albritton	**Pelican**	**ORUS_1769-1**	**Evie-2**	**FRA_1435**	**FVC_10-2**	**ORUS_3321**
Allstar	**Raritan**	**ORUS_1827-2**	**Frel**	**FRA_1455**	**FVC_11-1**	**ORUS_3322**
Annapolis	**Red_Rich**	**ORUS_1947-2**	**Gorella**	**FRA_1466**	**FVC_11-2**	**ORUS_3323**
Apollo	**Redchief**	**ORUS_1963-5**	**Hummi_Grandee**	**FRA_1557**	**FVC_11-3**	**ORUS_3324**
ArKing	**Redcoat**	**ORUS_2016-1**	**Idea**	**FRA_1580**	**FVC_11-4**	**ORUS_3325**
Atlas	**Redgauntlet**	**ORUS_2075-1**	**Korona**	**FRA_1620**	**FVC_11-5**	**ORUS_3326**
Badgerglo	**Redglow**	**ORUS_2159-2**	**Laxton's_Noble**	**FRA_1694**	**FVC_11-6**	**FRENCHBIN**
Blakemore	**Redrich**	**ORUS_2161-1**	**Madame_Moutot**	**FRA_1695**	**FVC_16-1**	**LB48xH4**
Bounty	**Robinson**	**ORUS_2180-1**	**Mara_des_Bois**	**FRA_1696**	**FVC_17-20**	**NETHBIN**
Cabot	**Seneca**	**ORUS_2240-1**	**Marmolada(Onebor)**	**FRA_1697**	**FVC_18-1**	**SARGENTDIPLOIDBIN**
Cardinal	**Sparkle**	**ORUS_2262-2**	**Melody**	**FRA_1698**	**FVC_18-18**	**SARGENTOCTOPLOID**
Catskill	**Stelemaster**	**ORUS_2361-1**	**Oberschlesien**	**FRA_1699**	**FVC_28-1**	**Yellow_WonderXPawtuckaway**
Cavendish	**Sunrise**	**ORUS_2369-1**	**Perle_de_Prague**	**FRA_1700**	**FVC_30-1**	
Delite	**Surecrop**	**ORUS_2427-1**	**Repita**	**FRA_1701**	**FVC_30-2**	
Delmarvel	**Tangi**	**ORUS_2427-4**	**Revada**	**FRA_1702**	**FVC_30-3**	
Dover	**Temple**	**ORUS_2490-1**	**Royal_Sovereign**	**FRA_1703**	**FVC_30-4**	
Dunlap	**Tribute**	**ORUS_2493-2**	**Sans_Rivale**	**JH_101-1**	**FVC_30-5**	
Earlibelle	**Veestar**	**ORUS_2676-1**	**Sarian**	**Lion's_Head_3**	**FVC_33-1**	
Earlidawn	**Vibrant**	**ORUS_2742-1**	**Senga_Sengana**	**MS_18-14**		

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