

USDA-NIFA Annual Report

Year 5

Progress Report

Title:	VacciniumCAP: Leveraging genetic and genomic resources to enable development of blueberry and cranberry cultivars with improved fruit quality attributes		
Sponsoring Agency	NIFA	Project Status	ACTIVE
Funding Source	Non Formula	Reporting Frequency	Annual
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Submitted By	Holly Lipkovich	Date Submitted to NIFA	11/25/2024

Program Code: SCRI**Program Name:** Specialty Crop Research Initiative**Project Director**

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Non-Technical Summary

This project will establish a nationwide coordinated transdisciplinary research approach to develop and implement marker assisted selection (MAS) capacity in Vaccinium breeding programs, to enable breeders to select and pyramid fruit characteristics (FCs) that positively contribute to fruit quality and market value. Vaccinium crops (blueberry and cranberry) provides vital contributions to human health and well-being, and collectively constitutes the economic backbone of many U.S. rural communities. Vaccinium genetic and genomic resources are developing rapidly but have not been translated to routine practical application. Specific objectives are to: (1) establish a cost effective genotyping platform to expand marker-trait association analysis (MTA) in Vaccinium, exploiting the shared ancestry of Vaccinium crops; (2) identify DNA markers linked to fruit characteristics and elucidate how and which fruit characteristics affect fruit quality, relative to consumer preferences, decay during mechanical harvest, processing and distribution; (3) develop DNA assays to implement MAS in core Vaccinium core breeding programs with a common focus on fruit quality traits; (4) enlarge market potential, and increase consumption of Vaccinium fruits by using socio-economic knowledge of consumer preferences to inform breeding; and (5) enhance sustainability of cultivar development by transferring MAS technologies to public and private U.S. Vaccinium breeding programs through training current and future breeders as well as engaging the production, distribution, processing and marketing sectors, allied scientists, and consumers. This Coordinated Agricultural Project proposal addresses SCRI Focus Area 1 (70%) and Focus Area 2 (30%).

Accomplishments**Major goals of the project**

Status: Vaccinium (blueberry and cranberry) breeders have little empirical data to assign level of importance to fruit characteristics (FCs) relative to consumer preferences, decay during production, processing and distribution, and few tools to select for high fruit quality. As a result, blueberry and cranberry cultivars often produce fruit with inconsistent appearance, texture and sensory profiles that do not consistently meet consumer expectations, processing and production quality needs. The Vaccinium industry recognized the need to improve fruit quality as the key breeding target for continued success.

Mission statement: Address major bottlenecks for growth of U.S. Vaccinium industry, by creating a nationwide coordinated

Progress Report

Accession No. 1020223

Project No. NC09879

transdisciplinary research approach to develop and implement marker assisted selection (MAS) capacity in *Vaccinium* breeding programs, to enable breeders to select and pyramid fruit characteristics (FCs) that positively contribute to fruit quality and market value. In the long term, this mission will increase production of fruit with improved characteristics that meet the ever-changing industry, market, and consumer preferences.

Specific project objective are: 1) Establish genomic resources to enable effective association mapping studies in blueberry and cranberry; 2) Discover DNA markers and fruit characteristics that maximize industry profitability and match consumer preferences in blueberry and cranberry; 3) Deliver molecular and genetic resources to improve blueberry and cranberry fruit quality traits that maximize industry profitability and match consumer preferences; 4) Assess the potential socio-economic impact of blueberry and cranberry fruit quality improvements on market demand; 5) Engage U.S. *Vaccinium* breeders and stakeholder groups to transfer advanced phenomics and genomics tools to build a more coordinated and efficient cultivar development system.

What was accomplished under these goals?

Obj. 1. Expanded Genomic resources. Completed data analysis the pan-genome. A large number of new genes were identified and will serve as target for future genetic studies. Continued efforts for identification of genes that have fruit specific or spatio-temporal expression patterns. Developed two new linkage maps for cranberry that are being used for QTL mapping. **Advanced development of the *Vaccinium* Genotyping platform.** Completed data analysis of the blueberry genotyping validation set. Results indicated that recovery rate was very high (~90%) in cultivated blueberry and remained in the high end (>60%) in the more distantly related diploid species. Initiated analysis of the cranberry genotyping data. Continued coordination of samples submission from members of the genotyping consortium. Submitted >8,700 samples in year 5. The consortium includes 16 members representing public and publish breeding programs, from the U.S., France, New Zealand, Canada and Italy and have genotyped 16,741 samples, across 28 projects, > 30 experiments. This year the platform has been used for marker traits association analysis, genomic selection as well as true to type verification in breeding programs. Overall, these activities are expanding use of molecular tools in blueberry and cranberry breeding and research programs and facilitating genetic discoveries.

Obj. 2. Advanced phenotyping methods. **Blueberry:** 1) Continued testing the acoustic system for texture analysis; 2) Completed improvement of software to use to detect bruising in blueberry fruits. **Cranberry:** 1) Completed development of an image based tools (BerryPortraits) to evaluate external appearance in cranberry. **Advanced fruit characteristics (FC) genetic studies.** **Blueberry:** completed GWAS for texture in NHB and SHB blueberry. Results indicated that texture is a complex traits, controlled by several QTLs with minor effect. Developed genomic prediction models that indicated moderate level of predictability. Candidate genes controlling major effect QTLs for anthocyanin acylation were identified and are being tested. Developed a modified VIGS method to assess the function of candidate genes in blueberry fruits. **Cranberry:** Completed two genetic studies for FRR, Tacy, TA, SSC, epicuticular wax, fruit size and yield. Twenty-one QTLs were identified and several were stable across the years. Completed preliminary QTL mapping in mapping population 3 for vine disease, bloom rating, % cover, establishment rating, flowers per upright, fruit development, fruit weight, percent bloom. QTLs for these traits were identified and data analysis for publication currently being evaluated. Additional QTLs were identified for quercetin 3rhamnose related to heat stress tolerance within the diversity panel, and organic acids: citric, malic, quinic, benzoic, total (both within the diversity panel and a biparental population). **Fruit quality (FQ) studies.** 1) Completed a second study to assess shelf-life. The results highlighted that texture at the harvest drive texture in post-storage and that three main mechanical components contribute texture in blueberry. Changes for parameters correlated to size were highly predictable, while most of the texture parameters had a low to moderate predictability. Chemistry parameters like pH, TA, sugars, and size do not contribute to texture change during storage. Larger size was associated with lower water loss and appearance of wrinkles and the size of the stem scar does not affect these traits. Parameters to select for berries with better post-storage texture and appearance were identified. 2) Completed a study to evaluate the relationship between sensorial texture and mechanical texture. Instrumental parameters able to predict sensorial hardness, crispness, springiness, or juiciness with high accuracy were identified. 2) Completed data analysis for cell wall composition during storage. 3) Completed data analysis for bruising rate vs mechanical texture.

Obj.3. Advanced validation of FC-QTLs. **Blueberry:** Four QTLs associated with pH/TA, chlorogenic acid, anthocyanin acylation and anthocyanin glycosylation were validated across multiple genetic backgrounds. Also 29 QTLs for 20 volatiles conserved in NHB and SHB GenStudy sets were identified. These QTLs represent ideal targets to design DNA markers for marker assisted selection. **Advanced simple DNA assay design.** **Blueberry:** designed and tested a KASP assay marker for Eucalyptol. Over 12,200 seedlings were screened and 6,200 genotypes were selected (discarded 49%) and transplanted to the field. This material will be used to assess marker predictability. **Cranberry:** two QTLs for total anthocyanin (Tacy) and color variation detected across two populations, overlap on the same physical map region and are being considered as validated. Three QTLs for yield, one for Tacy, and one for fruit rot resistance overlap with those identified in previous studies and will be evaluated further. Validated a QTL for citric acid. Tested markers associated with FRR in a biparental population. **Leveraged FC phenotypic data for breeding selection.** **Blueberry and cranberry:** continued making selections for genotypes with good performance for FC and propagated selections for trialing. Crosses of superior individuals were also performed and will be

Progress Report

Accession No. 1020223

Project No. NC09879

germinated in the fall of 2024 and spring 2025.

Obj. 4. Completed a study that assessed consumer preference and WTP for blueberry fruit quality attributes. The study indicated that flavor liking, intensity, and sweetness drive consumer acceptance and WTP. Instrumental measurements indicate sweetness and acidity as key factors, with higher WTP linked to moderate acidity and firmness. The study provides insights into how quality attributes like sweetness and firmness influence WTP, offering valuable benchmarks for improving blueberry breeding programs. Finalized a study assessing WTP for cranberry products based on added sugars content and sweetening method (regular sugar or juice concentrate from other fruits). The results indicated that consumers apply significant discounts for increases in added sugars reported on the label that vary based on the information provided to consumers about the health benefits associated with cranberries and/or recommendations to limit added sugars.

Obj. 5. Updated On-line platforms: added new data and information in the GDV and VacCAP websites. New products include: 1) six newsletters; 2) nine instructional videos; 3) three VacCAP traits information sheets; 4) seven webinar videos.

Maintained the VacCAP X/Twitter account that has 392 followers. Webinars: delivered seven webinars, attended by 260 participants. Recorded webinars available on the YouTube channel had 440 views. Provided project updates at 22 grower association meetings in the U.S. Project evaluation: survey data, feedback and recommendations were collected from 44% of webinar participants, including breeders and scientists from public and private organizations, technical staff members, post-docs and students, and education/extension specialists. More than two thirds reported that each webinar "greatly" or "moderately" improved their understanding of the topics (83% to 100% for six webinars, 70% for one webinar) and almost all would recommend the webinars to others (85% to 100% for six webinars, 65% for one webinar). Feedback and recommendations gained from Y4 were integrated into Y5 activities, and feedback received in Y5 is being considered in planning future activities. Over 10,000 (5,927 GDV+4,375 VacCAP) users and 386 newsletter subscribers from >100 countries accessed VacCAP and GDV. The VacCAP newsletter had an open rate of 45% compared to 43% of peers' newsletters. Audience includes scientists, agriculture and food service representatives. Overall, the evaluation matrix indicates that the project is reaching a very broad audience and the resources/information generated in the project have a positive impact on this community.

What opportunities for training and professional development has the project provided?

Project participants include 6 post-doctoral researchers, 12 professionals and technicians, along with 13 graduate students and undergraduate students fully or partially funded by the project across all the VacCAP team programs. These trainees are participating in VacCAP activities for phenotyping, genomic analysis, DNA profiling, development of DNA informed breeding strategies, data management and communication. These personnel are gaining knowledge, experience, and skills in accurate measurement of fruit characteristics, fruit physiology, phenotyping engineering, statistical analyses, quantitative genetics, bioinformatics, design and implementation of genetic tests, and breeding program planning and management. In addition, these participants are members of project teams and undertake targeted training through webinars, workshops and one-on-one in-person training on texture analysis.

How have the results been disseminated to communities of interest?

Updates about the VacCAP project and preliminary results were disseminated to the scientific community, including the U.S. wide community of Vaccinium crop breeders, through 21 peer reviewed publications, 12 conference proceedings and 34 posters and oral presentations at regional, national and international conferences (including the American Society of Horticultural Science, Plant & Animal Genome conferences, National Association of Plant Breeding annual meeting). The information was also disseminated to the broader Vaccinium community (producers, processors and distributors) through 22 oral presentations at commodity group meetings and 8 VacCAP/GDV newsletter articles. Seven webinars and ten instructional videos were delivered to transfer project outcomes/deliverables. Stakeholders and the general public were also engaged by feeding project updates and new information related to the project mission through two web sites (VacCAP and GDV) and a Twitter account (@VacciniumCAP). To engage the public and students, VacCAP PIs participated in and/or organized 11 outreach events targeting K12 middle and high schools, college students and the general public. Events included blueberry and cranberry field days, science fairs, and short lab training classes. Outreach activities were aimed at introducing students and general public to plant science and horticulture, breeding, food science, and scientific lab experiences based on protocol/research. All these activities emphasized the importance of breeding programs for blueberry and cranberry production, and general crop production. These events contribute to enhance public understanding and interest in learning and careers in plant science and specifically in plant breeding.

What do you plan to do during the next reporting period to accomplish the goals?

Objective 1. Establish genomic resources to enable effective genome wide association mapping studies in blueberry and cranberry.

- Finalize identification of dispensable genes that have fruit specific expression patterns in the Vaccinium pan-genome to identify cultivar-specific genes associated with fruit quality

Progress Report

Accession No. 1020223

Project No. NC09879

- Continue coordination of samples submission for genotyping from the VacCAP genotyping consortium
- Complete manuscripts for dissemination of results

Objective 2. Discover DNA markers and fruit characteristics that maximize industry profitability and match consumer preferences in blueberry and cranberry.

- Complete publication of bruising methods vs texture data
- Complete publication of cell wall composition in blueberry
- Complete QTL mapping in biparental populations and GWAS for texture, appearance and chemistry traits (organic acids, sugars, flavonols, anthocyanin, volatiles) in cranberry and blueberry. Publish manuscripts.

Objective 3. Deliver molecular and genetic resources to improve blueberry and cranberry fruit quality traits that maximize industry profitability and match consumer preferences.

- Finalize list of validated QTLs to continue selection of targets to develop DNA assay for marker assisted selection
- Analyze blueberry DNA assay data (KASP) and evaluate possible use of haplotype on prediction accuracy;
- Continue testing DNA assays for organic acids, wax, and fruit shape that were developed for cranberry in more diverse populations to evaluate sensitivity and specificity
- Evaluate performance of genotypes selected during year 1-5 for advancing them into trials or for use as parents in new crosses
- Plant seedlings so they are evaluated for their potential contribution to FC
- Prepare manuscripts for dissemination of results

Objective 4. Assess the potential socio-economic impact of blueberry and cranberry fruit quality improvements on market demand.

- Disseminate results of the re-assessment of industry breeding priorities

Objective 5. Engage U.S. Vaccinium breeders and stakeholder groups to transfer advanced phenomics and genomics tools to build a more coordinated and efficient cultivar development system.

- On-line platforms: Update VacCAP and GDV and train core and non-core labs on GDV through new training videos.
- Develop new issues of the GDV newsletter to update national and international partners on new tools and resources available on GDV
- Continue developing new VacCAP trait information sheets
- Newsletter and other media: release three newsletters; publish articles in trade magazines; maintain VacCAP accounts on social media
- Webinars: deliver five webinars
- Develop instructional videos on the use of new methodologies for fruit quality phenotyping developed by our team members
- Commodity group meetings: disseminate progress and results to commodity group meetings
- Annual meeting: organize the final VacCAP annual meeting (via zoom)
- Continue to engage and educate the general public about the project outcomes and impacts through outreach activities on our website, newsletter, and social media
- Project evaluation: continue project evaluation activity to improve stakeholder engagement, communication, and effectiveness of extension activities.
- Develop an impact statements.

Participants

Actual FTE's for this Reporting Period

Role	Non-Students or faculty	Students with Staffing Roles			Computed Total by Role
		Undergraduate	Graduate	Post-Doctorate	
Scientist	5.6	4	6	4.3	19.9
Professional	3.3	0	0	1	4.3
Technical	3	1.3	1.3	0.3	5.899999999999999
					95

Progress Report

Accession No. 1020223

Project No. NC09879

Actual FTE's for this Reporting Period

Role	Non-Students or faculty	Students with Staffing Roles			Computed Total by Role
		Undergraduate	Graduate	Post-Doctorate	
Administrative	0.1	0	0	0	0.1
Other	0	0	0	0	0
Computed Total	12.0	5.3	7.3	5.6	30.199999999999995

Student Count by Classification of Instructional Programs (CIP) Code

Undergraduate	Graduate	Post-Doctorate	CIP Code
6	8	6	01.11 Plant Sciences.

Target Audience

Blueberry and cranberry breeders; post-harvest physiologists, food scientists, germplasm collection curators, molecular geneticists, and other allied scientists of these crops; nurseries, producers, processors, marketers, and marketing organizations of Vaccinium crops; and consumers of these crops.

Products

DR 1020-006 Certification Statement

Yes, any applicable scholarly publications have been submitted to the National Agricultural Library's (NAL) PubAg and any applicable data assets have been submitted to NAL's Ag Data Commons. These submissions included the NIFA grant or accession number and digital persistent identifiers for the publication or data asset (such as DOI) and the authors (such as ORCID).

Type

Peer Reviewed Journal

Status

Published

Year Published

2023

NIFA Support Acknowledged

NO

Digital Object Identifier (DOI)

10.1111/pce.14684

Author ORCID(s)

Citation

Espley, R. V. & Jaakola, L. The role of environmental stress in fruit pigmentation. Plant, Cell & Environment, 46, 3663–3679.

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Type	Status	Year Published	NIFA Support Acknowledged
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Digital Object Identifier (DOI)

10.1002/jaa2.118

Author ORCID(s)

Citation

Canales, E., R. K. Gallardo, M. Iorizzo, P. Muñoz, L. Ferrao, C. Luby, N. Bassil, M. Pottorff, P. Perkins-Veazie, P. Sandefur, A. Colonna, and C. Sims. 2024. Willingness to Pay for Blueberries: Sensory Attributes, Fruit Quality Traits, and Consumers' Characteristics. HortScience 59(8): 1207-1218.

Type	Status	Year Published	NIFA Support Acknowledged
Peer Reviewed Journal	Published	2024	YES

Digital Object Identifier (DOI)

10.1002/jaa2.121

Author ORCID(s)

Citation

Ma, X., R.K. Gallardo, E. Canales, A. Atucha, J. Zalapa, and M. Iorizzo. 2024. Consumers' Discount for Added Sugars: An Application to Cranberry Products Under Different Nutrition-Related Information Treatments. Journal of the Agricultural and Applied Economics Association, 1-20.

Type	Status	Year Published	NIFA Support Acknowledged
Peer Reviewed Journal	Published	2024	YES

Digital Object Identifier (DOI)

10.1002/jaa2.118

Author ORCID(s)

Citation

Ma, X., R.K. Gallardo, E. Canales, and M. Iorizzo. 2024. Quality-Related Descriptors to Increase Fresh Blueberries Purchase - Evidence from a Basket-Based Choice Experiment. Journal of the Agricultural and Applied Economics Association, 1-20.

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Type	Status	Year Published	NIFA Support Acknowledged
Peer Reviewed Journal	Published	2024	YES

Digital Object Identifier (DOI)

10.1017/age.2023.38

Author ORCID(s)**Citation**

Ma, X., R.K. Gallardo, E. Canales, A. Atucha, J. Zalapa, and M. Iorizzo. 2024. Would Consumers Accept CRISPR Fruit Crops if the Benefit Has Health Implications? An Application to Cranberry Products. *Agricultural and Resource Economics Review*. 1-23.

Type	Status	Year Published	NIFA Support Acknowledged
Peer Reviewed Journal	Published	2024	YES

Digital Object Identifier (DOI)

10.1016/j.postharvbio.2024.112964

Author ORCID(s)**Citation**

Mengist, M.F., M. Pottorff, T. Mackey, F. Ferrao, G. Casorzo, M.A. Lila, C. Luby, L. Giongo, P. Perkins-Veazie, N. Bassil, and P. Munoz, P. 2024. Assessing predictability of post-storage texture and appearance characteristics in blueberry at breeding population level. *Postharvest Biology and Technology*, 214, p.112964.

Type	Status	Year Published	NIFA Support Acknowledged
Peer Reviewed Journal	Published	2024	YES

Digital Object Identifier (DOI)

10.1016/j.postharvbio.2023.112643

Author ORCID(s)**Citation**

Oh, H., M. Pottorff, L. Giongo, C.M. Mainland, M. Iorizzo, and P. Perkins-Veazie. 2024. Exploring shelf-life predictability of appearance traits and fruit texture in blueberry. *Postharvest Biology and Technology*, 208, p.112643.

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Peer Reviewed Journal	Published	2024	YES

Digital Object Identifier (DOI)

10.1016/j.postharvbio.2024.113160

Author ORCID(s)

Citation

Oh, H., L. Stapleton, L. Giongo, S. Johanningsmeier, M. Mollinari, C.M. Mainland, P. Perkins-Veazie, and M. Iorizzo. 2024. Predicting of Bsensory texture attributes by integrating multiple instrumental measurements. Postharvest Biology and Technology, 218, p.113160.

Type	Status	Year Published	NIFA Support Acknowledged
Peer Reviewed Journal	Published	2024	YES

Digital Object Identifier (DOI)

10.1111/jtxs.12866

Author ORCID(s)

Citation

Lopez-Moreno, H., M. Phillips, L. Diaz-Garcia, M. Torres-Meraz, D. Jarquin, J. Loarca, S. Ikeda, L. Giongo, E. Grygleski, M. Iorizzo and J. Zalapa. 2024. Multiparametric Cranberry (*Vaccinium macrocarpon* Ait.) Fruit Textural Trait Development for Harvest and Postharvest Evaluation in Representative Cultivars. J Texture Stud, 55: e12866.

Type	Status	Year Published	NIFA Support Acknowledged
Peer Reviewed Journal	Published	2024	YES

Digital Object Identifier (DOI)

10.3389/fpls.2024.1294570

Author ORCID(s)

Citation

Maule A.F., L. Diaz Garcia, J. Loarca, H. Lopez-Moreno, J. Johnson-Cicalese, N. Vorsa, M. Iorizzo, J. Neyhart, and J. Zalapa. 2024. Of Buds and Bits: A QTL study on traditional upright traits and modern plot phenotyping in cranberry (*Vaccinium macrocarpon* Ait.). Frontier in Plant Science, 15:1294570

Progress Report

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Digital Object Identifier (DOI)

10.1021/acsfoodscitech.3c00284

Author ORCID(s)**Citation**

Trandel M., S. Johanningsmeier, H. Oh, M. Iorizzo and P. Perkins-Veazie. 2023. Blueberry cell wall polysaccharide composition of three distinct fruit firmness phenotypes. Food Science & Technology, 3, 11, 1920-1930.

Type	Status	Year Published	NIFA Support Acknowledged
Peer Reviewed Journal	Published	2023	YES

Digital Object Identifier (DOI)

10.3389/fpls.2023.1341519

Author ORCID(s)**Citation**

Farneti B., L. Giongo¹, F. Emanuelli, P. Toivonen, K. Folta, M. Iorizzo. 2023. Editorial: Interdisciplinary Approaches to Improve Quality of Soft Fruit Berries II. Frontier in Plant Science, 14:1341519.

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Peer Reviewed Journal	Published	2023	YES

Digital Object Identifier (DOI)

10.1093/hr/uhad202

Author ORCID(s)**Citation**

Alan E. Yocca, A. Platts, E. Alger, S. Teresi, M.F. Mengist, L.F.V. Ferrão, J. Benevenuto, M. Jacobs, M. Babinski, P. Bayer, A. Golicz, J.L. Humann, D. Main, R.V. Espley, D. Chagné, N.W. Albert, S. Montanari, N. Vorsa, J. Polashock, L. Díaz, J. Zalapa, N.V. Bassil, P.R. Munoz, M. Iorizzo, and P.P. Edger. Blueberry and cranberry pangenomes as a resource for future genetic studies and breeding efforts. Hort Research, Volume 10, Issue 11, November 2023, uhad202.

Progress Report

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10.3389/fhort.2023.1339310

Author ORCID(s)

Citation

Clare S.J., M. Driskill, T.R. Millar, D. Chagne, S. Montanari, S. Thomson, R.V. Espley, P.R. Munoz, J. Benevenuto, D. Zhao, M. Sheehan, M.F. Mengist, L.J. Rowland, H. Ashrafi, K. Melmaiee, K.P. Kulkarni, E.M. Babiker, D. Main, J. Olmstead, J. Gilbert, P. Havlak, H. Hung, J. Kniskern, D. Percival, P. Edger, M. Iorizzo and N.V. Bassil. 2024. Development of a targeted genotyping platform for reproducible results within tetraploid and hexaploid blueberry. *Frontiers in Horticulture*, 2:1339310.

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10.1094/PHYTO-12-23-0477-R

Author ORCID(s)

Citation

Kawash, J, Erndwein, L, Johnson-Cicalese, J, Knowles, S, Vorsa, N, Polashock, J. 2024. QTL analysis and marker development for fruit rot resistance in cranberry shows potential genetic association with epicuticular wax. *Phytopathology* 114:6, 1366-1372

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Author ORCID(s)

Citation

Andrew P. D., C. Wu, J.I. Carvajal, H.M. Nguyen, C.S. Günther, C. Hamiaux, S. Bailey, C. Deng, M.F. Mengist, M. Iorizzo, T.M. Foster, D. Chagné, S. Montanari, R.V. Espley. Haplotyped genome mapping and functional characterisation of a blueberry anthocyanin acetyltransferase (AAT) controlling the accumulation of acylated anthocyanins. *Journal of Experimental Botany*.

Progress Report

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Author ORCID(s)

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Loarca J., T. Wiesner-Hanks, H. Lopez-Moreno, A. Maule, M. Liou, M.A. Torres-Meraz, L.A. Diaz-Garcia, J. Johnson-Cicalese, J. Neyhart, J. Polashock, G. Sideli, C.F. Strock, C.T. Beil, M.J. Sheehan, M. Iorizzo, A. Atucha, and J.E. Zalapa. 2024. BerryPortraits: Software for phenotyping of ripening traits with rapid automated imaging tools in cranberry (*Vaccinium macrocarpon* Ait.). Plant Methods.

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Peer Reviewed Journal	Submitted	2024	YES

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Author ORCID(s)

Citation

Ferrão, L.F., C. Luby, M. Pottorff, G. Casorzo, M.F. Mengist, T. Mackey, M.A. Lila, L. Giongo, N. Bassil, P. Perkins-Veazie, M. Iorizzo, and P. Munoz. 2024. Inference of the genetic basis of fruit texture in Northern and Southern highbush blueberries using genome-wide association analysis. Horticulture Research 11 (10): uhae233.

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Hislop L.M., J. Loarca, J. Humann, K.E. Hummer, N. Bassil, D. Zhao, M. Sheehan, A.M. Casa, G.T. Billings, D. Echeverria, H. Ashrafi, E. Babiker, P. Edger, M.K. Ehlenfeldt, J. Hancock, C. Finn, M. Iorizzo, T. Mackey, J. Olmstead, L.J. Rowland, P. Sandefur, J. Spencer, S. Stringer, N. Vorsa, A. Wagner and A.M. Hulse-Kemp. 2024. A Blueberry (*Vaccinium* L.) Crop Ontology to Enable Standardized Phenotyping for Blueberry Breeding and Research. HortScience, 59(10), 1433-1442.

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Lopez Moreno H., M. Phillips, J. Kawash , M. Torres?Meraz, L. Diaz?Garcia, J. Neyhart, G.M. Sideli, J. Polashock, M. Iorizzo & J. Zalapa. 2024. Novel QTLs and Candidate Genes Governing Fruit Texture in American Cranberry (*Vaccinium macrocarpon* Ait.). G3, submitted peer review article.

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Conference Papers and	Other	2024	YES

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Author ORCID(s)

Citation

Knowles, S., Herniter, I., Traband R., Bowman, C., Wang, X., Lo, S., Wysocki, K., Chitwood, D.H., Jia, Z., Vorsa, N. and Sideli, G.M.. Unusual leaf and fruit morphology in a low titratable acidity cranberry population. International Society for Horticultural Science XIII Vaccinium Conference, August 24-29, 2024, Charlottetown, PEI Canada. Poster presentation

Type	Status	Year Published	NIFA Support Acknowledged
Conference Papers and	Other	2024	YES

Digital Object Identifier (DOI)

Author ORCID(s)

Citation

Lopez-Moreno, H., Philips, M., Diaz-Garcia, L., Torres-Meraz, M.A., Ikeda, S., Bassil, N., Edger, P., Sheehan, M., Johnson-Cicalese, J., Kawash, J., Neyhart, J., Polashock, J., Sideli, G.M., Iorizzo, M. and Zalapa, J.. Identification of novel QTLs influencing fruit texture and quality in American cranberry (*Vaccinium macrocarpon* Ait.). International Society for Horticultural Science XIII Vaccinium Conference, August 24-29, 2024, Charlottetown, PEI Canada. Poster presentation.

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Conference Papers and	Other	2024	YES

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Author ORCID(s)

Citation

Torres-Meraz, M.A., Lopez-Moreno, H., Bassil, N., Edger, P., Sheehan, M., Johnson-Ciclese, J., Sideli, G.M., Neyhart, J., Polashock, J., Iorizzo, M., Zalapa. Genetic and Phenotypic Diversity in Wild and Cultivated Cranberries: Insights for Breeding. International Society for Horticultural Science XIII Vaccinium Conference, August 24-29, 2024, Charlottetown, PEI Canada. Poster presentation

Type	Status	Year Published	NIFA Support Acknowledged
Conference Papers and	Other	2024	YES

Digital Object Identifier (DOI)

Author ORCID(s)

Citation

Oh, H., Perkins-Veazie, P., Ma, G., Trandel-Hayse, M., Mainland, C., Iorizzo, M. Postharvest fruit chemistry changes in 61 blueberry cultivars after 6 weeks in cold storage. International Society for Horticultural Science XIII Vaccinium Conference, August 24-29, 2024, Charlottetown, PEI Canada. Poster presentation.

Type	Status	Year Published	NIFA Support Acknowledged
Conference Papers and	Other	2024	YES

Digital Object Identifier (DOI)

Author ORCID(s)

Citation

Trandel-Hayse, M., Johanningsmeir, S., Oh, H., Iorizzo, M., Perkins-Veazie, P. 2024. Blueberry texture and total polysaccharide composition of 10 southern highbush cultivars following cold storage. International Society for Horticultural Science XIII Vaccinium Conference, August 24-29, 2024, Charlottetown, PEI Canada. Poster presentation.

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Type	Status	Year Published	NIFA Support Acknowledged
Conference Papers and	Other	2024	YES

Digital Object Identifier (DOI)

Author ORCID(s)

Citation

Perkins-Veazie, P., Li, C., Oh, H., Iorizzio, M. Blueberry Bruise Detection Relative to Fruit Firmness. International Society for Horticultural Science XIII Vaccinium Conference, August 24-29, 2024, Charlottetown, PEI Canada. Poster presentation.

Type	Status	Year Published	NIFA Support Acknowledged
Conference Papers and	Other	2024	YES

Digital Object Identifier (DOI)

Author ORCID(s)

Citation

Bassil, N.V., Zhao, D., Munoz, P., Sheehan, M., Iorizzo, M. 2024. Overview of single nucleotide polymorphism markers in blueberry and their uses. International Vaccinium Symposium. Poster presentation.

Type	Status	Year Published	NIFA Support Acknowledged
Conference Papers and	Other	2024	YES

Digital Object Identifier (DOI)

Author ORCID(s)

Citation

J. Polashock and J. Kawash. Non-destructive detection of select systemic diseases of Vaccinium spp. using hyperspectral imaging. International Society for Horticultural Science XIII Vaccinium Conference, August 24-29, 2024, Charlottetown, PEI Canada. Oral presentation.

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Conference Papers and	Other	2024	YES

Digital Object Identifier (DOI)

Author ORCID(s)

Citation

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Conference Papers and	Other	2024	YES

Digital Object Identifier (DOI)

Author ORCID(s)

Citation

Neyhart, J., Kisselstein, B., Johnson-Cicalese, J., Sideli, G.M. Mixed-model approaches to analyze regional variety trial data in cranberry. International Society for Horticultural Science XIII Vaccinium Conference, August 24-29, Charlottetown, PEI Canada. Oral presentation.

Type	Status	Year Published	NIFA Support Acknowledged
Conference Papers and	Other	2024	YES

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Author ORCID(s)

Citation

Sideli, G.M. et al., Understanding genetic determinants for acidity in cranberry fruit. International Society for Horticultural Science XIII Vaccinium Conference, August 24-29, 2024, Charlottetown, PEI Canada. Oral presentation.

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Type	Status	Year Published	NIFA Support Acknowledged
Conference Papers and	Other	2024	YES

Digital Object Identifier (DOI)

Author ORCID(s)

Citation

Perkins-Veazie, P. How Rabbit-eye Blueberries Compare to Southern Highbush: Postharvest, Quality and Sensory Attributes. Georgia Fruit and Vegetable Expo, January 11, 2024, Savannah, GA, USA. Oral presentation.

Type	Status	Year Published	NIFA Support Acknowledged
Conference Papers and	Other	2024	YES

Digital Object Identifier (DOI)

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Citation

Iorizzo M. Exploring fruit/vegetable nutrigenomic properties as new target traits to improve phytochemicals and nutrients uptake/health outcomes. 7th Biennial NC State Plant Breeding Symposium, February 1, 2024, Raleigh, NC, USA. Oral presentation.

Type	Status	Year Published	NIFA Support Acknowledged
Conference Papers and	Other	2024	YES

Digital Object Identifier (DOI)

Author ORCID(s)

Citation

Iorizzo M. Identification and characterization of genes associated with anthocyanin acylation in blueberry. XXXI Plant & Animal Genome, January 12-17, 2024, San Diego, California, USA. Oral presentation.

Type	Status	Year Published	NIFA Support Acknowledged
Conference Papers and	Other	2024	YES

Digital Object Identifier (DOI)

Author ORCID(s)

Citation

Ma, X., R.K. Gallardo, E. Canales, and M. Iorizzo. 2024. Hedonic Related Labels Impact on Consumers' Willingness to Purchase Blueberries. Annual Meetings of the Western Agricultural Economics Association, June 23-25, 2024, San Francisco, CA, USA. Oral

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presentation.

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Digital Object Identifier (DOI)

Author ORCID(s)

Citation

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Type	Status	Year Published	NIFA Support Acknowledged
Conference Papers and	Other	2024	YES

Digital Object Identifier (DOI)

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Citation

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Digital Object Identifier (DOI)

Author ORCID(s)

Citation

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Author ORCID(s)

Citation

Bassil N., Lily Hislop, Amanda M. Hulse-Kemp, Dongyan Zhao, Moira Sheehan, Josi L. Humann, Dorrie Main, Massimo Iorizzo and Ebrahiem Babiker. Developing a New Crop Ontology for blueberry. XXXI Plant & Animal Genome, January 12-17, 2024, San Diego, California, USA. Oral presentation.

Type	Status	Year Published	NIFA Support Acknowledged
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Citation

Giongo L. Berries Genetics and Breeding: diversity, quality and sustainability. Fondazione Edmund Mach, November 12, 2023, San Michele all'Adige, Italy. Oral presentation.

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Author ORCID(s)

Citation

Bushakra, J., Jung, S., Bassil, N.V., Cheng, C., Lee, T., Yu, J., Humann, J.L., Buble, K., Zheng, P., Main, D. Updates on curation and standardization of phenotypic and genotypic data for horticultural databases. American Society of Horticultural Science Meeting, September 23-27, 2024, Honolulu, HI, USA. Oral presentation.

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Author ORCID(s)

Citation

Humann, J., Cheng, C.H., Lee, T., Buble, K., Zheng, P., Jung, S., Yu, J., Gasic, K., Ru, S., Bassil, N., Iorizzo, M. & Main, D. Genome Database for Vaccinium: A community resource for genetics, genomics, and breeding research. International Society for Horticultural Science XIII Vaccinium Conference, August 24-29, Charlottetown, PEI Canada. Oral presentation.

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Citation

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Citation

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Citation

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Type	Status	Year Published	NIFA Support Acknowledged
Conference Papers and	Other	2024	YES

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Type	Status	Year Published	NIFA Support Acknowledged
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Type	Status	Year Published	NIFA Support Acknowledged
Conference Papers and	Other	2024	YES

Digital Object Identifier (DOI)

Author ORCID(s)

Citation

Jung, S., Cheng, C. H., Lee, T., Buble, K., Humann, J. L., Zheng, P., Yu, J., Ficklin, S. P., & D. Main. Building blocks for developing resource-efficient community databases. Annual Plant Biology Conference, June 21-26, 2024, Honolulu, HI, USA.

Type	Status	Year Published	NIFA Support Acknowledged
Conference Papers and	Other	2024	YES

Digital Object Identifier (DOI)

Author ORCID(s)

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Main, D., Jung, S., et al. Research impact of plant community databases. Annual Plant Biology Conference, June 21-26, 2024, Honolulu, HI, USA.

Type	Status	Year Published	NIFA Support Acknowledged
Conference Papers and	Other	2024	YES

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Author ORCID(s)

Citation

Jung, S., Lee, T., Cheng, C. H., Humann, J. L., Yu, J., & K. Gasic. New features of BIMS including interoperability with other resources through BrAPI. XXXI Plant & Animal Genome, January 12-17, 2024, San Diego, California, USA. Oral presentation.

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Type	Status	Year Published	NIFA Support Acknowledged
Conference Papers and	Other	2024	YES

Digital Object Identifier (DOI)

Author ORCID(s)

Citation

Zalapa J. Genomics and genetics research in cranberry and applications to breeding at the USDA in Madison, Wisconsin. Seminar at Universidad Austral de Chile Valdivia May 12, 2024, Chile.

Type	Status	Year Published	NIFA Support Acknowledged
Conference Papers and	Accepted	2024	YES

Digital Object Identifier (DOI)

Author ORCID(s)

Citation

Oh, H., Perkins-Veazie, P., Ma, G., Trandel-Hayse, M., Mainland, C., Iorizzo, M. 2024. Postharvest fruit chemistry changes in 61 blueberry cultivars after 6 weeks in cold storage. Proceedings of the XIII International Vaccinium Symposium.

Type	Status	Year Published	NIFA Support Acknowledged
Conference Papers and	Accepted	2024	YES

Digital Object Identifier (DOI)

Author ORCID(s)

Citation

Trandel-Hayse, M., Johanningsmeir, S., Oh, H., Iorizzo, M., Perkins-Veazie, P. 2024. Blueberry texture and total polysaccharide composition of 10 southern highbush cultivars following cold storage. Proceedings of the XIII International Vaccinium Symposium.

Type	Status	Year Published	NIFA Support Acknowledged
Conference Papers and	Accepted	2024	YES

Digital Object Identifier (DOI)

Author ORCID(s)

Citation

Perkins-Veazie, P., Li, C., Oh, H., Iorizzio, M. 2024. Blueberry Bruise Detection Relative to Fruit Firmness. Proceedings of the XIII International Vaccinium Symposium.

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Conference Papers and	Accepted	2024	YES

Digital Object Identifier (DOI)

Author ORCID(s)

Citation

Iorizzo M., M. Ann Lila, P. Perkins-Veazie, M. Fentie Mengist, A. Colonna, J. Johnson-Cicalese, G. Sideli, P. Edger, N. Bassil, T. Mackey, P. Munoz, F. Ferrao, J. Zalapa, J. Loarca, R. K. Gallardo, A. Atucha, J. Russo, D. Main, J. Humann, L. Giongo, C. Li, J. Polashock, C. Sims, E. Canales, S. Montanari, D. Chagne, R. Espley, M. Coe. 2024. VacCAP, a community-based project to develop advanced breeding tools to improve fruit quality in blueberry and cranberry. Proceedings of the XIII International Vaccinium Symposium.

Type	Status	Year Published	NIFA Support Acknowledged
Conference Papers and	Other	2024	YES

Digital Object Identifier (DOI)

Author ORCID(s)

Citation

Humann J., C. Cheng, T. Lee, K. Buble, P. Zheng, S. Jung, J. Yu, K. Gasic, S. Ru, N. Bassil, M. Iorizzo and D. Main. 2024. Genome Database for Vaccinium: A community resource for genetics, genomics, and breeding research. Proceedings of the XIII International Vaccinium Symposium.

Type	Status	Year Published	NIFA Support Acknowledged
Conference Papers and	Accepted	2024	YES

Digital Object Identifier (DOI)

Author ORCID(s)

Citation

Bassil, N.V., Zhao, D., Munoz, P., Sheehan, M., Iorizzo, M. 2024. Overview of single nucleotide polymorphism markers in blueberry and their uses. Proceedings of the XIII International Vaccinium Symposium.

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Conference Papers and	Accepted	2024	YES

Digital Object Identifier (DOI)

Author ORCID(s)

Citation

Sideli G., S. Knowles, J. Johnson-Cicalese, T. Spain, N. Vorsa, J. Polashock, N. Bassil, J. Zalapa. 2024. Understanding genetic determinants for acidity in cranberry fruit. Proceedings of the XIII International Vaccinium Symposium.

Type	Status	Year Published	NIFA Support Acknowledged
Conference Papers and	Accepted	2024	YES

Digital Object Identifier (DOI)

Author ORCID(s)

Citation

Zalapa J. and M. Digman. 2024. A New Elite Breeding Initiative Launched at Wisconsin Cranberry Research Station. 2024 Summer Field Day & Trade Show, August 14, 2024, Wisconsin. In press. Conference proceedings

Type	Status	Year Published	NIFA Support Acknowledged
Conference Papers and	Accepted	2024	YES

Digital Object Identifier (DOI)

Author ORCID(s)

Citation

Loarca J., A. Atucha, and J. Zalapa. 2024. Cranberry Genetics Diversity & Fruit Quality. WI Cranberry School Proceedings Vol 32. In press. Conference proceedings

Type	Status	Year Published	NIFA Support Acknowledged
Conference Papers and	Accepted	2024	YES

Digital Object Identifier (DOI)

Author ORCID(s)

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Type	Status	Year Published	NIFA Support Acknowledged
Conference Papers and	Accepted	2024	YES

Digital Object Identifier (DOI)

Author ORCID(s)

Citation

Polashock J. and J. Kawash. 2024. Non-destructive detection of select systemic diseases of *Vaccinium* spp. using hyperspectral imaging. Proceedings of the XIII International Vaccinium Symposium.

Type	Status	Year Published	NIFA Support Acknowledged
Conference Papers and	Accepted	2024	YES

Digital Object Identifier (DOI)

Author ORCID(s)

Citation

Joseph Kawash, Iman Dehzangi and James Polashock. 2024. Using machine learning for discovery of epistatic fruit rot resistance markers. Proceedings of the XIII International Vaccinium Symposium.

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Theses/Dissertations	Accepted	2024	YES

Digital Object Identifier (DOI)

Author ORCID(s)

Citation

Sara Knowles, Rutgers University, Plant Biology Graduate Group. Investigations of trait relationships in American cranberry (*Vaccinium macrocarpon* Ait.) fruit rot resistance and low acid populations. PhD Thesis, 2024.

Type	Status	Year Published	NIFA Support Acknowledged
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Author ORCID(s)

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Type	Status	Year Published	NIFA Support Acknowledged
Other	Other	2024	YES

Digital Object Identifier (DOI)

Author ORCID(s)

Citation

M. Iorizzo. Vaccinium CAP status and updates: advancing genetic and genomic tools to improve fruit quality in blueberry and cranberry. 58th Annual Open House and Trade Show, January 17-18, 2024, Fayetteville, NC, USA. Presentations for Growers or Other Industry Stakeholders

Type	Status	Year Published	NIFA Support Acknowledged
Other	Other	2024	YES

Digital Object Identifier (DOI)

Author ORCID(s)

Citation

M. Iorizzo. VacCAP: A community-based project to develop advanced DNA and phenotyping breeding tools to improve fruit quality in blueberries. The Blueberry Summit, September 25-27, 2024, Denver, CO, USA. Presentations for Growers or Other Industry Stakeholders

Type	Status	Year Published	NIFA Support Acknowledged
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Digital Object Identifier (DOI)

Author ORCID(s)

Citation

Giongo L. Updates on Blueberry Breeding at FEM. Fondazione Edmund Mach, September 1, 2023, San Michele all'Adige, Italy. Presentations for Growers or Other Industry Stakeholders

Type	Status	Year Published	NIFA Support Acknowledged
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Author ORCID(s)

Citation

DeVetter L.W. and N. Bassil. VacCAP Highlights: Progress, Achievements, and the Future of Blueberry Breeding. Blueberry Field Day, North Willamette Research and Extension Center, July 24, 2024, Aurora, OR. USA. Presentations for Growers or Other Industry Stakeholders

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Other	Other	2024	YES

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Author ORCID(s)

Citation

Zalapa J. A New Elite Breeding Initiative Launched at Wisconsin Cranberry Research Station. Wisconsin State Cranberry Growers Association. 2024 Summer Field Day & Trade Show, August 14, 2024, Pittsville, WI, USA. Presentations for Growers or Other Industry Stakeholders

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Author ORCID(s)

Citation

Zalapa J. Cranberry breeding update. Wisconsin State Cranberry Growers Association open house event, Meeting On The Marsh. August 29, 2024, Wisconsin Rapids, WI USA. Presentations for Growers or Other Industry Stakeholders

Type	Status	Year Published	NIFA Support Acknowledged
Other	Other	2024	YES

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Author ORCID(s)

Citation

Zalapa. Video series for public communications on research conducted at the WSCRS. Cranberry research filming project. Cranberry Breeding, Genetics and Phenotyping Project. Wisconsin State Cranberry Growers Association. Millstone, WI. July 10, 2024. Presentations for Growers or Other Industry Stakeholders

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Project No. NC09879

Type	Status	Year Published	NIFA Support Acknowledged
Other	Other	2024	YES

Digital Object Identifier (DOI)

Author ORCID(s)

Citation

Zalapa J. Cranberry breeding updates. Proposal and Report Presentation Meeting. Wisconsin State Cranberry Growers Association, March 13, 2024, Millston, WI, USA. Presentations for Growers or Other Industry Stakeholders

Type	Status	Year Published	NIFA Support Acknowledged
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Citation

Zalapa J. Ask the researcher's questions panel. Cranberry School. January 24-25, 2024, Madison, WI, US. Presentations for Growers or Other Industry Stakeholders

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Other	Other	2024	YES

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Citation

Zalapa J. Genetics Diversity & Fruit Quality. Cranberry School Presentation, January 24-25, 2024, Madison, WI. US. Presentations for Growers or Other Industry Stakeholders

Type	Status	Year Published	NIFA Support Acknowledged
Other	Other	2023	YES

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Citation

Zalapa J. Cranberry processing plant tour and fruit quality discussion with processors. December 20, 2023, Necedah, WI, US. Presentations for Growers or Other Industry Stakeholders

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Citation

Zalapa J. Cranberry Research Round Table. VacCAP update. November 17, 2023, Madison, WI, US. Presentations for Growers or Other Industry Stakeholders

Type	Status	Year Published	NIFA Support Acknowledged
Other	Other	2024	YES

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Author ORCID(s)

Citation

Polashock J. and Kawash, J. Field plot scanning for cranberry disease incidence and fruit quality, American Cranberry Growers Association Summer Meeting, August 22, 2024, Chatsworth, NJ, US. Presentations for Growers or Other Industry Stakeholders

Type	Status	Year Published	NIFA Support Acknowledged
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Author ORCID(s)

Citation

Polashock J. Improvement of blueberries in the genomic era. New Jersey Blueberry Open House Hammonton, February 14, 2024, NJ, US. Presentations for Growers or Other Industry Stakeholders

Type	Status	Year Published	NIFA Support Acknowledged
Other	Other	2023	YES

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Citation

Sideli G. "Next Generation Cranberries". Brown Bag Seminar series, Wisconsin cranberry grower meeting, December 15, 2023, Madison, WI, US. Presentations for Growers or Other Industry Stakeholders

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Sideli G. "Historical Breeding Efforts Shape Future Trajectory". American Cranberry Growers Association (ACGA) Winter meeting, January 18, 2024, NJ. Presentations for Growers or Other Industry Stakeholders

Type	Status	Year Published	NIFA Support Acknowledged
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Citation

Atucha A. VacCAP updates. Wisconsin Cranberry Research Round Table Meeting November 15, 2023. Presentations for Growers or Other Industry Stakeholders

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Other	Published	2023	YES

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Atucha, A., Russo, J., DeVetter, L., Gallardo K., and Iorizzo, M. The CRISPR Question: Would Consumers Accept CRISPR Cranberries with Reduced Added Sugar? VacCAP Newsletter Issue 9, December 2023. <https://www.vacciniumcap.org/CRISPRQuestion>

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Author ORCID(s)

Citation

Atucha, A., Russo, J., DeVetter, L., Polashock, J., and Iorizzo, M. Mitigating Cranberry Fruit Rot Through Breeding for Resistance. VacCAP Newsletter Issue 9, December 2023. <https://www.vacciniumcap.org/cranberryfruitrotresistance>

Progress Report

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Other	Published	2023	YES

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Citation

Atucha, A., Russo, J., DeVetter, L., Edger, P., Jacobs, M., Iorizzo M. Identification of Molecular and Genetic Markers Associated With Resistance to Anthracnose Fruit Rot. VacCAP Newsletter Issue 9, December 2023.
<https://www.vacciniumcap.org/blueberryanthracnose>

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Author ORCID(s)

Citation

Atucha, A, Russo, J., DeVetter, L., Edger P., Iorizzo M., Bassil N., Main D., Humann J., Zalapa J., Polashock J., D. Chagne. VacCAP highlith Objective 1. Issue 10, July 2024. <https://www.vacciniumcap.org/sites/default/files/inline-files/VacCAP%20Objective%201%20Feature%20Newsletter%20.pdf>

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Citation

Humann JL and Main D. Genome database for Vaccinium newsletters, Issue 9, October 2023.
<https://www.vaccinium.org/sites/default/files/files/GDV%20Newsletter-Oct2024.pdf>

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Digital Object Identifier (DOI)

Author ORCID(s)

Citation

Humann JL and Main D. Genome database for Vaccinium newsletters, Issue 10, January 2024.
<https://www.vaccinium.org/sites/default/files/files/GDV%20Newsletter-Jan2024.pdf>

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Digital Object Identifier (DOI)

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Citation

Humann JL and Main D. Genome database for Vaccinium newsletters, Issue 11, April 2024.
<https://www.vaccinium.org/sites/default/files/files/GDV%20Newsletter-Apr2024.pdf>

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Citation

Humann JL and Main D. Genome database for Vaccinium newsletters, Issue 12, July 2024.
<https://www.vaccinium.org/sites/default/files/files/GDV%20Newsletter-Jul2024.pdf>

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Author ORCID(s)

Citation

Atucha, A., Russo, J., DeVetter, L., Oh, H., Perkins, P., Iorizzo M. Blueberry TA and pH. VacTrait, January 2024.
<https://www.vacciniumcap.org/sites/default/files/inline-files/VacTrait%20TA%20and%20pH%20.pdf>

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Other	Published	2024	YES

Digital Object Identifier (DOI)

Author ORCID(s)

Citation

Atucha, A., Russo, J., DeVetter, L., Neilson, A., Iorizzo M. Blueberry Chlorogenic Acid. VacTrait, August 2024.
<https://www.vacciniumcap.org/sites/default/files/inline-files/Blueberry%20Chlorogenic%20Acid%20VacTrait.pdf>

Progress Report

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Digital Object Identifier (DOI)

Author ORCID(s)

Citation

Atucha, A., Russo, J., DeVetter, L., Johnson-Cicalese, J., Sideli, G., Iorizzo M. Cranberry Organic Acids. VacTrait, August 2024. <https://www.vacciniumcap.org/sites/default/files/inline-files/VacTrait%20Cranberry%20Organic%20Acids.pdf>

Type	Status	Year Published	NIFA Support Acknowledged
Other	Other	2024	YES

Digital Object Identifier (DOI)

Author ORCID(s)

Citation

Perkins-Veazie. Update on VACcap research and results. North Carolina Blueberry Growers Field Day, Castle Hayne, NC. May19, 2024. Presentations for Growers or Other Industry Stakeholders

Type	Status	Year Published	NIFA Support Acknowledged
Conference Papers and	Other	2024	YES

Digital Object Identifier (DOI)

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Citation

Espley, R.V., et al. Unraveling genetic mechanisms that define anthocyanin quality in blueberry. International Society for Horticultural Science XIII Vaccinium Conference, August 24-29, 2024, Charlottetown, PEI Canada. Oral presentation.

Type	Status	Year Published	NIFA Support Acknowledged
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Digital Object Identifier (DOI)

Author ORCID(s)

Citation

Sideli, G. Update on the development of a fruit rot resistant cranberry variety, American Cranberry Growers Association Summer Meeting, August 22, 2024, Chatsworth, NJ, US. Presentations for Growers or Other Industry Stakeholders

Progress Report

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Digital Object Identifier (DOI)

Author ORCID(s)

Citation

Sideli, G. Next Generation Blueberry Breeding at Rutgers. New Jersey Blueberry Open House, Hammonton, NJ, February 14, 2024. Presentations for Growers or Other Industry Stakeholders

Type	Status	Year Published	NIFA Support Acknowledged
Conference Papers and	Published	2023	YES

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Author ORCID(s)

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Jacobs M., S. Thompson, A.E. Platts, M.J.A. Body, A. Kelsey, A. Saad, P. Abeli, S.J. Teresi, A. Schillmiller, R. Beaudry, M.J. Feldmann, S.J. Knapp, G. Song, T. Miles, & P.P. Edger. Uncovering genetic and metabolite markers associated with resistance against anthracnose fruit rot in northern highbush blueberry. Horticulture Research. 10(10), 169.

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Citation

Munoz P. Blueberry Breeding and Genetics: methods, programs, traits, and news. US Highbush Council. Sept 29, 2023. Savannah, SC. Presentations for Growers or Other Industry Stakeholders

Type	Status	Year Published	NIFA Support Acknowledged
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Citation

Munoz. P. UF/IFAS Blueberry Breeding Update. Florida Blueberry Growers Association. October 25, 2023. Bonnet Springs Park. Lakeland, FL. Presentations for Growers or Other Industry Stakeholders

Progress Report

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Type

Conference Papers and

Status

Other

Year Published

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Digital Object Identifier (DOI)

Author ORCID(s)

Citation

Munoz P. Advanced tools for breeding, Plant and Food Research. Feb 26, 2024. Te Puke, NZ. Oral presentation.

Other Products

Type

Databases

DOI or Other Persistent Identifier

Associated Publication DOI(s)

Author ORCID(s)

Description

GDV data updates. The Genome Database for Vaccinium (GDV, <https://www.vaccinium.org>) is an online community database providing access to integrated Vaccinium peer-reviewed genomic, genetic, and breeding data and analysis tools. During year 5 the gene, mRNA, and functional annotation information for all the genomes were added to the database and the genomes were added to the BLAST, Synteny Viewer and JBrowse genome tools. Two lingonberry genomes were also added to the PathwayCyc tool. New JBrowse tracks of aligned markers, GWAS, QTL, and SNPs were added for 9 representative genomes across all four crops hosted on GDV. One blueberry expression dataset was added. For genetic data, we curated data from 6 manuscripts and added 22,297 genetic markers (include new blueberry genotyping Flex-Seq platform), 311 GWAS and 3,317 QTL. During year 5, GDV was accessed by 5,927 users from 138 countries, with 12,808 visits and 311,369 pages served (Google Analytics)

Type

Databases

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Description

GDV tools updates. Improvements and upgrades were done to the tools deployed on GDV. More permission levels were added to BIMS to facilitate Team Project Management, more

Progress Report

Accession No. 1020223

Project No. NC09879

functionality for the management of Image data in BIMS, BIMS supports Field Book sync function, Protein FASTA file download available from sequence search, Trait Descriptor Search updated for new data format.

Type

Databases

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Vaccinium CAP project website (<https://www.vacciniumcap.org>).

- During year 5 we continued to update content with new webinars, VacCAP traits, short video, and newsletters.

- Website stats summary (September 1, 2023–August 31, 2024)

- o 11,616 pageviews

- o Top 5 Pages Based on Views: Home/About/Newsletters/Team/Publications

- o 4,375 users

- o Top 5 Counties Based on User Locations: United States (2,500 users); China (208 users); Canada (113 users); Australia (82 users); India (81 users)

- o 3,320 sessions (1.23 sessions per users)

Type

Other

DOI or Other Persistent Identifier**Associated Publication DOI(s)****Author ORCID(s)****Description**

Social Media Twitter and YouTube channel

A X/twitter account (@VacciniumCAP) was maintained to disseminate information about the project as part of the social media strategy, in conjunction with a YouTube channel (<https://www.youtube.com/channel/UCpAdvtTEebzZjvJ4SJcoXwg>).

- Twitter Stats (September 2023–August 2024)

- o 392 followers

- YouTube (September 2023–August 2024)

- o 1,370 video views

- o 96.8 hours of watch time

Progress Report

Accession No. 1020223

Project No. NC09879

Type

Audio or Video

DOI or Other Persistent Identifier**Associated Publication DOI(s)****Author ORCID(s)****Description**

Webinars. The following seven webinars were made available on VacCAP:

- Uncovering the Genetic Control of Organic Acids and Sugars in Blueberry on October 10, 2023. Presenter: Heeduk Oh. Webinar presentation. 37 live participants, 125 YouTube views.
- Blueberry Cell Wall Polysaccharide Composition of Three Distinct Fruit Firmness Phenotypes on December 12, 2023. Presenter: Dr. Marlee Trandel-Hayse. Webinar presentation. 37 live participants, 64 YouTube views.
- Would Consumers Accept CRISPR Fruit Crops if the Benefit has Health Implications? on February 1, 2024. Presenter: Dr. R. Karina Gallardo. Webinar presentation. 89 live participants, 44 YouTube views.
- Assessing Predictability of Blueberry Sensorial Texture Descriptors Using Instrumental Measurements on March 25, 2024. Presenter: Heeduk Oh. Webinar presentation. 29 live participants, 85 YouTube views.
- Assessing Post-Storage Texture and Appearance Characteristics in Blueberry on April 22, 2024. Presenters: Dr. Massimo Iorizzo and Dr. Lara Giongo. Webinar presentation. 29 live participants, 92 YouTube views.
- Enhancing Fresh Blueberry Demand Through Labels With Hedonic Descriptors on May 20, 2024. Presenter: Dr. R. Karina Gallardo. Webinar presentation. 12 live participants, 14 YouTube views.
- Consumer Response To "Added Sugar" Labeling in Cranberry Processed Products on June 17, 2024. Presenter: Dr. R. Karina Gallardo. Webinar presentation. 27 live participants, 16 YouTube views.

For videos see here: <https://www.youtube.com/@vaccaproject2641>

Type

Audio or Video

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Instructional video. Two instructional video to educate our audience about ongoing research and methods were released.

1. Barcoding as a Breeding Tool. Learn how DNA barcoding can facilitate plant breeding and is used in the Vaccinium Coordinated Agriculture Project (VacCAP) featuring Felipe Ferrão, Blueberry Breeding Program, University of Florida. November 30, 2023. Produced by Dr. Lisa

Progress Report

Accession No. 1020223

Project No. NC09879

Wasko DeVetter, Washington State University. <https://www.youtube.com/watch?v=UBiMevG3sXY>

2. Breeding for Blueberry Flavor. Learn how sensory evaluation can facilitate breeding higher quality blueberries and is used in the Vaccinium Coordinated Agriculture Project (VacCAP). featuring Dr. Charlie Sims, FSHN Sensory Testing Lab, University of Florida. November 30, 2023. Produced by Dr. Lisa Wasko DeVetter, Washington State University. <https://www.youtube.com/watch?v=7WnLnmxrNVI&t=6s>

Video training. Seven “how to” videos for GDV were released. These short videos provide instruction and training on how to use the tools and features available on GDV. The following videos were released:

1. Humann JL and Main D. Marker search by trait and viewing genome position. https://www.youtube.com/watch?v=G6v0_GU3YMQ&list=PLMHx16OgbKiMtjWOHwzXPPvtn8Vo6-ji&index=2
2. Humann JL and Main D. How to use the Ortholog/Paralog search. https://www.youtube.com/watch?v=7_rfrg0HN7k&list=PLMHx16OgbKiMtjWOHwzXPPvtn8Vo6-ji&index=3
4. Humann JL and Main D. How to download protein sequences. <https://www.youtube.com/watch?v=I5WdRrnetQg&list=PLMHx16OgbKiMtjWOHwzXPPvtn8Vo6-ji&index=4>
5. Humann JL and Main D. Downloading markers from a map region. <https://www.youtube.com/watch?v=la3F-hUrvQ8&list=PLMHx16OgbKiMtjWOHwzXPPvtn8Vo6-ji&index=5>
6. Humann JL and Main D. Finding a marker associated with a trait. <https://www.youtube.com/watch?v=KyLpbFqSy0I&list=PLMHx16OgbKiMtjWOHwzXPPvtn8Vo6-ji&index=6>
7. Humann JL and Main D. Learn How to view correspondences between genomes and genetic maps. <https://www.youtube.com/watch?v=dFMn9g5NsTw&list=PLMHx16OgbKiMtjWOHwzXPPvtn8Vo6-ji&index=7>
8. Humann JL and Main D. Learn how to use the Expression Heatmap Tool. <https://www.youtube.com/watch?v=QU6trudNegg&list=PLMHx16OgbKiMtjWOHwzXPPvtn8Vo6-ji&index=8>

Type

Other

DOI or Other Persistent Identifier**Associated Publication DOI(s)****Author ORCID(s)****Description**

Genotyping platform. Continued coordination of sample submission for the Vaccinium genotyping consortium. This year, a total of 7,513 blueberry samples were genotyped from 11 organizations and 1,294 cranberry samples from two organizations. The platform is available for use through LGC.

Progress Report

Accession No. 1020223

Project No. NC09879

Type

Survey Instruments

DOI or Other Persistent Identifier**Associated Publication DOI(s)****Author ORCID(s)****Description**

Survey industry breeding priorities. Completed re-assessment of blueberry and cranberry breeding priorities through a survey. Results indicated that fruit quality remain a top priority for both blueberry and cranberry. Mechanical harvestability and disease resistance were next top priorities for blueberry while disease resistance and tolerance to abiotic stress were other top priorities for cranberry. The outcomes of the survey guided planning activities for VacCAP 2.0.

Type

Other

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Fostered collaborations and new proposals: VacCAP activities fostered multiple collaborations. Perkins lab established collaboration with breeder, postharvest physiologist at Auburn University were developed to follow changes in blueberry chemistry with environmental and storage treatments. Also developed collaborative small fruit consortium grant to characterize chlorogenic acid and anthocyanins in rabbiteye germplasm. These collaborations have led to evaluation of chemistry in 10 Rabbiteye cultivars and six advanced Rabbiteye selections.

Established collaboration with USDA-ARS Poplarville Mississippi Breeding Program. Genotyped 187 southern highbush blueberry genotypes with the Blueberry Flex-Seq genotyping platform and are using the data to assess the genetic diversity and the relationships within this collection. The genotypic data is being used to detect genomic regions associated with adaptation and fruit quality traits using phenotypic stability indices. VacCAP results were leveraged to develop a new international funded research program in Italy (Agritech PNRR) that will further study the microbiome of Vaccinium and stress tolerance.

Progress Report

Accession No. 1020223

Project No. NC09879

Type

New Germplasm

DOI or Other Persistent Identifier**Associated Publication DOI(s)****Author ORCID(s)****Description**

Cranberry. At the Rutgers program new breeding populations carrying fruit rot resistance, high yield and new germplasm have been added to the cranberry breeding program, and new field plots evaluating advanced selections have been established. Continued selection for low acid lines, new selections planted in field plots in 2023 were maintained and will be used to do further testing and get large enough samples of fruit to do taste tests on juice. At the USDA-Wisconsin: 1200 4x4 plots were established in the spring of 2024 based on eight half sib-families using #35 as a male Potter's Favorite, Stevens, Sundance, Pilgrim, HyRed, Ruby Star, WSU108, Ben Lear. These half sib families will be analyzed based on VacCAP phenotypic and genotypic resources and will serve for future cranberry breeding efforts.

Blueberry. At the UF program, over 6,000 plants selected based on a DNA marker for Eucalyptol were planted. At FAM program in collaboration with USDA Oregon as part of the VacCAP network, a new field was established that includes a number of wild species of Vaccinium to use in future activities of pre-breeding to introgress resistance traits, both biotic and abiotic. During year 5, 591 new lines, belonging to 37 wild species were developed and grown: 408 were phenotyped for plant vigor, leaf morphology and images were taken for flower analysis. The first year phenology was completed for 178 genotypes. Other 33 new species were imported in December 2023, again from the Corvallis Genebank, and developed during year 5, producing 120 new plants and other still germinating. In year 5, the potential of hybridization was started to be explored: 235 cross combinations were performed and are ongoing. At the end of year 5, we have used the parameters validated within the project to select for texture in more than 30 different elite lines, related to FM, DFM and A_YM in the FEM breeding and pre-breeding program.

Type

Protocols

DOI or Other Persistent Identifier**Associated Publication DOI(s)****Author ORCID(s)****Description**

Developed protocol for use of an easily available freeze dryer to freeze blueberries in test tubes, including freeze temperature, dry temperature, dry times. This provides an inexpensive, large volume, rapid, and easy to use alternative to scientific and more expensive freeze dryers for preparing blueberries samples for assays.

Progress Report

Accession No. 1020223

Project No. NC09879

Type

Software or NetWare

DOI or Other Persistent Identifier**Associated Publication DOI(s)****Author ORCID(s)****Description**

A new software was released to assess cranberry external appearance called BerryPortraits. The software is available at <https://github.com/Breeding-Insight/BerryPortraits/>. Developed protocol for use of an easily available freeze dryer to freeze blueberries in test tubes, including freeze temperature, dry temperature, dry times. This provides an inexpensive, large volume, rapid, and easy to use alternative to scientific freeze dryers for preparing freeze dried blueberries for assays.

Changes/Problems

The delay of funding release from the USDA-NIFA during Year 1 and COVID-19 requirements during 2020-2022, delayed multiple activities and led the team to request a second-year no cost extension. A summary of affected activities are summarized below:

Obj. 1. Development of genotyping platforms was delayed. As a result, delivery of the genotypic data for genetic studies expected in Y4 was delayed and publications will be completed in Year 6. Obj. 2. Delay in the delivery of genotypic data delayed some of the genetic studies that will be completed in Y6. Due to COVID-19, and the loss of a key PI due to illness evaluation and analysis of cranberry data at Rutgers was delayed. Obj. 5. Given the delay on some project outputs, the extension team will continue to work with PIs to develop newsletters and webinars. Budget re-allocations were processed to support these additional work.