WISCONSIN CRANBERRY BOARD, INC.
2009 PROGRESS REPORT SUMMARIES

The following progress reports were provided to the Wisconsin Cranberry Board, Inc. by the individuals and groups that received project funding during the 2008-09 fiscal year. These reports were presented to the WCB at or prior to the Budget Meeting on March 30, 2010. Copies of the full reports can be obtained from the authors or from the Wisconsin Cranberry Board, Inc. office.

Crop Research

Pesticide Screening for Cranberries

Principal Investigator: Jed Colquhoun, UW Madison, Department of Horticulture

Cooperators: Dan Mahr, UW Madison, Patricia McManus, UW Madison, Jack Perry, UW Madison

Objectives: The mission of the 2009 program was to investigate fungicides, insecticides and herbicides for use in cranberry production. Objectives were twofold: 1) investigate pesticides currently registered for use in cranberries to refine their use patterns and to further identify their pest control spectrum; and, 2) investigate pesticides not currently registered for use in cranberries for their potential to address existing pest problems.

Summary: In the 2009 growing season, thirty-three field trials were conducted on fifteen Wisconsin marshes including fifteen insecticide trials with a varying number of treatments at each site evaluating treatments for six target pests and five fungicide trials on three marshes with fourteen treatments conducted. Insecticide research focused on product evaluations for tipworm, fireworm, flea beetle, fruitworm loopers and white grub control, as well as a refinement of recently registered insecticides. Fungicide evaluations focused on potential products for fruit rot control.

In the insecticide trials all of the registered products performed much as expected. The older organophosphate products were broad-spectrum across most test pests and were generally effective as long as the pest was present at the time of the application. Control ranged from acceptable to excellent. The newly registered products, particularly the insect growth regulator-types (IGR), were more pest-specific. Lepidopteran pests were controlled well with IGRs, the dipterans less so and the other pests mostly not controlled. Although all of the newer products were generally equally effective, the timing of applications with these products was critical to performance – late egg-to-early instar applications were efficacious whereas applications to later instars were significantly less effective - to be expected with these types of insecticides. Tank mixes of the newer products with the organophosphates lessened the necessity for precise timings of applications. Of the candidate insecticides one was a stellar product.

The purposes of the 2009 herbicide trials were threefold: 1) investigate new post-applied products for possible use in cranberries; 2) stay current with use patterns for Callisto (mesotrione); and 3) continue to investigate a candidate herbicide for dodder control. There are few new post applied products coming from industry. Most of the existing possible products have been investigated by us in previous years. Several of those products have shown potential for use in Wisconsin cranberries. In our 2009 trials, two of the candidate herbicides caused discernable crop response. One of these products induced season-long crop injury. Crop response from the other candidate herbicide was less long lasting but still unacceptable. Although the crop responses induced by either product did not result in significant yield reduction, the visual response was unacceptable. The visual crop response induced by a third candidate herbicide was minor, however several tested treatments with this product resulted in significant crop reduction.

Two candidate herbicides demonstrated good promise for use in Wisconsin cranberries. The weed control spectrum of both of these products would make these great companion products for Callisto as they provide good control of weeds that are weaknesses with Callisto. Another candidate herbicide provided good control of St. Johnswort and yellow loosestrife. No crop responses were noted in these products. In 2009 seven trials were conducted in two marshes to investigate use patterns of the product (rates, application timing, tank mixes) for dodder control. The candidate herbicide continued to be highly efficacious for dodder control; application timing is critical to good control. Two other candidate herbicides did not control dodder.

Five fungicide trials were conducted on three marshes that have experienced significant fruit rot problems in recent years. LaMunyon, Stevens and Ben Lear were the subject varieties. Fourteen treatments were evaluated. Treatments included various timings of applications of the registered products Bravo, Abound and Indar. Three non-registered products were

also included. Bravo and Abound were the most effective products. Indar was less effective. The current recommendation is for two applications of a fungicide at 50% bloom and at early post bloom. Additional applications at pre-bloom or late berry set did not contribute significantly to enhanced disease control. None of the three candidate fungicides was very effective.

In addition to the aforementioned research, time has been invested this season in supporting use of recently registered pesticides such as Callisto, as well as troubleshooting potential pesticide-related production issues. Research results will continue to be communicated to the industry through regional and national newsletters, grower meetings, and field workshops.

Cranberry Production for a Sustainable Future

Principal Investigators: Jed Colquhoun and Heidi Johnson, University of Wisconsin-Madison and University of Wisconsin-Extension

Cooperators: Wisconsin Cranberry Growers

Objectives: 1) To quantify the positive economic, social and environmental impacts of cranberry production, and communicate these impacts to the general public, buyers and retailers, and public agencies. 2) To identify areas of potential improvement and needed research that would further promote industry sustainability.

Summary: In fall 2009, a survey was developed in concert with the cranberry industry and sent to 251 Wisconsin cranberry growers. Growers were asked about their current production practices and how those have changed over the last 20 years. Responses were received from 152 marshes representing 13,274 acres of a total of about 17,700. The results of this survey were striking – not only had growers made vast improvements in production practices and other parameters typically considered in sustainability programs, but their level of compliance in such parameters was very high and exceeded expectations relative to other cropping systems. We are currently in the editing process, with a professional editor, of publishing a summary of the formal and informal survey work conducted over the last 6 months. Three end-products will result: an end-user/buyer/retailer publication that encompasses the results of our work; a consumer-oriented brochure of sustainable cranberry production; and an internal document that can be used to guide a research agenda based on sustainability into the future.

Breeding Cranberry for High Yields and Ease of Culture When Grown Under Wisconsin Conditions

Principal Investigators: Brent H. McCown, Department of Horticulture, UW-Madison; Eric Zeldin, Researcher

Cooperators: Wisconsin cranberry growers, Ocean Spray Cranberries, Inc.

Objectives: 1) Support and monitoring of 'HyRed' growers and propagators. 2) Continued evaluation of the 'A-X15' selection. 3) Continued evaluation of second generation selections. 4) Continued evaluation of existing tetraploid plots.
The above objectives have been modified to accelerate the breeding project for release of a new cultivar, improved evaluation of tetraploids, better understanding of yield parameter traits and the production of new crosses to be proactive in response to current and future climate change in Wisconsin.

Summary: In 2009 there was considerable increase in the planting of 'HyRed'. Utilizing new cultivars will carry some degree of learning as the optimization for unique traits may require modification of the growing regime. This was certainly true with 'HyRed', where the fertilization regime has yet to be optimized, however it is clear that greater fertilization levels are required to see optimal results as compared to 'Stevens'. While 'HyRed' was released for early and intense fruit color, selection for yield parameter traits was included (specifically general bud set and rebud, or return bloom). This has resulted in excellent yields of high quality fruit in 2009. The first full bed (3.5 acres) of a four-year-old 'HyRed' planting was harvested September 15th in Juneau County, WI, with yields setting a farm record of 532 barrels per acre.

'A-X15' has proven in 2009 to be worthy of release as a new cultivar. One of our philosophies is that any release based in part on yield must have high yield results from a conventionally planted and harvested, minimum 0.5 acre bed, and also have specific, reproducible yield parameter traits. In 2009 high yield results were obtained from a 0.7 acre dedicated bed of four-year-old 'A-X15' at a farm in Wood County, WI. This bed yielded 492 barrels per acre, while the farm average for established 'Stevens' was 243 barrels per acre (individual beds of 'Stevens' ranged from 217 to 278). Furthermore, a two acre, half-bed planting of three-year-old 'A-X15' yielded 242 barrels, matching the 'Stevens' average. A major difference in the performance results was likely due to both nitrogen fertilizer tolerance and positive response. The 'Stevens' were fertilized with 42 units of nitrogen which is near the upper limit of what it can tolerate without causing excessive vegetative growth and possible yield reductions. The 'A-X15' were fertilized with 72 units of nitrogen and while reasonable runners were present for the age of the plantings, fruit set, upright formation and bud set were all favorable.

This fertilizer response was well documented in an older, well-established planting in Monroe County, WI, where an intent to over fertilize a large plot for propagation material failed. One section of the plot received 32 units of nitrogen along with the rest of the bed while the remainder of the plot received an additional 34 units of ammonium sulfate and 45 units of slow release organic based fertilizer. Virtually no runners were present at either fertilizer level, and while high yields were present in both, the extra fertilizer produced a 10% increase in yield, but more importantly, a much greater increase in flower bud set particularly in rebud.

One second generation selection, "WI02-A4G-X1', has shown great promise for a number of traits: it is even earlier than 'HyRed', it reproducibly produces multiple fruit per upright, has very high rebud and in general has shown great yield responses in young plantings. This selection will be scaled up to a four acre bed in 2010 for yield proofing and it is anticipated this selection will be released in 2015. Four other second generation selections in performance plots have been identified for further scale up in 2010 or 2011 due to promising traits, incorporating both yield and other unique features. Sustained desirable traits will warrant further evaluation.

The limited runnering of tetraploids has compromised the proper evaluation of fully established plots. We have undertaken the philosophy that full evaluation of tetraploids requires a conventional planting at high density to overcome this limitation. In 2009, existing large plots of tetraploids were heavily fertilized. The bed these plots are in will be extended in 2010, the plots mowed and conventionally replanted adjacent to the existing plots. Because tetraploids are quick to set buds, we anticipate that evaluation will proceed quickly and we will have results as early as 2011. High flower density and controlled bee activity are essentials to realizing the full potentials of tetraploids.

There has been significant change in the climate of the cranberry growing regions of Wisconsin during the last few decades and this change is likely to continue, leading to a longer growing season and other effects. A philosophy of the breeding project is to build resiliency into individual cultivar releases and into the program as a whole, so that the range of releases will yield greater resiliency for the growers of Wisconsin. Towards that goal, we are both carefully considering our current selections and examining new crosses to proactively exploit the present and future climate change in the state. These new crosses are focused on combining traits that will increase both yield and reliability in future plantings. The crosses have been performed and seed is currently being extracted for subsequent field planting in the summer of 2010.

Assessing the Biological Impact of IPM Adoption by the Wisconsin Cranberry Industry

Principal Investigator: Dan Mahr, UW Madison;

Other Investigators: Merritt Singleton, UW Madison; Dr. James Polashock, USDA ARS

Objectives: 1) Survey the beneficial natural enemies occurring in cranberry beds. 2) Determine if the adoption of IPM practices has resulted in the increase of natural enemies of cranberry pests. 3) Determine if the adoption of IPM practices has resulted in an increase in incidence of bluntnosed leafhopper or the false blossom disease.

Summary To assess the biological impacts of IPM adoption, fourteen cranberry farms have been sampled during each of two field seasons (1) to determine the abundance of natural enemies present and (2) to survey for the potential presence of bluntnosed leafhopper, the vector of the causative mycoplasma of false blossom. Four of the farms were producing for the certified organic market and ten were conventional farms. The conventional farms were spread along a continuum of degree of IPM adoption. In Year 1, three sampling methods were used: sweep sampling during the pre bloom period, pitfall traps during the post bloom period, and yellow sticky traps throughout the season. Each farm was sampled once every two weeks. In Year 2, in order to improve statistical relevancy, the sampling intensity was approximately tripled.

2008 (Year 1) Results: For conventional farms, natural enemy numbers ranged from a low of 771 to a high of 2,305 with an average of 1,454. For organic farms, natural enemy numbers ranged from a low of 999 to a high of 2,266 with an average of 1,847. Organic farms averaged 27% more natural enemies than conventional farms. In Year 1, there was no positive correlation of natural enemy numbers in relation to Natural Enemy Toxicity Scores. In 2008, total leafhopper counts (multiple species combined) sampled by yellow sticky traps varied from a low of 18 to a high of over 250 per farm. Numbers averaged 122 per conventional farm and 153 per organic farm. None of the leafhoppers caught were bluntnosed leafhopper, the vector of false blossom. Because of the increased sampling intensity in 2009, data assessment and statistical analysis are still in progress. At this point, we intend to finish this work by late spring or early summer.

Cranberry Fruit Rot in New and Established Plantings
Principal Investigator: Patricia McManus, UW Madison
Summary: The funding was to be used to support a Graduate Student. However a suitable student was not identified so the project was delayed one year. The Principal Investigator plans to have a student in place in 2010 to begin the work in time for the 2010 growing season.

Cranberry Fruitworm Control: Validation of Degree Day Model
Principal Investigators: Jayne Sojka and Tanya Palmer, Lady Bug IPM, LLC
Objectives: Validate a degree day model for timing of cranberry fruitworm (CFW) control and document the efficacy of using pheromone traps with egg laying and Intrepid use in controlling cranberry fruitworm.
Summary: In our research with cranberry we discovered that the original 100 Growing Degree Day (GDD) model from the 1st CFW adult caught, correlated to early to scattered bloom. We know that in cranberry, CFW lay their eggs on swelling pinheads so the timing was not appropriate for cranberry. The common thread on these four properties was egg laying time. The correlating Growing Degree Days range from 521 to 532. The data indicate that the timing of Intrepid at egg lay had the best results. There was only a 2 to 3 day margin between peak flight and egg lay. The typical grower may not take the time to examine pinheads/small fruit for eggs. Counting CFW adults in pheromone traps, once a week, may be a more accepted methodology. It is quite difficult determining peak flight until and we actually went past that point in time with some of our methods.

Rates and timing for potassium for cranberry nutrition
Principal Investigator: Teryl R. Roper, Dept. of Plants, Soils, and Climate. Utah State University
Objectives: 1) To conduct small plot experiments where different rates of potassium fertilizer are applied with various timing schemes. A four week timing will be compared to a two week timing. 2) To compare large late season K applications to a control. 3) To compare chloride and sulfate forms of potassium fertilizers at two rates. 4) To understand the exchange of cations in soil columns when soils are exposed to large doses of potassium.
Summary: Plots were established in commercial cranberry beds of 'Stevens' in Central Wisconsin. Plot size was 3 x 5 meters and treatments were replicated eight times. Plots received uniform rates of nitrogen (30 lbs/a) and phosphorus (45 lbs P_2O_5/a) in three split applications. Potassium was applied at various rates and timings. Tissue samples and soil samples were collected in late August and were submitted for analysis. In September prior to commercial harvest, square foot samples were collected for determining yield and fruit count. Fruit were collected for color analysis in late September. Total anthocyanin in 100 gram samples was measured by extracting the fruit in 0.2 N HCl using the standard industry protocol.

Higher rates of potassium fertilizer application led to tissue K values that generally trended upwards with application rate. However, significant differences were found the first year in both locations and at the upland location for 2008. Even after three years of no application of K fertilizer the control plots were still within the sufficient range for tissue K. Soil test K typically trended upwards with application rate. For 2008 there were no differences in soil test at either location except that our 800 pound rate was higher than the remainder. It is likely this is a function of high amounts of K remaining in the soil following the large late season application. At the highest application rate, soil test K exceeded what would generally be recommended for soil K. It is interesting that there is no clear relationship between soil test K and tissue K. There were no significant differences in yield, count or size at either location across three years of research. None of the tissue samples were in the deficient range. In fact, all tissue samples are still in the mid-sufficiency range and in this range we would not anticipate finding treatment differences. This should provide very strong evidence for the cranberry grower community that yield and potassium fertilizer application are not correlated.

Annual Projects

Wisconsin Cranberry Crop Management Newsletter – Volume XXI
Project Coordinator: Matthew P. Lippert, Wood County Extension
Cooperators: University faculty and staff, private cranberry consultants, Ocean Spray Cranberries, Inc., Cliffstar Corp.
Summary: Ten issues of the CCM Newsletter were published between May and September of 2009. Copies were sent at no charge to managers of all known cranberry marshes in the state. The newsletter was also made available via the cranberry e-mail list.

Wisconsin Cranberry School - 2010

Project Coordinators: Wisconsin Cranberry Research and Education Foundation; WSCGA Education Committee; Dan Mahr, UW Extension.

Objective: To conduct a two-day grower educational program for all Wisconsin cranberry growers focusing on improved farm management and business practices.

Summary: The WSCGA Education Committee met with UW Extension Faculty to evaluate previous schools and identify topics and speakers for 2010. The Wisconsin Cranberry School was held January 12-13 at the Stevens Point Holiday Inn Hotel and Convention Center. During the two day session topics relating to all aspects of cranberry production were presented with Teryl Roper, of Utah State University as the featured speaker. Packets with relevant information were distributed to all attendees. Proceedings from the School are sent to all participants. The 2010 Wisconsin Cranberry School attracted over 450 growers and industry people.

Cranberry Weather Forecasts

Project Coordinator: Wisconsin State Cranberry Growers Association

Objective: To provide Wisconsin cranberry growers with accurate, regional weather forecasts.

Summary: The WSCGA worked with a private weather forecasting consultant to develop regional cranberry weather forecasts. These forecasts were available to growers via a toll-free number and online at the WSCGA website www.wiscran.org . Service was available from April 15 through October 31.

Harvest Communications Program

Project Coordinator: Wisconsin State Cranberry Growers Association

Objectives: (1) To provide targeted media with information on cranberries, cranberry products and information on the results of health related research on cranberry consumption. (2) Conduct fall harvest media campaign to educate the consuming public on the cranberry industry in Wisconsin.

Summary: The harvest communications program entailed working with a public relations firm to develop key messages and themes, strategies, a plan and execution of the planned activities. The activities included a news release in conjunction with the crop projection announcement by USDA; an extended media outreach to target national and regional media including Associated Press; cooperative effort with Cranberry Marketing Committee to publicize tour by international trade representatives attending their annual marketing conference and general use of the website to communicate with media and track efforts and visits.

Individual components included working with the Rachel Ray television program to be featured as "snack of the day", assisting with the production of Curiosity Quest, a PBS children's program from California The 2009 earned media efforts generated about $1.3 million in advertising value and more than $3.89 million in publicity value. Traceable media placements of more than 568 had 23.3 million impressions. Additionally, these are conservative figures as some of the stories generated are not included in the value report, as the information was not available.

Brochure Printing

Project Coordinator: Wisconsin State Cranberry Growers Association

Objective: Provide members of the general public with information on cranberries through high-quality, professionally produced brochures.

Summary: The grant was used to print and distribute 18,700 copies of the 2009 Fall Harvest brochure, printing of 12,000 copies of the new recipe brochure and 9,000 copies of the Cranberry Activity Books.

Wisconsin State Fair Promotion Program

Project Coordinator: Wisconsin State Cranberry Growers Association

Objectives: (1) Provide information on cranberries and cranberry growing to visitors to the Wisconsin State Fair. (2) Promote consumption and sales of cranberry products at the Wisconsin State Fair. (3) Increase overall awareness of cranberries and their economic, environmental and cultural importance to the state. (4) Educate the public on the health benefits of cranberry consumption. (5) Educate the public on the many cranberry products available and their uses.

Summary: WSCGA contracted with Wisconsin State Fair Park for space in the Wisconsin Products Pavilion. The booth space (10'x30') was divided into two components: the first being an educational display, the second a sales area for cranberry products. The grant was used for promotion activities at the Fair including media drops of products, interviews on air, daily cranberry cooking demonstrations, appearance by the cranberry mascot daily at the Fair.

Stock Photos
Project Coordinator: Wisconsin State Cranberry Growers Association
Objective: Acquire professional photographs and images to be used by media, researchers, in brochures and exhibits featuring cranberries.
Summary: WSCGA retained a photographer who shot photos of wildlife and cranberry harvest. The photos were added to the industry collection, catalogued and assembled in an electronic format.

Product Sample Products
Project Coordinator: Tom Lochner, Executive Director, WSCGA
Objective: Provide promotional samples of cranberry products for distribution.
Summary: WSCGA worked with cranberry handlers to secure sweetened dried cranberries which were then packaged into sample packets by the Occupational Development Center in Wisconsin Rapids.

Cranberry Marketing Program – Paid Advertising
Project Coordinator: Wisconsin State Cranberry Growers Association
Cooperators: Milwaukee Brewer Radio Network
Objectives: (1) Conduct a paid advertising campaign to communicate health, environmental, tradition and economic messages on a regional basis. (2) Establish relationship between healthy sporting activities and cranberries. (3) Link cranberry growing tradition with other major state traditions. (4) Improve image of industry throughout the state.
Summary: Wisconsin's cranberry growers were again sponsors of an in-game feature of each Milwaukee Brewer Baseball Radio broadcast on the statewide network. The feature "On Your Plate", the introduction of the umpires for each game, was presented by Wisconsin's cranberry growers. The promotion also featured in game and post game mentions and Cranberry Night at Miller Park promotion.

Into the Outdoors
Coordinator: Tom Lochner, WSCGA Executive Director
Cooperators: Discover Media Works, WSCGA Public Relations Committee, WSCGA Education Committee
Objective: Create a multi-media communication tool highlighting the Wisconsin cranberry Industry in an entertaining and educational format. Into the Outdoors is a television program designed for children that goes from adventure to adventure across the state of Wisconsin. Joining a diverse group of kids and adults from all locations Into the Outdoors introduces fishing, camping, environmental concerns and outdoor safety - just to name a few topics.
Summary: The WSCGA named a working group of members of the Education and Public Relations Committees to work on the project. WSCGA began working with the ITO staff in June, 2008 on concepts for the four segments, ideas and opportunities. Following those initial discussions it was determined the segments would be based on a theme of the four seasons. The first segment would be on the fall harvest, the second on winter activities (ice making and sanding), the third on springtime, (frost watch and wildlife on the marsh) and the fourth on summertime (bloom and pollination with bees). The first two segments have aired. fall harvest and winter activities. In 2009 the final three episodes were produced and aired. WSCGA is utilizing the video on cranberry as it develops an updated curriculum packet for elementary students.

Operations and Promotions - Wisconsin Cranberry Discovery Center
Project Coordinator: Barbara Hendricks, Business Manager, Wisconsin Cranberry Discovery Center
Objectives: Educate the public about Wisconsin's role as the nation's leading producer of cranberries.
Summary: The Cranberry Museum, Inc. utilized the grant to support activities at the Wisconsin Cranberry Discovery Center in Warrens, Wisconsin. The funds were allocated toward general operations and promotion efforts. Over 20,000 visitors came to the Discovery Center in the 2009 season. These numbers are based on customer counts from the Point of Sale (POS) system at the Center and hand counts by employees. They do not include traffic during the Warrens Cranberry Festival. Special promotions were supported with the funding including a Cranberry Blossom Day, Public Harvest Tours, leisure tours, regular news releases and other day to day activities at the Center.

Wetherby Cranberry Library Project
Project Coordinator: Barbara Hendricks, Business Manager, Wisconsin Cranberry Discovery Center
Objectives: Organize and catalog new and existing materials at the Wetherby Cranberry Library.
Summary: Since the hiring of a librarian to implement the project in May 2008, we have cataloged the existing materials at the Wisconsin Cranberry Discovery Center, a process that involved creating nearly 12,000 individual records; created the Wetherby Cranberry Library Digital Collection, the largest on-line repository of cranberry related items on the

Internet. The collection features 400 unique objects, consisting of 2,500 .jpg images focusing on the history and importance of cranberry production in Wisconsin; established relationships with the Wisconsin State Historical Society, University of Wisconsin-Madison, Wisconsin Library Services and Wisconsin Heritage On-Line in order to further promote the importance of cranberry production in Wisconsin; integrated the Wetherby Cranberry Library Digital Collection into the Wisconsin Cranberry Discovery Center's Web site, thereby boosting the targeted audience's awareness of the Center and also making the collection more assessable and implemented both digital and archival protection strategies for the existing physical and digital collections. Since the middle of June through the middle of July, 2576 new items of the Edward Grygleski Donation has been cataloged. Of those items, 261 have been scanned. Ultimately, the entire collection will be scanned, optimized, and uploaded to the website for online display and search ability. There are currently 1007 items available on the Wetherby Cranberry Library Digital Collection. There are currently 250 objects (or materials composed of multiple pages) made up of 2576 items (an item is one side of a page) in the Edward Grygleski Donation. Of these 2576 items, 355 items have been scanned, and re-sized for online display. 105 if the 355 digitized items have corresponding text files and are ready to be uploaded to Content DM. The library grant has allowed the library to purchase a computer workstation, necessary for supporting the continued cataloging, scanning, and uploading of new items to the digital resource center online

Nutrition Education Initiatives 2008-2010

Project Coordinator: Sherry Tanumihardjo, UW Madison

Objectives: 1) Support of reproduction of "How does your garden grow?" 2) Support to purchase fruit and juice for a human intervention trial to assess nutritional status of 59 women aged 19-30 years old. 3) Develop brochures on a variety of fruit for the intervention study that can be used by young women with a special emphasis on cranberry intake and urinary tract infection

Summary: The project resulted in the printing and distribution of approximately 1,000 booklets this year for education in 2009. Cranberry products were purchased and used in studies in women which ended September 2008. Analysis is ongoing and manuscripts are in preparation. The third objective has been delayed as a result of a change in personnel in the lab. It will be reevaluated in 2009. Two papers as a result of the work have been accepted into peer reviewed literature. The educational objectives of both of these papers were supported by prior funding to the PI by WCB.

1) Tanumihardjo SA, Valentine AR, Zhang Z, Whigham LD, Lai HJ, Atkinson RL. Strategies to increase vegetable or reduce energy and fat intake induce weight loss in adults. Exp Biol Med. 2009; was published in January 2009.

2) Valentine AR, Whigham LD, Tanumihardjo SA. Pedometers are perceived as useful tools for weight loss. J Extension. 2009; was published in April 2009.

WISCONSIN CRANBERRY BOARD, INC. – CRANBERRY INSTITUTE HEALTH RELATED RESEARCH - PROJECT REPORT SUMMARIES

The Wisconsin Cranberry Board, Inc. and Cranberry Institute have partnered to fund a variety of research projects related to the health benefits of cranberry consumption. Under this partnership the organizations issue a joint request for proposals. Researchers submit applications to the Cranberry Institute. The applications are reviewed by a Health Advisory Committee of the Cranberry Institute which makes recommendations for projects deserving funds. Those projects deemed worthy of funding are then jointly funded by Wisconsin Cranberry Board, Inc., the Cranberry Institute and other funding organizations. The Cranberry Institute then manages the research projects. In 2009 projects totaling $100,000 were funded by the WCB through the CI. The following are summaries of the reports of the projects funded through the partnership in 2009.

Cranberry Polyphenols and Gut Health: Integrated Cranberry Health Research at UW-Madison

Project Coordinator: Jess Reed, UW Madison

Objectives: Develop integrated cranberry health research program at UW Madison. Implement a pilot research project to develop novel mouse models to investigate cranberry PACS interaction with the gut mucosa and gut associated lymphoid tissue (GALT).

Summary: Ten proposals have been submitted to funding entities with 3 funded and two pending. Two undergraduate research awards were considered, one funded and one pending. To date $184,000 in research dollars have been generated. New research directives involving UW Scientists include: Cranberry PAC antifungal agents, Cranberry

PAC biofilm and anti-bacterial action, effect of cranberry tannins on bacterial growth and cranberry products in meat processing. Significant progress has also been made in the development of a mouse model of GALT function. Tissue preparation protocols and fluorescent microscopy imaging parameters have been established. The collaborative network has focused on the ability of cranberry PAC to modulate pathogenic bacterial populations, virulence and invasively properties in the gastro-intestinal tracts and impact resultant diseases such as UTI.

Cranberry Proanthocyanidin Inhibition of *Escherichia coli* Invasion of Prostate and Intestinal Epithelial Cells *in Vitro*

Project Coordinator: Dr. Walter Hopkins, University of Wisconsin-Madison

Summary: Early results appear to support findings in a prior study demonstrating that cranberry PACs inhibit bacterial invasion of certain cells in laboratory trials. In addition, they are now learning that it is the larger PAC oligomers, ie those with chains of 8-9 or 10-12 units, which appear to be most effective. Their immediate next step is to evaluate these PACs with mouse prostate epithelial cells, which will be more representative of cells in-vivo.

The Effects of Cranberry on Delaying pathogenesis of a Mouse Model of Alzheimer's Disease

Project Coordinator: Dr. Sige Zou, National Institute on Aging

Summary: They have used a mouse model in which a 1% cranberry extract was fed to AD and normal mice, with water as a control. To date, they have found that cranberry supplementation significantly reduces the B-amyloid plaque, and these results suggest that cranberry has a potential beneficial effect to delay the onset of AD symptoms. They have also investigated the effect of cranberry on inflammatory response. They have found that genes involved in autoimmune diseases are induced in AD mice compared to the controls. This inflammatory response is attenuated by cranberry supplementation, suggesting that cranberry delivers an anti-inflammation function. They expect to complete the project by June, except for one element where the sample size was insufficient.

Can cranberry constituents inhibit allergic response by immune cells?

Project Coordinator: Cathy Neto, University of Massachusetts-Dartmouth

Summary: Work is underway in the Neto laboratory on the preparation of cranberry fractions for this study. Crude extract has been shipped to Dr. Hurta's lab, where the biological experiments are planned for the summer and fall of 2010.

Pilot Clinical Trial on Effect of Cranberry Juice Consumption on Biofilm Formation

Project Coordinator: Terri Camesano, Worcester Polytechnic Institute, Worcester, MA

Summary: Their protocol has been approved by the Internal Review Board at WPI, and at this point they have enrolled 24 subjects, all of whom have consumed either 16 oz of CJC or a placebo, and their urine samples have been collected and frozen. Biofilm formation with 6 gram-negative *E.coli* strains and one gram positive *S. aureus* will be determined, all of which are uropathogenic. Results to date show decreased biofilm formation 2-6 hours after CJC consumption, lasting up to 24 hours. This project is on schedule, and they expect completion by July. This work was presented at the American Chemical Society's national meeting last week.

Influence of Cranberry Juice Components on Denture-related Stomatitis and Inflammatory Reactions of Gingival Fibroblasts

Project Coordinator: Jeg Babu, University of Tennessee-Memphis

Summary: To date, cranberry NDM (non-dialyzable material) was found to inhibit adherence of the oral bacteria tested (*S. mutans* and *S. sanguis)*, to dental amalgam and hydroxyapatite discs in a dose-dependent manner. NDM was found to be more efficient in blocking adherence of bacteria to amalgam than the HA discs. Current indications are that specific cranberry extracts could become part of the arsenal of therapeutic means of improving oral health by reducing the rapid, inflammation-induced bone loss in specific circumstances.

PRIOR PROJECTS:

Bioassay to detect anti-adhesive properties of cranberry metabolites in urine

Project Coordinator: Terri Camesano, Worcester Polytechnic Institute, Worcester, MA

Summary: They have been working with Amy Howell and have shown that bacterial anti-adhesion was present in the urine within 2 hours of cranberry consumption, with this effect lasting for approximately 8 hours. This work is virtually complete, and they will be submitting a manuscript to a peer-reviewed journal by January 1st.

Presentations:

- "Activity of Cranberry Metabolites in Urine against Bacterial Adhesion". 13th IACIS International Conference on Surface and Colloid Science and 83rd ACS Colloid and Surface Science Symposium, New York City, NY. June, 2009,
- Cranberry Juice's Inhibitive Effects on Adhesion of Uropathogenic Bacteria. ACS Northeast Regional Meeting. A manuscript on the atomic force microscopy experiments is in preparation.

Cranberry Flavonoid consumption and biomarkers of lipid peroxidation and inflammation in subjects with Metabolic Syndrome (MeS)

Project Coordinator: Arpita Basu, Oklahoma State University

Summary: This is a pilot clinical, in which they are measuring glucose and lipid levels, plus biomarkers of oxidative stress and inflammation, vs placebo. To date they have observed a decreasing trend in systolic blood pressure in the cranberry supplemented group vs the placebo group. They expect completion of this study by June.

Action of Cranberry Proanthocyanidins Against Bacterial Adhesion to Biomaterials and Mammalian Cells: Implications for Mitigation of Urinary Tract Infection, Prostatitis, and Endocarditis

Project Coordinator: Nathalie Tufenkji, McGill University, Montreal, Quebec

Summary:

Findings:

- Cranberry PACs can influence bacterial motility (movement) and metabolism (iron regulation) and thus act to prevent biofilm formation. These results imply that cranberry PACs can potentially act as an anti-infective strategy for bacterial-related infections.
- Other results show that cranberry PACs can have a significantly beneficial effect in preventing infection of kidney cells,
- Have developed new methodologies re both Gram-negative and Gram-positive bacteria.

Publications:

- A submission has been to *FEMS Microbiology Letters*
- Work has been published in *Food Research International*.

Follow-up Grant Applications:

Have been awarded a grant from the *Natural Sciences and Engineering Research Council of Canada* entitled: *New Hybrid Anti-Adhesive Biomaterials for the Medical Devices Industry*, in which the goal is to develop a new generation of anti-adhesive and anti-infective biomaterials for use in the manufacture of implantable medical devices by incorporating cranberry-derived compounds.

Investigations into the antiviral effects of store-purchased and pure cranberry (*Vaccinium macrocarpon)* juice drinks on the infectivity of rotavirus

Project Coordinator: Steve Lipson, St Francis College, New York

Summary: Presented their research, which shows that cranberry juice inhibits the activity and infectivity of certain viruses in model systems, at the New England Science Symposium (NESS) organized at Harvard University Medical School on February 28th, 2010. A paper on the work has been accepted by *Flavor and Health Benefits of Small Fruits.* Amer. Chem. Soc. Press, Chicago, which is currently *in press.*

Cathy Neto, University of Massachusetts-Dartmouth

Cathy Neto has received previous grants from WCB and others investigating cranberries and health. The following is a summary of the activity as a result of the research.

- **Manuscript:** Based on cranberry-prostate cancer studies, funded in part by a 2006 Cranberry Institute grant, a manuscript was submitted with Robert Hurta of UPEI in October 2009 to ***Nutrition and Cancer:*** **"North American cranberry (*Vaccinium macrocarpon*) stimulates apoptotic pathways in DU145 human prostate cancer cells *in vitro".***
- **Ongoing studies on cancer: cranberries and prostate:** A feeding study employing the TRAMP mouse model of prostate cancer funded by the National Cancer Institute of Canada is currently underway at UPEI. Hurta and Neto continue to study the effects of cranberry phytochemicals on cellular processes related to prostate cancer, particularly apoptosis and matrix metalloproteinase expression.
- **Book chapter**: Catherine C. Neto and Joe A. Vinson, "Cranberry", ***Herbal Medicine: Biomolecular and Clinical Aspects,*** a volume in the Oxidative Stress & Disease Series, Iris Benzie & Sissi Wachtel-Galor (Editors), *to be published by the Taylor & Francis Group in 2010.*

- **Invited presentations:**
  - 1) The **7th Natural Health Products Research Conference** in Halifax, Nova Scotia, May 23-26th, 2010, in the plenary symposium "Product Innovations: Berry Good". Presentation Title: Cranberry bioactives: potential benefits for cancer and other diseases of aging.
  - 2) The **240th American Chemical Society National Meeting** in Boston, MA, August 22-26th, in an AGFD symposium entitled "Agricultural and Food-Derived Products for Preventing and Combatting Disease".

- **Abstracts accepted for presentation:**
  - **ACS Meeting**: "Inhibition of *Candida spp.* and *Cryptococcus neoformans* by cranberry extracts *(Vaccinium macrocarpon)*" (Poster in AGFD Division).
  - **Experimental Biology**:Hurta, R., K. Neto,
    - "Proanthocyanidins (*Vaccinium macrocarpon*) induce apoptosis in DU145 human prostate cancer cells"
    - Deziel, B.A., Patel, K., Neto, C.C., Gottschall-Pass, K., Hurta, R., "Proanthocyanidins from cranberry (*Vaccinium macrocarpon*) inhibit matrix metalloproteinase expression in prostate cancer cells by affecting multiple cell signaling pathways"
- **Grants:** "Microarray analysis of cancer cell gene expression when treated with cranberry constituents". $23,000, UMD.
- **UMD Cranberry Research Proposals**:
  - "Efficacy of cranberry extracts for the prevention of selected oral biofilms". (C. Neto and F. Scarano, PIs), Request: $20,088
  - "Direct observation of cranberry constituents entering live human cells and their intracellular iron-scavenging and antioxidant activity: relevant to their bioavailability and bioactivity" (M. Guo, PI; C. Neto Co-PI), Request: $36,500.
  - "Microarray Analysis of Cancer Cell Gene Expression when treated with Ursolic Acid, a Cranberry Component". (T. Ferreira, PI. C. Neto and A. Liberty, co-PIs).
  - "Cranberry Phytochemicals and the Role of Hedgehog Signaling in Prostate Cancer". (C. Neto and R. Hurta, PIs)- also submitted to CI. They requested a $10K match if CI/WCB funds this proposal.