

Annual Meeting of Multistate Regional Project NE1839

Development and Evaluation of Broccoli Adapted to the Eastern US

Participants and affiliations: Christy Hoepting, Cornell Vegetable Program; Thomas Björkman, Cornell; Brian Ward, Clemson CREC; Andre da Silva, University of Georgia, moving to Auburn University in mid-February; Lincoln Zotarelli, University of Florida; Mark Hutton, University of Maine; Phil Griffiths, Cornell University; Ashley Edwards, Virginia Extension; Gordon Johnson, University of Delaware; Jeanine Davis, North Carolina State University; Margaret Bloomquist, North Carolina State University; Phillip Williams, University of Florida Southwest Research and Education Center; Steve Sargent, University of Florida; Mark Farnham, US Vegetable Lab (USVL), Charleston (retired); Jim Myers, Oregon State University; Andy Nagy, Oregon State University; Tom Bewick, USDA NIFA; Morgan Stone, Clemson CREC; Matt Horry, Clemson CREC; Jill Eccleston, Cornell.

Session 1: January 21, 2021, 2:00-5:00 pm

INTRODUCTIONS

Christy Hoepting called the meeting to order at 2:17 pm and introduced current officers:

Chair: Christy Hoepting, Chair

Vice-Chair: Brian Ward

Secretary: Andre da Silva.

A round of introductions from all participants followed.

NOMINATIONS: Christy called for nominations for position of secretary for 2021. Brian Ward nominated Matt Horry, who accepted. Jim Myers seconded. Participants approved.

SCHEDULING OF 2022 ANNUAL MEETING: Tentatively set to coincide with the 2022 Southeast Fruit and Vegetable Growers Association meeting in Savannah, GA, with the possibility of an agricultural tour in Hastings, FL earlier that week. A Zoom option will be available to accommodate those unable to travel to Savannah. Dates for the 2022 SEFGA meeting are not yet posted, but the Multistate meeting would likely happen on Thursday during the week of the Savannah meeting. If the in-person meeting is cancelled (which will be determined by October 2021), all attendees will participate by Zoom.

Tom Bewick advised the group to have a plan for holding the meeting virtually, in the event that travel remains restricted. He also encouraged a virtual option (even if an in-person meeting happens) to engage people who might not otherwise be able to travel.

ADMINISTRATIVE ADVISOR REPORT: none.

NATIONAL INSTITUTE OF FOOD AND AGRICULTURE (NIFA) UPDATE – Tom Bewick.

The new administration brings changes to NIFA.

Transition (all of these worked in the Obama administration):

- Tom Vilsack has been nominated as Secretary of Agriculture (had same role during the Obama administration).

- Kevin Shea (who is also administrator of APHIS) is Acting Secretary of Agriculture until Vilsack is confirmed by the Senate.
- Katharine Ferguson: Chief of Staff for the Office of the Secretary.
- Robert Bonnie: Deputy Chief of Staff, Senior Advisor, Climate.
- Sara Bleich: Senior Advisor, Covid (currently with Harvard Medical School).
- Kumar Chandran: Senior Advisor, Nutrition.

Staff picks show Biden Administration priorities:

- Covid pandemic “front and center”
- Climate: Mitigating negative impacts of climate change
- Nutrition

The last 2 coincide with the Eastern Broccoli Project’s (EBP) goals of reducing food miles and increasing production of a nutritious vegetable. The EBP is well-positioned to take advantage of new priorities.

State of NIFA (employee numbers):

1/1/16: 419 employees

7/1/19: 200 employees. Then came announcement of the move to Kansas City.

10/1/19: 80 employees (number who accepted reassignment). Hired aggressively.

12/1/20: 200 employees

- Hiring focus has prioritized restaffing people who manage awards and funds to get the money into accounts so the work can proceed.
- At one point, NIFA had 130 national program leaders. About ten accepted the reassignment, about 20 more have been hired.
- Reduced numbers mean they’ve had to stop some things, e.g., project director workshops, departmental reviews.

The State of NIFA:

- **Carrie Castille:** NIFA Director. Science background with policy focus. First permanent (not acting) female director of NIFA.
- **Parag Chitnis** was acting director of NIFA (and went to Kansas City); he now returns to role as Associate Director of Programs.
- **Bill Hoffman:** former Chief of staff for NIFA, now transitioning to National Science Liaison. Lots of experience in Extension.
- **Project CAFÉ** [Collaboratively Achieving Functional Excellence]: how to remake NIFA so that it can efficiently continue its mission to support research, education, extension.
 - Initiated by Scott Angle just before move to Kansas City.
 - External and internal processes.
 - Has resulted in several changes, including schedule for RFA release for all non-AFRI programs (will maintain schedule moving forward, updating as necessary):
 - Go to NIFA home page > grants > RFA list > upcoming RFA calendar (i.e., this link: <https://nifa.usda.gov/upcoming-rfa-calendar>).
 - Started an electronic newsletter, sign-up pops up on home page, comes out once a week, quick read, announces RFAs, etc.

Significant Administrative Changes to SCRI (resulting from 2018 Farm Bill):

- Added additional qualifiers to legislative focus areas.
- Went from 1 year money, which meant funds had to be obligated in the year they're made available, to two years. Having 2 fiscal years to obligate funds makes it administratively easier (not up against September 30 deadline).
- ***Once funds are obligated, they are available until expended.*** Previously, leftover funds reverted to the Treasury at the end of the award period. 2016 is next award year to be impacted by this. Allows funds to be rolled over into a sixth year.

SCRI schedule:

Nov. 15, 2020: FY2021 request for pre-applications was released

Jan. 26, 2021: pre-applications due

Mar. 29, 2021: RFAs to invitees

May 25, 2021: full applications due

July 30, 2021: funding recommendations finalized

Oct 1, 2021: awards completed (approximately)

Oct 15, 2021: FY 2022 RFPA released

Contact Info:

Tom Bewick (tbewick@usda.gov): National Program Leader, SCRI Program Director.

Megan O'Reilly (megan.oreilly2@usda.gov): Program Specialist SCRI Program Coordinator.

Comment/Responses to questions:

- The Chief Scientist is undersecretary for Research, Education, and Economics (REE) mission area; they haven't had one for several years. Undersecretaries play a key role in budget process. Vilsack will be quick to nominate people.
- Panels will likely be virtual for now. New building in Kansas City has conference rooms for on-site panels, but no one is in the building yet.
- Move to Kansas City looks to be permanent. Only about half of the people that work there are actually there. It will be different, but they will get the job done.
- Vilsack under Obama improved employee-friendly rating by 30 spots, to number 7. Anticipating more employee-friendly policies to keep people engaged.
- Bewick is VP for the NIFA union local. They are advocating for maximum workplace flexibility. A lot of new hires are still where they were when they hired them – they have people all over the country.
- New building is across the river from the airport, easy to get to. Nice district for dining and entertainment a couple of miles away.

TRIAL REPORTS AND LOCAL MARKET COMMENTS BY STATE.

(Yield trial results are not given here; they are discussed in the official reports.)

Mark Hutton, University of Maine.

- Season was delayed because of the pandemic (no Yield trial, only Quality trial plantings). Aroostook County had a severe drought, which was bad for broccoli

and potato growers, especially those without irrigation. Broccoli acreage is holding steady, cauliflower acreage is increasing.

- There was interest in Alternaria and other diseases this year. In 20 years of growing broccoli in the same 3 fields, Mark has never had to use insecticide or fungicide. Occasionally he uses herbicide, but since site doesn't have irrigation, and rain is unpredictable, mechanical cultivation with cultivating tractor is often the best option. Not organic, not conventional, just very low input.
- Swede midge is a recent arrival. It wiped out broccoli for smaller, organic growers in Aroostook County and nearby New Brunswick. The heavy spray program that big growers use for Leps and aphids seems to take care of swede midge. (Green peach aphid is a problem in the County because they also grow potatoes and grain.)
- Weed management is growers' biggest problem; they are moving away from chemical control and into mechanical weed control with camera-assisted cultivation. Mix of direct-seeding and transplants leads to erratic stands.
- Mark has a new Research Associate. She has a farming background, PhD from Minnesota, and was a post doc in Eric Gallandt's program. Half time on fruit, half time on vegetables.

Gordon Johnson, University of Delaware Extension Fruit and Vegetable Specialist.

Broccoli 2020 trials were conducted at the Carvel Research & Education Center.

Delaware has a lot of disease and insect pressure coming from both the North and South. There are large cabbage growers nearby. A regional processor is interested in sourcing broccoli and cauliflower from this area.

Delaware Spring trial (no EBP materials, just commercial broccoli hybrids):

- Weather: cooler than usual in May. Warmed up in June (few 90° days), July was hot. Transplanted spring trial on April 29, later than normal; lots of heat stress.
- Transplanted eight commercial varieties on white plastic, double row, 1' in-row spacing, drip irrigated, 160 lbs./a N, 80-plant plots, RCB with 4 blocks, harvested June and July. Took data on number, weight, grades, defects, and diseases.
- Two regional standards had highest yields. Some varieties that have performed well in the past did not do well this year.
- Major defects: unevenness, not domed, florets not firm, loose heads, some brown bead; no head rot in this trial, but it did have some black rot.

Delaware Fall trial (commercial hybrids and EBP hybrids):

- Weather: Temperatures moderate in August, September (one day in the 90's in September). One windstorm but no excess rain.
- Transplanted August 15. Same growing system as spring (white plastic, etc.). Nine varieties, 40-plant plots. Harvested October – November.
- One of the seven experimental lines had the highest yields. Three additional experimental lines performed fairly well, but three others did not.
- Major Defects in fall trial: brown bead, loose heads, unevenness, not domed, small, thin stem; no head disease, but some black rot.

Lincoln Zotarelli, University of Florida, Hastings Agricultural Extension Center

- Acreage: expect to be about the same, about 2000–2500 acres.

- This season has been slightly drier and colder than normal. That is not a problem once plants are established but can cause problems for direct-seeded broccoli because it is difficult for subirrigation to bring the moisture up. But once plants are established, these conditions are actually very good.
- They saw some bacterial soft rot, specific to 2 lines.
- Second Quality trial planting is in the ground now, will harvest in 4-5 weeks; third planting is seeded in the greenhouse. Yield trial will be planted this week.

Phillip Williams, University of Florida Southwest Florida Research and Education Center.

- Seed of Yield trial entries was sown in the greenhouse in late December. Transplant is scheduled for the week of February 22.
- Working with a grower who just added 300-400 acres of broccoli. He is already done with his own harvest but is willing to accommodate this trial. His broccoli acreage is market driven – fits in his bean-sweet corn rotation. He wants more broccoli to extend the season.
- The market for sweet corn, peppers, and tomatoes fell out last year due to the pandemic. Markets were still depressed going into the fall, but news at a recent Vegetable Advisory Committee meeting was that crops coming out now have the highest market in years.
- Still common for growers not to plant unless they have a contract.

Andre da Silva, University of Georgia, moving to Auburn University in mid-February.

- Andre thanked Thomas Björkman and Steve Sargent for speaking at the virtual SEFVGA meeting.
- Crop modeling: Andre and a PhD student are collaborating with crop modelers in Florida. They are adapting a decision support model developed for cabbage to use with broccoli, identifying parameters that need to change. They will collect information on leaf area index, biomass accumulation, nutrient and nitrogen accumulation. Info will go in the cabbage model to check model performance, then they will adjust the coefficients. He will apply for funding this year and is open to collaborating with others in the Multistate group – can discuss in a future meeting.
 - The modelling work is relevant to climate goals of new administration: simulations can be used to see what the effect of a given increase in temperature during the growing season will be.
 - Data collection could be easily done during routine field work activities.
 - For broccoli, model could predict a heat or other stress-related event, which would let grower know they need to take action, e.g., irrigate.
- Georgia Yield trial:
 - 2020 trial had three entries.
 - Biggest disease problem was black rot. Alternaria is always around, but it tends to be more of a problem in the fall.
 - 2021 Yield trial has 6 entries, seeded last week. Will transplant to field in about 3 weeks.

Christy Hoepting, Cornell Vegetable Program, New York.

2020 NY Yield trial:

- Planted June 25 using grower's planting configuration: row spacing 32", 1' between plants, around 16,000 plants/acre. Harvested 7 times (every 3-4 days) beginning in August. Trial is 1.5 hours away, so it is not easy to go to site more frequently.
- Culls had brown bead, yellow bead, bolting/loose heads.
- Average marketable head size ranged from 0.44 to 0.69 lbs.
- After his own crop was harvested, the grower stopped fungicide sprays, which led to some incidences of rot that would not have happened had the program been continued. Can look at data with/without those crowns added back in.
- Some differences in Alternaria incidence (on foliage and heads) among the different hybrids was observed.
- Heat stress + Alternaria complex: heat stress causes flatter head that allows water to pool, as well as more brown and yellow bead (necrotic) and loose heads that let water drip into head. All interact to increase Alternaria incidence.

Comments:

- Phil Griffiths commented on importance of plant morphology and maturity for disease resistance.
- Jim Myers asked about causal agent of head rot. On the West Coast, he sees a lot of soft rot from Pseudomonas – bacterial, smells awful.

Jeanine Davis and Margaret Bloomquist, NC State University.

- They are in the western part of the state. There is also a broccoli industry in the eastern part of the state, towards the Coastal Plain region.
- Transplant production has improved since the start of this project. Had great production for Yield trial and first Quality trial planting this year. The second Quality trial planting had some issues but probably a one-off (missed watering, disease came in). Remaining plants grew well.
- Yield trial was in McDowell County. Temperature and precipitation this year were average. Fitted raised beds protected plants from one big rain event at the start of the season. Transplanted in May, harvest came on quickly in late June.
- Market: they are not yet encouraging their growers to plant in the high heat summer window. After 10 years, there are still two issues preventing development of a local broccoli industry: 1) still no cooling facilities to handle broccoli, and 2) growers say they are not making money from broccoli; they have local markets (restaurants, direct sales) but are not getting prices for wholesale profitability. Buyers come around, then they don't hear back. But they continue to hear from seed companies.

Jim Myers, Oregon State University. Jim breeds for the broccoli processing industry and conducts trials, including some heat trials, in Oregon. Entries don't overlap much with East Coast trials, but some hybrids that he evaluates could be worth trialing in the eastern US.

- 2020 was a challenging year: pandemic, wildfires, main processor went bankrupt. Eventually an Oregon potato company bought the processing plant. Acreage is about the same now.

- Mechanical harvest development (some of it is grower-driven, some from ag equipment manufacturers) has impacted the traits he works on, but that area has also seen some changes. Mechanical harvest efforts seem to be targeting the fresh market industry in California. Most aim for a once-over cut, which requires highly uniform maturity. Some projects are developing vision systems to allow selective harvest of mature crowns; leaves around the head are a problem.
- Multistate group should consider a future meeting in California to see the technology being used out there.

OSU program:

- Yearly schedule: Take cuttings from fall trials into the greenhouse, make self-pollinations and crosses to generate seed, start transplants with that seed in June, transplant to the field in August. Jim conducts a yield trial and evaluates breeding materials in the field.
- Objective: looks for broccoli that is productive and has traits that are good for processing: uniform, dark green color, fine beads, short pedicels, small floret size, etc. Evaluates hollow stem, floret size, % small florets. (If florets exceed 2.5", they have to be sent back through a different line for more cutting. OSU hybrids have mostly small florets, commercial ones tend to have more large florets.) A smooth dome without much segmenting will have more blanding. Branching depth has to be not-too-deep, otherwise harvested head has a longer stalk or loses some florets. Issues: uniformity (needed for a once-over harvest) and leaves in the head.
- 2021 OSU yield trial had 4 checks plus 7 OSU experimental hybrids. There were no significant differences in yields of these varieties, but there were differences in head diameter. (Breeding for segmentation and reduced blanding on floret edges produces some heads that are larger but not as dense.)
- Some lines achieve weight by producing really large heads, which can have a high proportion of florets that are too big and need to be sent back for more cutting.
- OSU Heat trial (conducted with Alex Stone). Faculty research assistant Andy Nagy, who worked on the trial, summarized outcomes.
 - Entries: 20 commercial hybrids and four experimental lines from 10 sources. Trial had 6 planting dates to capture some hot weather. Evaluated on a 1 to 9 scale for color uniformity, head shape uniformity, head firmness, head diameter, cut head weight, floret weight, usable floret weight, maturation uniformity.
 - No one hybrid was good everywhere. "Best" depends on what trait is most important: maturation uniformity, or early maturity, or yield, etc.
 - Brown beading (beige beading) resulted in a lot of culls.

Comments:

- One of the eastern experimental entries showed some heat tolerance. Some of that is from a blue-green, fairly heat tolerant line developed in the Cornell program. Seed is still available, if a seed company is interested. It could a niche hybrid.
- How is processed broccoli handled? (This question was actually posed on Day 2.) It is dumped into totes, hauled to plant, dumped on floor of feeding system, put into the line. No cooling happens until blanched product goes through a blast tunnel to

cool (IQF process). Then it is put back in big totes and bagged out through winter as needed for retail.

- Most harvest is still done by hand; there is some mechanical harvest, but it is problematic.

Session 2: January 22, 2021, 9 am to 12 noon

TRIAL REPORTS BY STATE, CONTINUED.

Morgan Stone, Matt Horry, Brian Ward, Clemson CREC.

SC Yield trial:

- Transplanted in 92°F heat in Ridge Springs on September 2. Temperatures (°F) were in the 80s and high 70s for the rest of the month. During harvest (October to mid/late November), temperatures were in the 60s-70s days and 35-40°F at night.
- The site is a 2.5-hour drive from CREC. Trips this year were restricted to two per week, down from three/week last year.
- Some coastal growers had severe disease problems, but border row plots in Charleston showed no signs of disease; applied spray once early, then weather cooled; may have just missed.

Ashley Edwards, Virginia Cooperative Extension.

Virginia Yield trial:

- Transplanted June 4 and harvested July 24 to August 7. Spacing: 12" between plants, 72" between centers.
- One entry suffered stand loss shortly after transplant, not sure why.
- Defects: Some head rot underneath that was not visible from top. Not a lot of leaf symptoms. One entry had hollow stem for one of two weeks it was harvested. All entries had some brown bead. This early trial had better quality than the 2019 late summer one.

Comments:

- Jim Myers thinks fine, tight beads help against head rot.

Thomas: Björkman: overview of Yield trial results.

- For each location, showed graphs of a) total and marketable yield (number of 22-lb boxes), and b) cumulative yield. Expect slopes of cumulative yield to stay same.
- Some of the smaller, fast maturing hybrids could be planted with the main crop so grower gets an early cut or two in the hot part of the season, before the main harvest begins – but the grower must pay attention, or else they go by quickly. Evaluating them also requires close attention; mature crowns are smaller.
- Georgia: two new commercial hybrids were in shooting range of the standard.
- Virginia: One experimental hybrid was 5 days earlier than the standard. It did not have high yields, but it was QUICK, allowed an earlier harvest with 1-2 cuts.
- Old Fort, NC: smaller portion of yield was marketable this year.
- South Carolina: mix of early hybrids and newer commercial varieties. Brown bead was common in one hybrid, but with different manifestations: sometimes just a few around head, but sometimes widespread, making it susceptible to head rot.

- New York: trial had a rot issue because the grower stopped spraying. One hybrid seems to have lower incidence of Alternaria, another had exceptionally early maturity. One line seems to have a high incidence of yellow bead; are there places or practices that avoid that problem?
- Florida: historically entries have high marketability, but not last year. Defects: early flower opening, more like “leaking” open.

Comments:

- Some years are better than others. Proportion marketable is what matters.
- Newer hybrids go in 2 directions: heavy heads vs lighter, fast maturing ones. Even though they are smaller, rapidly maturing hybrids need more space because they grow faster over less time. What practices help those to work the best? Whether it makes sense to back off on space if it might increase yields depends on land cost and cost of keeping extra space free from weeds: weed control, extra plastic, etc. If land is cheap, a moderate population to minimize disease pressure or competition may be okay.
- If marketable yield of quick hybrids could be increased, earliness would give them a big advantage. Perhaps keep the lack of a vernalization requirement but adjust maturity to get a bigger frame. Can also try crossing heat tolerant lines with new/different germplasm to produce heterosis.
- Goal under USDA was to create germplasm with unique characteristics (not necessarily best hybrid ever).
- A commercial seed production company is increasing seed of several public hybrids, and 4-5 small cage increases are planned. All that seed could potentially be available for Multistate yield trials.
- Because of the no-cost extension (grant can go another year on paper), we can think about Yield trials that finish after July or August 2021. We don’t get additional money, but rule change means accounts don’t have to be emptied this year.
- The number of trials depends partly on whether people have made other plans and whether they have the facility to do it. Can also start to look at the Multistate project having a bigger role, as successor to the EBP.

RESEARCH PRESENTATIONS

Steve Sargent – Post-harvest studies

- Goal: help growers in Florida (and elsewhere) look at potential for iceless broccoli. What are the effects of iceless vs iced on quality, shipping life, postharvest life?
- MS student compared standard slush icing with forced air cooling and hydrocooling. Interesting results led to a project that looked at the application of 1-MCP after cooling: forced-air cooled broccoli was placed in shipping container and treated for 12 hours with gaseous 1MCP. Results were promising. Concern of shippers is water loss – but buyers more and more don’t like water dripping. Hoping to get funding to conduct more tests this year.
- Steve and Carl Sams will set up a shipping trial testing the 3 cooling methods. Will check the quality of freshly harvested and cooled broccoli in Hastings, ship to UT, then check quality again receipt in Knoxville. Carl can run nutritional and aroma

volatile analyses. He still has samples from 1-MCP study last spring, hopes to analyze those soon. (Covid closures delayed analysis.)

Comments/responses to questions:

- Is iceless really gaining? A big retailer one year said no more ice, then several weeks later asked for it back.
- Palette shroud (plastic cover over whole pallet) keeps humidity high, which reduces water loss and shriveling.
- There are also films for individual boxes. Covering pallets works in truck, but then at warehouse they break up pallets and individual boxes aren't covered. Plastic liners are not cheap (around 80¢/box).
- Must have a cold product to use plastic because there is no venting – don't want them to warm up during shipping.
- Individually shrink-wrapped heads are more expensive but also value-added. A shrink-wrap machine in the Netherlands priced at \$50,000 claimed to give a shelf life of 3 weeks with no cooling expectation.
- Plastic films may not be biodegradable (not sure). They are leaky to prevent an anaerobic environment. O₂ and CO₂ permeate, water vapor doesn't.
- UC Davis information shows slush icing is by far the costliest cooling method.
- Steve took weights before and after forced air cooling (which took about 2 hours) and was surprised to find that there was not much water loss; but product must be protected after that first cooling so that it doesn't lose more water. Cold rooms and trucks are at 50% RH.
- Can also hydrocool in sanitized water – it will hydrate broccoli, and there is no food safety issue if water is properly sanitized.
- NC growers would have more options if iceless broccoli is acceptable. They have vacuum coolers, hydrocooling, plus storage facilities from big apple industry.
- It is all about buyer perception. Buyers and consumers have different expectations.

Christy Hoepting – Control Alt Delete. \$2.7 million project, four years, multistate. Project is “broccoli centric”, focusing primarily on *Alternaria* in broccoli.

Website: <https://alternariabroccoliproject.uga.edu/welcome/>

Participants: Bhabesh Dutta at UGA is PD, Chris Smart from Cornell is a PI, as is Andre da Silva. See website for complete list.

Objectives:

1. Use genomics, population genetics and fungicide resistance profiling to characterize population structure and develop diagnostic tool(s) for *Alternaria* that cause *Alternaria* leaf spot and head rot in broccoli.
 - Conduct surveys, collect isolates from different fields, characterize them.
 - Use phylogenetics, family trees to understand what is related to what. Is it a new species or subspecies? How do you distinguish virulent from non-virulent?
 - What hosts do isolates prefer? Identify which genes have mutated.
2. Develop management practices.
 - Emphasis on fungicide evaluation trials in different regions, both conventional and organic.
 - Will also do some fertility, plant population, irrigation work.

- Screen varieties (EBP informs those).

Other notes:

- Huge stakeholder component: growers, industry – touch base every step.
- Advisory panel includes mostly industry people, and also Thomas Björkman.
- Andre will conduct big field trials testing irrigation method, 3 Nitrogen rates (recommended plus higher and lower). Still working out details of those trials. Will monitor his Yield trial for Alternaria, then select varieties to test. They haven't discussed plant population. All trials will be conducted in fall.
- If anyone wants to send isolates, it is easiest to send to Chris Smart, who has a permit to accept them (otherwise, check website for closest place). Her lab processes samples as they can. They can't promise follow-up, but samples will be tested. (NC group sent samples but has not heard back.)
- Andre requested that people report cases of fungicides not working, as they are also testing those.

BREEDING AND GENETICS REPORTS

Phil Griffiths, Cornell

- Broccoli for the crown cut market has become a fairly uniform product. Part of that is because breeding programs tend to be channeled, with limited genetics.
- Each public breeding location has its own challenges, which impact the materials developed. Oregon is a soft environment, SC is brutal but predictable, NY conditions are very erratic. In NY trials, OSU lines don't do well, and SC lines tend to be earlier and smaller.
- Industry develops lines that grow well in California. Broad, not regional, adaptation.
- EBP has promoted work between breeding programs, which allowed combination of lines between programs, including seed company programs. Helps diversify what broccoli is and where it is going. Results take time, but some efforts are coming to fruition. Gave examples of 4 very promising co-hybrids from the Cornell program.
- EBP work could lead to more suitable varieties for other regions with similar challenges How do broadly adapted broccoli types with improved heat tolerance (and maybe elements of lines with smaller head sizes or earlier maturity) fit in to different areas?
- Work on broccoli has led to some interesting side projects and potential directions for future endeavors.
- EBP has provided an opportunity to strengthen the standard market, develop material that can play into more regional markets, and enable a pivot into new directions.

Mark Farnham, US Vegetable Lab, Charleston

- Program focus: developing broccoli that produces quality crowns in mid-July in Charleston (season/location guaranteed to have heat). Combining individual lines into hybrids gives best heat tolerance. Over the last 10 years, he's also made progress on smaller beads, somewhat tighter heads.
- Developed a population of about 100 doubled haploids (from a segregating population). He has been able to select pretty good heading types from it.

- Point: it (heat tolerance that makes it possible to get a good quality head) is a selectable trait. It is a complex, quantitative. They've done some good genetic studies, identified 7 QTL (and there are probably more), and have some idea of what is going on. In past 10 years, they've gained a much better understanding of some attributes of broccoli.
- A big challenge has been that inbred lines that do well in the high temperature environment fell apart in fall environments. However, he now has a line that looks decent in summer and fall, seems consistent in warm and cold. It was the best heat tolerant line in Fall trials.
- Mark officially retired last summer but has collaborator status at the USVL so that he can wrap up efforts, assist in moving material developed for EBP "out the door". Will possibly travel to see some trials.

Jim Myers, Oregon State University

Status of broccoli germplasm at OSU.

- Jim regularly works with 16 advanced generation inbreds.
- In looking at phylogenies of Brassicas for his recent Sagra talk, he was surprised to see that Chinese kale/gai lan is pretty distant from other Brassicas. It has a lot of earliness, maybe has the same genes for not having a strong vernalization requirement and producing heads early.
- Many years ago, he developed an OP population from OSU inbreds and some commercial hybrids. Growers around the country would select and send seed back. Then he would mix up returned seed and send it out again the next year. Repeated for several rounds. A grower on Long Island had some gai lan nearby. Jim thinks that it may have inadvertently increased the genetic diversity in this material. Eventually, he split the population so that now there are West Coast and East Coast versions, each better adapted to its place. Thomas has seed of the East Coast one, but the increase was a while ago so germination is low. (Jim still has some seed of that one at OSU.)
- Material was always selected in organic systems.
- Jim started pulling out inbreds from that system and putting them into the processing breeding program. One of those is currently his best inbred for combining ability and heterosis. Another has regular and glossy mutant versions.
- Pandemic has limited seed production so doesn't have any for EBP this year.

Quality trials. Results inform breeding program decisions and Yield trials, so getting them out quickly has been a priority.

- With the extension, we have an unexpected full year in 2021. What can we get done?
 - Finish Year 4 leftovers (FL plantings in progress, 1 NC planting in spring) – all set to happen
 - Use 2021 trial to document breeding progress, featuring entries of the best stuff now (that has seed), plus standards, best commercial hybrids from 2009-10 and what was best in public programs then. It may be the first time that breeding progress is demonstrated in horticultural crop.
- We now have access to a statistical program that will rapidly turn out reports.

- Going to from 3 to 2 plantings/location would reduce labor/resources needed, as well as seed numbers.
- Need to check budgets to see how much is available.
- Will have follow-up discussion next week.

Grants and funding.

- Demonstration trial is an opportunity to promote accomplishments/success stories in the media and to let growers see results. Success stories also support funding applications for new projects that build on EBP work.
- Good to keep momentum going. Multistate project works as a framework to continue; there is also a lot of goodwill, and good interactions with other projects.
- Impact statements and success stories have been part of the project from the beginning and will be a priority this year.

The group discussed ideas for future efforts and several funding options, including larger, longer-term CAP grants (project director needed) that build/pivot off of the EBP, as well as smaller state grants. New people could be brought in where appropriate.

Margaret Bloomquist and Jeanine Davis presented NC Quality trial slides and information.

- Quality trials are in Waynesville, Haywood County, at some elevation.
- One planting (PD2) was transplanted in mid-July, another (PD3) in mid-August.
- More lines this year were suitable for processing than she would have expected (no analysis, just impression).
- They are flexible with Quality trial dates – could even double up on first planting to blend Year 4 and Year 5 P1.
- Because of pandemic impacts on staff, accessibility, etc., they decreased the number of evaluations/week from 3 to 2 in 2020 and will likely stay with 2/week in 2021.
- They were lucky to be able to do any plantings in 2021. Will finish up with P1 this spring. Jeanine will have to check the budget to see if a Yield trial is possible. If it is, would we want to get a cooperator in mountains or foothills?
- Quality could even move to early May or early June if want to double up on first planting date.

MEETING REPORTS

Roles of Multistate Officers: Secretary writes minutes, vice-chair writes annual report, chair organizes annual meeting.

- As chair this year, Brian Ward will take the lead in organizing a meeting – should start planning, choosing dates in October.
- Normally Andre would write the annual report, which is due 60 days after annual meeting, and Matt submits the minutes. (But Jill will put together a report this year based on EBP reports and will pass report and minutes to Andre and Matt.) They can work with project advisor (Jan Nyrop) or Thomas to get report and minutes submitted.

Quality trial leaders will meet to discuss trial plans next week. It will probably take several conversations to see how much to replan the coming year.

Christy adjourned at 12:06 pm.