The UMass Research and Extension Experiences for Undergraduates (REEU) Internship Program

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According to the USDA's "Employment Opportunities for College Graduates in Food Agriculture, Renewable Natural Resources and the Environment 2020-2025" Report, employment opportunities for college graduates in food and agriculture are almost perfectly matched with the number of anticipated graduates, with 7,300 graduates and 7,900 job opportunities (the remaining 600 jobs are expected to be filled by graduates in allied fields of study). Specialties like horticultural crop scientists, consultants, pest management specialists, and extension and outreach educators are expected to be in high demand. Furthermore, employers are expected to prefer graduates with practical experience.[1]

Students often disregard agriculture as a future career due to a lack of knowledge on the diversity of job experiences it offers.[2] Even at land-grant institutions, undergraduates are often unaware of Extension departments and the wide variety of services they have.[3] Remedying this by demonstrating the variety of opportunities beyond basic food production is the first step towards recruiting the future agricultural workforce.[4] The next step after that is practical agricultural education, which has three components: classroom instruction, experiential learning, and leadership education.[5] Combined, these three attributes empower students to pursue agriculture as an engaging and fulfilling career. Another important factor in recruitment is personal connection and mentorship.[6] When contacting stakeholders for this project, Dr. Terence Bradshaw, of the University of Vermont, stated, "*Having been mentored by an Extension Professor myself as an undergrad, that experience was hands-down the most important training I had in helping me to build skills to relate to and educate growers*."

The above barriers discourage undergraduate students who could enjoy a successful and fulfilling career in agricultural science. Namely, there is a lack of opportunity for hands-on practical agricultural education that would expose them both to the diversity of opportunity in the that field and mentors to help them determine their niche within that field. In 2022. Liz Garofalo and Dr. Jaime Piñero started the "***Engaging Undergraduates in Research and Extension Training using Experiential Learning and Technology to Enhance the Sustainability of Food Production Systems"*** program, an internship for UMass and local community college undergraduates. Its objectives are three-fold:

1. To provide research training to undergraduate students through formal internships integrating hands-on applied research and technology-based experiences.

2. To engage interns in Extension activities that will both demonstrate Extension's role in local food systems and provide them with unique training experiences and professional development.

3. To increase awareness of agricultural research education and Extension employment opportunities within the high school and community college student groups in cities with large historically underrepresented groups.

The internship program, advertised as the Research and Extension Experiences for Undergraduates (REEU) internship, is set to run for five years, starting in 2022. This report will detail the internship structure and then go over results from the final survey filled out by participating 2022 interns.

Materials and Methods

Logistics. REEU runs each summer for 14-15 weeks, starting the first week after the end of the UMass spring semester and ending the week before the UMass fall semester begins. Interns work for 37.5 hours per week, with an hourly wage. In 2022, working the full summer was required. In 2023, the option was given to applicants to work either the full summer or a combination of 3 "sessions", roughly one per month, in order to increase flexibility.

Required Personnel. Program Directors (J. Piñero and E. Garofalo) provide direction and final decision for all internship activities, control funding, and mentor interns. Research Coordinator (currently Mateo Rull-Garza) sets deadlines, leads research seminars, provides feedback on drafts, and mentors interns through the scientific process. Program Coordinator (Zoe Robinson in 2022 and 2023) sets the schedule of intern activities, coordinates logistics such as transportation with the director and serves as a point of contact for all module leaders, farmers, and other involved stakeholders.

Recruitment. The REEU program is advertised through several channels, including a dedicated internship website (CAFE: Research and Extension Experiences for Undergraduates (REEU) Program), flyers posted at local community colleges (namely Greenfield Community College, Holyoke Community College, and Springfield Technical Community College), professors in science departments at UMass Amherst and local community colleges (same as above) who are asked to discuss the REEU program with their students, and word-of-mouth advertising by the REEU personnel. Potential applicants are required to be currently enrolled in UMass Amherst or community colleges in the area. For 2022 and 2023, the UMass students were also required to have at least one semester of their undergraduate left after the completion of the REEU internship they were applying for. There is no requirement for specific majors or prior research experience. Instead, students who lack research or Extension experience are encouraged and, in some cases, favored to apply. The application cycle begins in November and ends in March. Applicants are interviewed to gauge interest and ability to commit to program timelines. Offers are sent out in early March. In 2022, we extended an internship offer to five UMass students. That amount increased to nine in 2023. Based on an internal assessment, we expect to decrease the number of slots per year to six, with a goal of 2-3 community college and 3-4 UMass students per cohort.

Activities. The weekly REEU schedule includes a variety of activities designed to give interns experience with both research and Extension.

Learning Modules: Most weeks include a learning module taught by a UMass faculty or staff member(s). Modules introduce different segments of agriculture, including soils, fruit production, entomology, and agrijournalism, or specific crops, like grapes or cranberries. This develops a common knowledge base and introduces interns to the role of Extension in each sector. In addition to classroom time, most modules include hand-on activities that provide interns with an opportunity to apply their new knowledge.

Independent Research: Each intern is required to design and execute their own independent research project with assistance from the program directors and the research coordinator. The research topic can relate to work pioneered by UMass faculty or be entirely novel. Either way, the intern goes through all steps of the scientific process, including project conception and development, data collection and analysis, and project write-up in the form of a full research report and a popular-science-style article for the REEU magazine. To this end, the research coordinator prepares and imparts lectures on the scientific method and how to write various parts of a research paper, as well as providing feedback on drafts, mentoring, and assistance with data collection.

Farm Visits: About once a week, interns visit a farm, cidery, nursery, or winery. This provides an opportunity to observe the variation of growing operations in Massachusetts, talk to farmers, and participate in some hands-on farm labor.

Additional Lectures and Field Trips: Lectures on niche topics, such as nematodes, unmanned aerial vehicles (UAVs), or a career options panel, round out the intern's knowledge and spark curiosity in the more niche subjects within agriculture. Field trips, such as our 2023 trip to the Forest Pest Management Lab, also exposes interns to the variety of careers in agriculture.

Professional Development Workshops: REEU partners with the UMass CAFÉ Summer Scholars program to participate in their professional development workshops on topics such as resume building, scientific writing skills, and networking.

Field Days: the interns attend at least one field day: the Massachusetts Fruit Growers Association annual summer meeting. At this meeting the interns listen to research presentations and then present an overview of their own research projects.

REEU Symposium: On the last day of the internship, the interns present their research to UMass faculty and staff, along with colleagues, friends, and family.

Survey Data Collection. Each week, the interns were asked to fill out a Google survey. The survey asked about the interns' opinions on the schedule clarity, the amount of time allocated to research, the internship's overall pace, and feedback. The interns also filled out a final longer survey at the end of the summer asking how much their knowledge of the scientific process and their knowledge of agriculture and research in general had changed.

In 2022, the final survey asked intern's to rank specific activities on how helpful and how engaging they were. In 2023, the 'helpful' and 'engaging' rankings were included in the weekly survey in order to get feedback closer to the actual time of the activity. This feedback is used to refine the activity roster for the following summer.

Results

In 2022, there were five REEU interns, all of whom were UMass undergraduates in various majors ranging from plant and soil science to political science. All five interns successfully completed their research paper and REEU magazine article, and three presented their projects at the REEU 2022 symposium. They participated fully in the modules and other activities. In 2023, the number of REEU interns increased to nine, three of which were from community colleges. All 9 students presented their work at the REEU 2023 symposium. Two research articles conducted by students are included in this issue of Fruit Notes.

The results from the final survey show that, in both years, all interns reported a moderate to significant increase in knowledge about Extension and agriculture as a direct result of their REEU Experience (Figure 1). Such a level of increase in knowledge about Extension and agriculture seems to be comparatively greater than the increase in knowledge reported for research and the scientific process (Figure 2).

Furthermore, the 2022 interns reported an overall 27% average increase in Scientific Competence across various criteria because of their REEU experience. In 2023, that figure soared to a 41% increase in scientific competence (Table 1). Specifically, the interns were asked to rate their competence in various areas of research before and after the REEU internship on a scale of 1 to 5 (with 1 being poor and 5 being highly

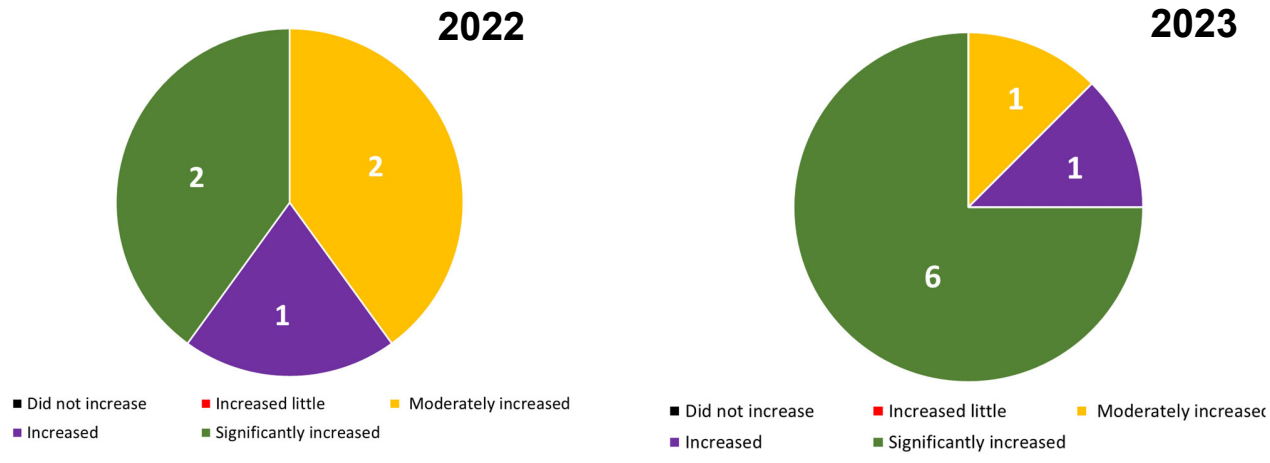

Figure 2. For 2022 and 2023, REEU intern's self-reported change in knowledge research and the scientific process.

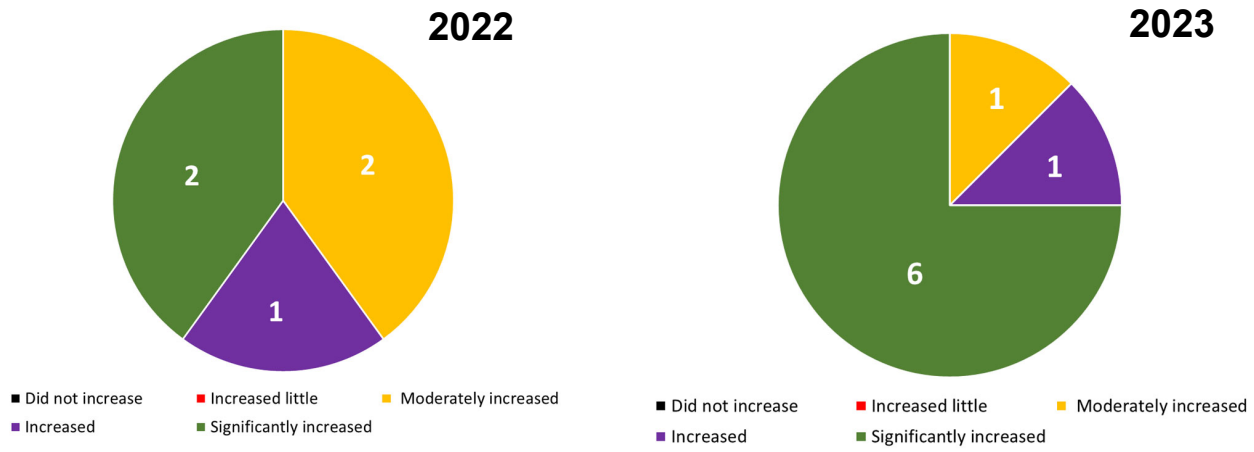

Figure 2. For 2022 and 2023, REEU intern's self-reported change in knowledge research and the scientific process.

Table 1: Average percent increase in scientific competency across criteria for 2022, 2023, and across both program years.

Year	Experimental Skills	Communication Skills	Ability to Conduct Experiments / Surveys	Ability to Excel in Academic Laboratories	Ability to Pursue Graduate Education
2022	32%	16%	40%	28%	20%
2023	35%	40%	45%	35%	48%
Overall	33.50%	28%	42.50%	31.50%	34%

skilled) as follows:

- Field and/or laboratory skills (e.g., following experimental procedures, collecting data, taking field samples, conducting surveys, identifying agricultural pests etc.):
  - » In 2022, the average increase was 32%, from 2.2 to 3.8.
  - » In 2023, the average increase was 35%, from 2.1 to 3.9.
- Science Communication Skills (e.g., presentations, reports, posters, fact sheets, popular articles, podcasts, etc.):
  - » In 2022, the average increase was 16%, from 2.6 to 3.4.
  - » In 2023 the average increase was 40%, from 2.1 to 4.1.
- Ability to conduct experiment (or survey)-based research:
  - » In 2022, the average increase was 40%, from 2.2 to 4.2.
  - » In 2023, the average increase was 45%, from 1.6 to 3.9.
- Ability to excel in academic laboratories:
  - » In 2022, the average increase was 28%, from 2.4 to 3.8.
  - » In 2023, the average increase was 35%, from 2.6 to 4.4.
- Ability to pursue future education that involves research (e.g., master's degree, doctoral degrees, and post-baccalaureate programs):
  - » In 2022, the average increase was 20%, from 2.4 to 3.4.
  - » In 2023, the average increase was 48%, from 1.7 to 4.1.

After participating in the 2022 REEU program, Matthew Bley stated, "*I know that this summer's experience will stick with me as I find myself inspired to pursue science and research further in the field of agricultural entomology.*" Matthew went on to apply for an M.S. graduate degree at the UMass Stockbridge School of Agriculture, which he got accepted to. Further, he later applied and was hired as a UMass Extension Educator in August 2023.

Conclusion

Although the REEU program is only in year 3 of 5, it has made significant progress towards its stated goals of providing students with research training, Extension experiences, and increased awareness of employment opportunities in research and Extension.

All interns indicated an increase in research knowledge. Intern perception of their ability to conduct experiments increased, on average, 40%. One student wrote in their reflection "*I feel much more confident walking into a laboratory setting*". After moving through the research process during the summer, interns were much more confident in their competence to conduct future research.

All interns indicated an increase in knowledge about agriculture and Extension. Most indicated that the hands-on modules were the most engaging and helped them to understand the purpose of Extension.

As with all programs, there are some limitations that, if overcome, would better the program. The number of community college students who participate in REEU is limited because of a lack of applications from community college students. Out of a total of 14 students across both 2022 and 2023, only 3 of these students came from Community Colleges, and two of them participated only for one third of the total summer experience. This could be remedied in two ways. First, with an improved recruitment campaign, perhaps by liaising with the head of pertinent programs, such as environmental science or agriculture. The REEU team has started creating relationships with community college faculty and staff. Second, by encouraging students to apply for the whole internship term. The REEU team stipulated in the 2024 application that priority will be given to students who apply for the whole internship term.

While the full impacts of the REEU program cannot be fully assessed until its completion, the results of years 1 and 2 are very promising. The continued investment in the future of agricultural research and Extension through hands-on internships such as REEU will ensure a vibrant future workforce, contributing to the overall sustainability of our food system.

Acknowledgements

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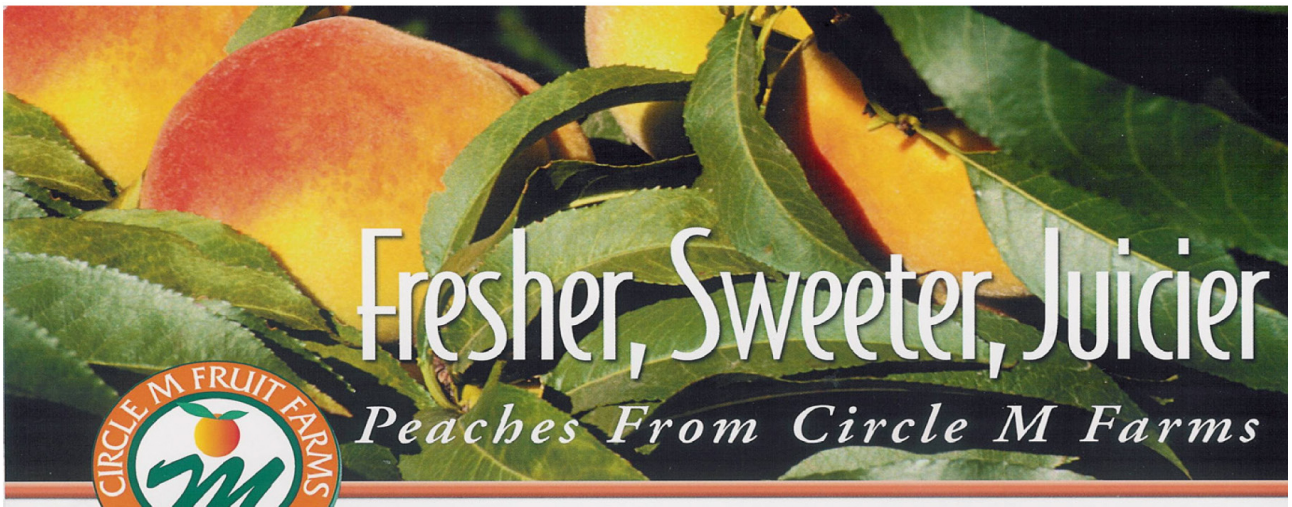

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