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Authors: Eric Benson, Quinn Morgan Ferris, Jennifer Hain Teper, and Anneka Vetter
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American Institute for Conservation
727 15th Street NW, Suite 500
Washington, DC 20005
info@culturalheritage.org www.culturalheritage.org

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ERIC BENSON, QUINN MORGAN FERRIS, JENNIFER HAIN TEPER, ANNEKA VETTER

A Case for a New Case Paper: From Farm to Table to Desk to Bench

INTRODUCTION

In March 2018, two library conservators from the University of Illinois at Urbana–Champaign brought a class of information science graduate students on a field trip to the Fresh Press Agricultural Fiber Papermaking Laboratory. The field trip was part of the curriculum for their course, titled "IS 590PC: Preservation and Conservation for Special Collections Care." The scope of this class was to introduce burgeoning library and archives professionals to the material and technical underpinnings of the objects that they eventually will be stewarding in their collections. Considering that a good portion of the syllabus for 590PC is organized around a foundation in the history of papermaking and book binding, it was fortunate to find that there was a papermaking studio just up the street from the conservation laboratory, where the students could experience pulling their very own sheets of paper. As the students got elbow deep in paper pulp and experienced the challenges of building a post (fig. 1), Eric Benson, the co-founder of Fresh Press, discussed the studio's mission while passing around finished papers made from a variety of agricultural fibers (agri-fiber). Handling the papers as they circulated, the conservators thought that the color, weight, and overall feel of the agri-fiber paper was reminiscent of another material that many book conservators know and love—University of Iowa Center for the Book (UICB) PC4 flax case paper. At the conclusion of their visit, the conservators were struck by an idea—what if a cross collaboration between the Fresh Press and Library Conservation could yield a new source of sustainable, locally sourced paper for conservation use?

Fresh Press

The Fresh Press at the University of Illinois was founded in 2011, with their mission always having been focused around studies into sustainability. Since their founding, they have been conducting research on how to change the paper supply chain from forest to farm—including a campaign for a new system in which otherwise unused agricultural fibers may be sold to paper mills to significantly reduce carbon emissions and curb deforestation. By replacing wood fiber with "agricultural residues" (or the crop materials leftover after a harvest), they also consequently replace forests with farms in the paper industry. To that end, they have pioneered the production of a variety of papers and products for artistic use, as well as packaging and building materials.

Kimberly-Clark demonstrated that wheat straw and other agricultural fibers have a smaller environmental footprint than tree fiber in a 2018 life cycle analysis externally reviewed by a panel of experts from the World Wildlife Fund, Canopy, and sustainability consulting firm Quantis. Partnering with the University's Sustainable Student Farm, the Biofuels Energy Farm, and the local Prosperity Gardens farm, Fresh Press uses seasonal agricultural residue—namely stalks and stems—to create handmade artisanal paper. Typically, these agricultural residues would be burned in the field at the end of harvest, contributing to air pollution. In North America, more than 200 million tons of agricultural residue goes unused, as reported by the US Department of Energy Bioenergy Technology Office (2011).

Agri-papers can be made with an extensive array of fibers: from corn and soybean sourced from the larger agriculture industry farms in the area to native Illinois prairie grass and even sunflowers and tomato stems grown in a backyard. Each fiber is significantly different and provides a unique set of working characteristics—for example, some are more flexible or rigid, and some are soft or woody. To produce a more robust paper, the agri-fibers are sometimes combined with a percentage of recycled cotton to add flexibility and strength. The cotton is also sustainably sourced from old papermaking blotters and cotton linters, which are recycled trimmings from the textile industry.

The use of regional agricultural fibers can be (as demonstrated by the new Columbia Pulp Mill in the State of Washington) an economic boon to the local area and, by keeping the harvest and manufacture in close proximity, can reduce the overall transportation carbon footprint of paper manufacturing. Agricultural fiber will become a

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Fig. 1. Students learning to pull sheets of agr-fiber paper at Fresh Press

faster-growing industry as the 2018 American Farm Bill provides a path forward for industrial hemp. The Canadian nonprofit group Canopy is behind this idea of agricultural fiber with its Second Harvest Pulp and Paper project.

As innovative as Fresh Press Studio is, they are not the first to propose the use of fibers alternative to bast and wood pulp for paper production. Book and paper conservators may be familiar with the 19th-century British papermaker, Matthias Koops, who Dard Hunter, in his seminal publication on papermaking, described thusly:

> In the search for new papermaking materials the work of Matthias Koops towers above all of his predecessors, for Koops is responsible for the growth of the paper industry as it is today . . . It was Koops . . . who first made use of various vegetable fibers on a large commercial scale. (Hunter 1943, 332)

Koops developed and advocated for processes that substituted vegetable fibers for the ever-decreasing supply of cotton and linen rags. With the rise of education and literacy by the end of the 18th century and into the 19th century, papermakers were confronted by an acute and quickening scarceness of domestic rags, barely enough, in fact, to keep pace with the mass production of newspapers, schoolbooks, business papers, pamphlets, and works of literature (Baker 2010). Although the notion of wood as material for paper came first from René de Réaumur in the first decades of the 18th century, Koops was the first papermaker to be successful in making paper from virgin fibers on a commercial scale (Baker 2010). As early as 1800, Koops secured several English patents related to papermaking, including one for removing ink from used paper before repulping for recycling into new sheets, and two for producing paper from "straw, hay thistles, waste and refuse of hemp and flax and different kinds of wood and bark" for printing (Hunter 1943). Koops believed so deeply in the potential of bark, straw, recycled waste paper stock, wood pulp, and any other vegetable substance that he printed a treatise on the subject of papermaking materials on a golden-hued paper made from straw from his own recipe, with an additional index made from wood alone (fig. 2).

The modern conservator is, of course, disappointed that in the arms race of paper fiber sources, it was inexpensive groundwood papers that historically won out—as so much of

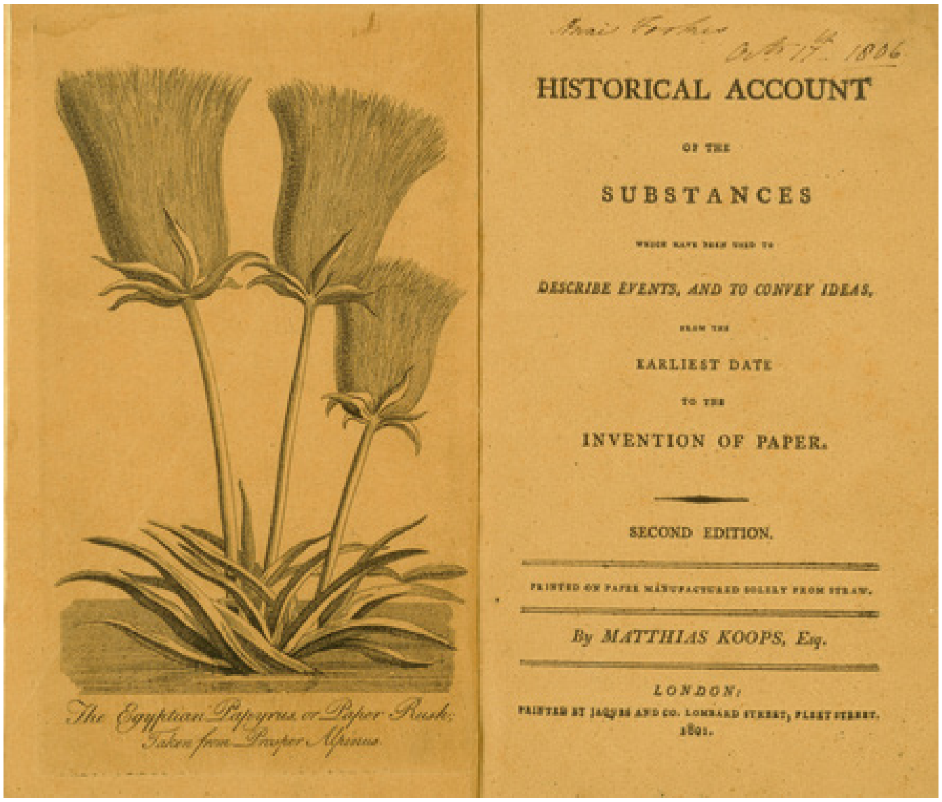

Fig. 2. Title page and frontispiece of Matthias Koops' treatise on papermaking substances, printed on paper made from straw

conservation work attempts to overcome the challenges presented by older wood-based papers. Additionally, with such a significant impact to environment having been made over decades of deforestation and commercial waste, it is strange to imagine what might have been if Koops' straw paper became the mainstream after all. Inspired by the work of Koops and colleagues at Fresh Press, the conservators at the University of Illinois could easily see the benefits and research interest in exploring the potential of alternative fibers for use in conservation papermaking, especially given the ever-increasing need for sustainability in production and industry.

Case Paper: an Ideal Material

As conservators interested in developing the Fresh Press' agri-fiber papers for book conservation, it is important to touch on what makes an ideal conservation material, especially in the context of using laced paper case bindings for conservation treatment. Paper case bindings are largely based on the structures of 17th- and 18th-century Italian limp paper and vellum imprints that historically have proven to provide a versatile and enduring structure (Barrios 2006). Paper cases modified using conservation-friendly materials have been championed by notable book conservators from Christopher Clarkson to Gary Frost as an alternative to using environmentally reactive parchment (fig. 3), as well as a generally pleasing option for rebinding when necessary (Frost 1979; Clarkson 2005). Although not necessarily a "conservation binding," the construction of a laced case binding made of limp paper meets the requirements for durability, stability, and nondestructiveness, as it offers ease of opening and is inexpensive. Furthermore, it is adhesive free, customizable, and reversible if needed. Regarding rare books that have lost their contemporary bindings, it also offers a historically sympathetic binding without either obfuscating or assuming an original binding structure (fig. 4).

"Case" paper—that is, a paper that is designed specifically for use in the creation of paper cases for books—is something of common parlance now for book conservators but has not always been a material at our disposal. Its development came from several studies conducted by papermaker Timothy Barrett as he investigated revived methods of European papermaking using high-quality unfermented flax fiber to provide maximum strength (Barrett 1989). As the director of the UICB papermaking facility, Barrett and his students produced a long-fibered flax case paper, called *PC4*, that had characteristic good tear resistance and high fold endurance. The UICB later made it available for sale directly through their campus facility, as well as through third-party sellers such as Talas Supplies for Bookbinding and Conservation in

Fig. 3. Example of the more severe environmental degradation in a small limp vellum Spanish prayer book. Image courtesy of Marco Valladares.

New York, New York. It has grown in popularity steadily over the past two decades, having applications in both conservation and in artist and fine bookbinding.

A desirable conservation case paper such as UICB PC4 flax paper would be a heavy cartonnage-like paper that could withstand scoring, folding, punching, and other manipulation to create a secure, one piece cover that could be laced onto supports (which are often made of parchment or alum-tawed skin). Once laced on, the cover can be either adhered to a pasted down end sheet or not, depending on the treatment necessities. In addition to this use of case paper, conservators also find it useful as a more stable but still aesthetically accurate replacement for parchment in bindings, fills, repairs, and the creation of slipcases and portfolios, as well as bespoke laminated paper boards.

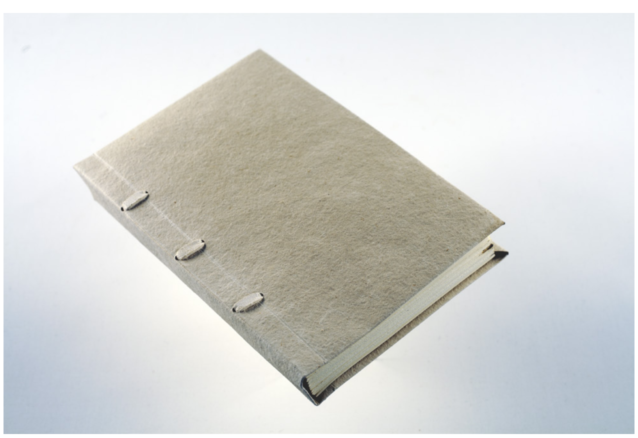

Fig. 4. Model of a limp laced case binding, sewn on alum tawed supports and covered with University of Iowa PC4 flax paper. Image courtesy of Marco Valladares.

For many years, the most preferred paper available was that of the PC4 flax paper from UICB. As mentioned, PC4 is a strong, 100% flax paper that is close textured, externally sized, and relatively rigid. It takes and holds a fold exceptionally well and, up until recently, came in a small range of subdued colors that were both appealing and appropriate for conservation use. In recent years, PC4 flax paper has become harder to source, presumably due to a shift in focus and supply production at the University of Iowa program.

Twin Rocker has been suggested as a possible substitute case paper source, and although Twin Rocker does produce fine text-weight paper for use in bookmaking, most of their heavier stocks are art and watercolor papers, which do not have the same characteristics as PC4. Cave Paper, a material by an artist papermaking studio out of Minneapolis, Minnesota, and produced by UICB-trained papermakers, has been considered another feasible alternative to PC4 because it is similar in makeup and physical characteristics.

Although these various papermaking sources offer a diverse array of potential case papers, this project aims to focus on creating a more sustainable alternative by cutting down the carbon footprint of papermaking and transportation. Conservation papers require high-quality materials, such as flax and cotton, most of which are only grown in certain areas of the world and have a high carbon footprint. In publishing our testing criteria and a detailed research plan, the authors hope to model and encourage other conservators to explore the potential benefits of using locally sourced papers and materials in their work (fig. 5).

A Cross-Campus Collaboration

Starting in the summer of 2018, a small group of colleagues—consisting of two conservators, a graphic design faculty member/papermaker, and a research assistant with a strong chemistry background—met to discuss the potential for a shared research partnership. Early on, several of the fundamental goals and desired outcomes of this research were immediately apparent:

- To collaboratively work across multiple disciplines to create a new, locally sourced paper that could be manufactured at the University of Illinois and be used in book conservation

Fig. 5. From left to right: A long-stitch binding using University of Iowa PC4 flax case paper, a similar model prepared using University of Illinois Fresh Press' corn/rye/cotton blend, and a slip case made with Fresh Press rye/cotton paper

- To methodically test material and chemical characteristics of the papers to determine the best fiber combinations and production details
- To disseminate outcomes with an eye toward open source, enabling others to try the same or similar locally minded approaches and promote sustainability

Less clear, however, was how to begin achieving those goals. After a brief literature review, the authors used any and all information at their disposal to form a research plan and move experiment design forward. This included, but was not limited to, conservation science studies of paper and aging, TAPPI guidelines for paper testing, articles on plant fiber classification and morphology, histories of papermaking, and pilot experiments in paper.

As conservation professionals, the authors had a personal and professional idea of how this new paper needed to work and feel. However, to achieve these characteristics, it was necessary to investigate how the paper handled and to develop some means of quantifying the nonquantifiable attributes such as folding, scoring, and rigidity. Other variables, such as internal and external sizing, ideal weight and adhesion, and especially how these new papers withstood aging, were also characteristics that were prioritized in testing.

The resulting research plan loosely outlined two phases for the creation of a sustainable conservation case paper. In the first phase, the collaborators would produce an initial set of papers using commonly available and locally source fibers and recipes, followed by basic chemical and working characteristic tests. Much of this phase of the research was designed to rely on what was already available without external funding, such as raw material, sheets of paper from successful fiber combinations, and laboratory/studio setup. The second phase, based on the results of the efforts of the first, aimed to hone the paper recipe, consistently produce sample papers, select a final fiber combination, and carry out full analytical testing protocols to inform decisions for future production implementation.

Between the Fresh Press' studio space and extra inventory of a wide variety of materials, the conservation laboratory's access to basic scientific setup and instrumentation, and the mutual excitement between the four authors to move forward on this goal, the setup for the initial phase of work was not a challenge. However, it was clear that to undertake the high-level technical analyses, perform accelerating aging tests, and produce more standardized papers than what was already in stock would require additional funding. Using unrestricted gift funds, the conservation laboratory was able to purchase an accelerated aging oven with controlled temperature and relative humidity. The research partners also established an agreement with Dr. Sameh Tawfick from the University of Illinois' Department of Mechanical Engineering, who was willing to perform the

Fiber	Details
Miscanthus/Cotton	50/50 miscanthus/cotton linters, 3 hour cook, + soda ash, beat time unknown
Corn/Cotton	50/50 corn/cotton linters, 3 hour cook, + soda ash, 45 min beat
Rye/Cotton	50/50 rye/cotton linters, 3 hour cook + soda ash, 1 hour beat
Corn/Rye/Cotton	50% cotton/unknown rye and corn ratio, 3 hour cook, + soda ash, beat time unknown
Tomato Vine/Cotton	50/50 tomato vine/cotton linters, 3 hour cook, + soda ash, 1 hour beat
Soybean/Cotton	50/50 soybean/cotton linters, 3.5 hour cook, + soda ash, 75 min beat
Eggplant/Cotton	50/50 eggplant/cotton linters, 3 hour cook, + soda ash, 35 min beat
Big Blue Stem/Cotton	50/50 big blue stem/cotton linters, 3 hour cook, + soda ash, ~1 hour beat
Sunflower/Cotton	50/50 sunflower/cotton linters, 3 hour cook, + soda ash, ~1 hour beat
Hemp/Cotton	50/50 hemp/cotton linters, 3 hour cook, + soda ash, ~1 hour beat

Fig. 6. Table detailing the fiber mixes and recipes used for papermaking

TAPPI testing protocols on our samples for a modest fee going forward. Dr. Tawfick had already done some analysis of previous paper stocks with Professor Benson before this project began. Throughout the first phase, the authors additionally applied for grants and funding sources to later be able to afford the second phase of the project.

MATERIALS AND METHODS

Papermaking

At first, the team took previously made papers from the Fresh Press' inventory for comparison. These papers had been made with all different recipes, which led to a review of previously published recipes to base future work and standardize methods. With Research Assistant Anneka Vetter and Papermaking Assistant Veronica Steffen, 10 different fiber blend papers were cast in small batches. To start, all papers were blends of agri-fibers and cotton, as these were papers with which the authors were familiar. Additionally, previously gathered analytical data suggested positive outcomes with cotton blends—which was, of course, unsurprising given that cotton rags were a source for historic papermakers.

Each blend had a 50% cotton linter content and 50% varying agricultural fibers e.g., 50% rye with 50% cotton), and one combination fiber that was approximately 33% corn, 33% rye, and 33% cotton. These were cooked for approximately 3 hours with soda ash, rinsed, and beaten for approximately 1 to 2 hours with a Hollander Beater (although the beat time was variable from fiber to fiber), then internally sized with premade Carriage House Paper internal sizing. Beating time was the hardest step of the recipe to standardize across the different fibers, as the softer fibers took much less time to beat and vice versa. The agricultural fibers we used were miscanthus (a native prairie grass), corn leaves, rye grass, tomato vine, soybean stems, eggplant vine, big bluestem grass (a native prairie grass), sunflower stems, and hemp (not agricultural waste in the state of Illinois yet likely to be more available in the near future with recently passed legislation) (fig. 6).

Basic Analytical Testing

For the initial analytical experiments, the authors relied on the TAPPI Standards, which has official published guidelines on what tests should be conducted to produce an archival-grade or conservation-grade paper. Although many of these analytical and mechanical tests were beyond the conservation laboratory's capacity, the authors were able to conduct a few basic tests, specifically average fiber length, grammage, caliper, and pH before and after artificial aging. Average fiber length was determined by using a Leica S8AP0 microscope with an MC170 HD camera attachment and the integrated Leica Application Suite 4.0, utilizing raking light and illuminated light to differentiate fibers. Average caliper (or thickness) was tested using a standard micrometer, and grammage was measured using an analytical scale and ruler. Aging tests were carried out in a Memmert Humidity Chamber 2 with accelerated aging conditions set at 90°C and 55%RH for 14 days. On both aged and unaged samples, pH tests were performed, having been adapted from ASTM Standard Test Methods for Hydrogen Ion Concentration (pH) of Paper Extracts, cold-water extraction method (ASTM 2007). Measurements of pH were taken using an Oakton pH meter with a standard wide range pH probe (figs. 7, 8). Color analysis

Fig. 7 & 8. Cold extraction pH testing of various paper samples

Fig. 9. Wettability testing on paper samples that have been externally size with 2% gelatin solution (right) and unsized (left)

was measured using a ColorMuse digital color matching device that provided us with basic RGB and L*a*b*color space data.

Workability Testing

Each paper sample was evaluated for wettability using deionized water, as well as acceptance of the common conservation adhesives wheat starch paste and polyvinyl acetate (PVA), with both externally sized and unsized papers (fig. 9). It should be noted that all papers except hemp were made with premade internal sizing, produced by Carriage House Paper. Before the paper samples were exposed to water or adhesives, samples were externally sized with a 2% gelatin solution. Wettability tests were performed by placing a droplet of distilled water on the surface of the paper, observing and timing how quickly the droplet was or was not absorbed. Adhesion tests were performed by lightly applying the adhesive (either PVA or wheat starch paste) to a small area of the paper sample, lightly pressing another piece of the same paper onto the area, observing the samples as they actively dried, and examining after drying.

Qualitative Testing

The authors designed a ranking system in which paper samples were lettered and ordered randomly to conduct a double-blind study to quantify information about how the papers subjectively felt and performed. The characteristics evaluated were color, speckliness, texture, flexibility, opacity, scorability, foldability, and burst, without using any formal analytical measurements. The authors all had the same instructions and paper samples, which they individually ranked from least to greatest for each factor (e.g., least flexible to most flexible) and were asked to list their top three personal favorites for each characteristic. This qualitative testing was an important way to compare and evaluate our papers from a more realistic perspective by mimicking what might normally be done to the papers on the conservator's bench.

RESULTS

During papermaking, the fibers were chipped, cooked, and beaten as similarly as possible, although quite a bit of differentiation in length and thickness from fiber to fiber was noted during the papermaking process, and was later confirmed by our basic analytical testing and measurements (see fig. 9). This obviously affects working characteristics like folding and flexibility, and thus recipe development will be a crucial step to moving forward to be able to truly compare the papers analytically.

After the aging tests, a slight to moderate darkening of nearly all paper samples was noted (including samples of the Iowa PC4 case paper and Cave Paper samples, which were included in the tests). Papers made from tomato, corn, and rye fiber papers showed the highest level of discoloration from accelerated aging. The 50% rye and 50% cotton paper

Fiber of Paper (with Cotton)	Grammage (gsm)	Fiber :ength (mm)	Thickness (mm)
Rye	238.1	1.466	0.201
Corn	236.3	1.285	0.237
Miscanthus	276.2	1.869	0.347
Big Bluestem	391.4	2.035	0.417
Sunflower	115.8	1.661	0.156
Hemp	276.2	1.424	0.351
Soybean	79.9	1.419	0.13
Eggplant	159.7	4.952	0.234
Tomato Vine	195.7	1.954	0.265
Corn/Rye	196.5	1.742	0.19

Fig. 10. Summary of basic analytical measurements

sample did show some spotted discoloration that could be foxing, although other rye papers from multiple batches were tested and still others did not show any observable discoloration, and thus the issue is most likely batch related (fig. 10).

Cold extraction pH tests were also performed before and after aging (fig. 11). All unaged samples produced pH results in acceptable ranges (7.8 to 8.6); however, after aging, we found that the pH increased on all of our samples except big bluestem and the corn/rye blend. This finding was not anticipated, although we hypothesize that the increased pH may be related to residual soda ash in the papers that was not thoroughly rinsed after the cooking process. This can have an effect on the surrounding matrix when the temperature and moisture increase during aging studies, although further investigation is needed to confirm.

Evaluating each paper's wettability and acceptance of conservation adhesives was an important part of testing that

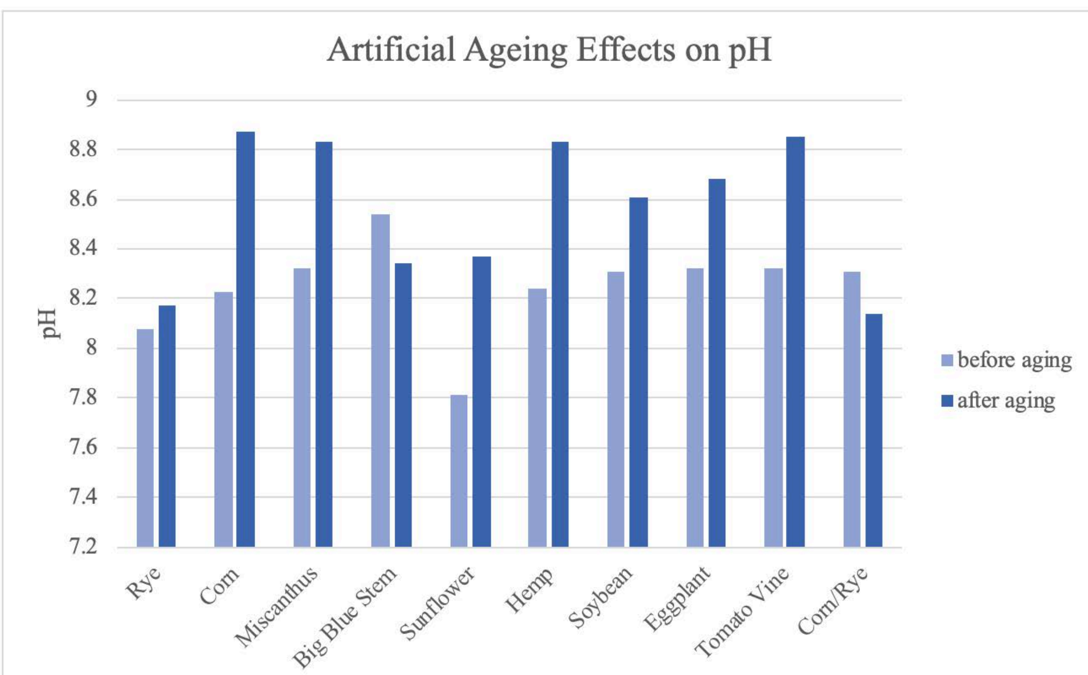

Fig. 11. Chart displaying pH test results of aged and unaged paper samples, showing an increase in pH after aging in most samples

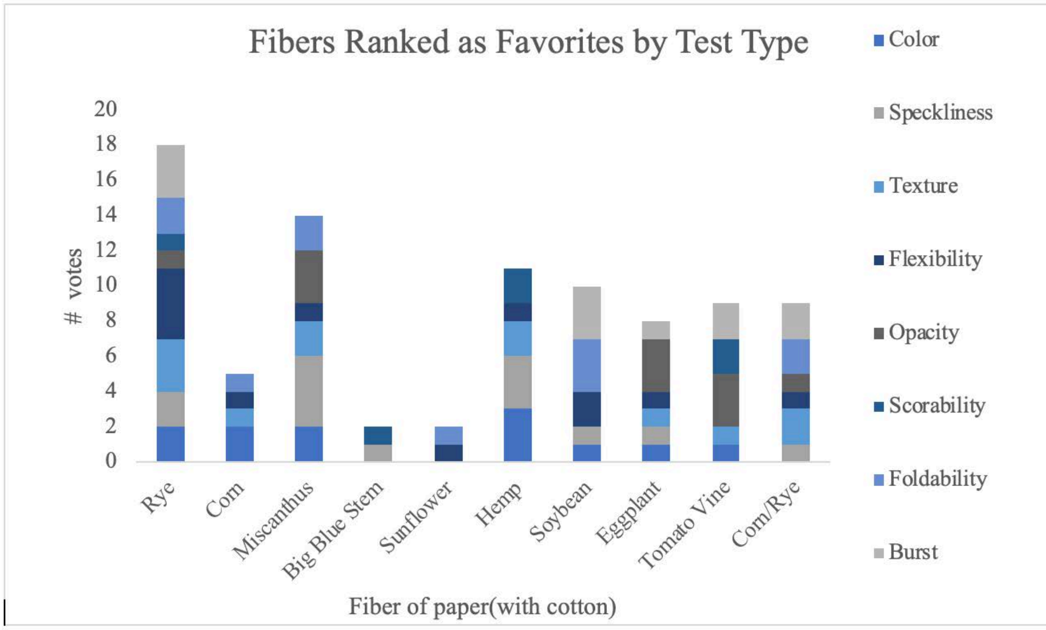

Fig. 12. Chart depicting cumulative results of the research team's ranked favorites during qualitative tests

added to our knowledge of how our papers perform in more specific ways. Although some papers (corn/rye both sized and unsized, and unsized big bluestem) showed rapid absorption, sized samples of big bluestem, tomato, sunflower, soybean, and eggplant all slowly absorbed the water. Only the sized and unsized rye, corn, miscanthus, hemp, and unsized tomato showed little to no absorption.

Each paper's acceptance of the two most common book conservation adhesives (PVA and cooked wheat starch paste) was also evaluated. Overall, little reaction, other than a slight sheen, was found in the acceptance of the papers to the application of PVA, except for a slight curling of the soybean paper. However, significant warping after the application of wheat starch paste (after complete drying) was found in rye and soybean samples, with moderate warping observed in corn and sunflower (fig. 12).

In the qualitative double-blind testing, the ranking of "favorites" was found to be the most helpful in selecting the most promising fiber sources. Of the 10 samples evaluated (Iowa PC4 and Cave Paper were not ranked), rye and hemp were clear front-runners, with miscanthus and soybean also garnering several votes in multiple categories.

DISCUSSION

The interdisciplinary nature of this project makes it an interesting representative of cross-campus collaboration, as well as a good candidate for discussion and presentation in multiple academic venues; however, the specificity of the reasoning and goals of the project actually make it a difficult project to fund. As a research project, "A Case for a New Case Paper" is not entirely scientific or purely sustainability focused, nor is it exclusively art based, nor conservation oriented. Many of the applications that have been submitted on behalf of this project have come close to acceptance but ultimately were unsuccessful. The authors speculate that this may be because their project narrative is so interdisciplinary that it can be somewhat hard to specifically tailor to any singular facet that might appeal to traditional funding bodies. Until funding is secured, the more formal analytical testing will have to wait.

Practically speaking, designing experiments with consistent controls was a little challenging throughout the course of this research—Fresh Press is a papermaking "studio" and not an industrial papermaking laboratory, so ensuring exact replication of processes across paper production was a challenge. Especially when considering that many fibers in use are not usually found in papermaking, it should be no surprise that it came as a challenge to form consistent sheets of paper using different fibers. For example, eggplant has different optimum chip length than hemp or sunflower; therefore, creating an experimental paper that is conformant for the purposes of having a control standard is not easy.

Regardless of these challenges, by the conclusion of the first phase, the authors felt encouraged about their progress and future directions. Most encouraging, of course, was that the accelerated aging tests did not yield any obvious exclusions due to any dramatic shifts in pH. Future paths of inquiry include additional experimentation to see how adjusting rinsing methodology, the balance of internal/external sizing, and decreasing the proportion of cotton linter to agricultural fiber mixes will influence the ultimate results of the paper.

Surprisingly, all of the paper sets are very close to a material that would be appealing to use as conservation case paper, especially from a handling perspective. All of the agri-fiber papers were in the same basic family of the University of Iowa PC4 case paper in appearance, weight, and texture. Even more surprisingly, none of the samples were totally eliminated based solely on performance—although there were some, such as soybean and sunflower, that were removed from consideration due to specific qualitative characteristics. Although test results varied from fiber to fiber, several fibers (hemp, rye, corn, big bluestem, and miscanthus) all showed promising results in different areas. For this reason, the authors feel strongly that they are headed in the right direction.

Research will continue toward creating more paper samples with blends of these fibers, hopefully maximizing the respective positive characteristics of each. Additionally, subsequent efforts toward this research will focus on greater standardization in the papermaking process, as well as more thorough testing to clarify some of the more interesting early data, such as the pH testing results.

Perhaps even more importantly, our research has been a great cross-campus collaboration that has garnered a good deal of interest from our campus sustainability program, the library's Innovation and Seed Funding Initiative, and the Department of Art + Design. The University of Illinois is generally a collaborative environment, but such a unique collaboration has attracted the attention of multiple on-campus news outlets, which has resulted in articles featuring this work. Therefore, our hopes are high that our work can continue forward with some additional financial support. The authors will continue to pursue funding opportunities and, pending success, hope to partner with the University of Illinois Department of Mechanical Engineering, as previously mentioned, to collect more analytical data on the papers' performance.

Additionally, the authors are looking forward to producing consistent, high-quality papers that can actually be integrated into laboratory use. Long term, they would like to see the creation of a variety of agri-fiber paper made available for purchase by interested parties outside the University of Illinois to provide both a new material with many potential applications in the field of conservation and a source of revenue for Fresh Press Studio to continue their efforts in sustainability.

The ultimate hope for this research is to find a successful way to share it for implementation outside the community of artists and conservators. Paper for conservation use is a niche market, and it is highly unlikely that this very specific shift in the supply chain for conservation case paper would be enough to offset the environmental impact of the entire paper industry. However, it does not seem unreasonable to aspire to the creation of a practical setup and production methodology that could be open sourced and reproducible by other communities. Conservators, papermakers, or artists who have access to their own locally sourced agricultural waste could then consider producing their own papers for use and cut out the immense carbon footprint that comes just from shipping materials from one coast of the US to the other. By extension, these grassroots (pun intended) efforts at replicating the research undertaken at the University of Illinois with native waste fibers further Fresh Press' mission of changing the paper supply chain from forest to farm.

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ERIC BENSON
Associate Professor and Chair of Graphic Design, School of Art + Design
College of Fine and Applied Arts, University of Illinois
Champaign, IL
ebenson@illinois.edu

QUINN MORGAN FERRIS
Senior Conservator for Special Collections
University of Illinois Libraries
Urbana, IL
qferris@illinois.edu

JENNIFER HAIN TEPER
Velde Professor and Head, Preservation Services
University of Illinois Libraries
Urbana, IL
jhain@illinois.edu

ANNEKA VETTER
Research Assistant
University of Illinois Libraries
Urbana, IL
aevetter@illinois.edu