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Postharvest Loss: Global Collaboration Needed to Solve a Global Problem

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ABSTRACT

In early October 2015, the First International Congress on Postharvest Loss Prevention was held in Rome, Italy. Individuals from more than 62 countries were in attendance representing academia, corporations, and various governments. Postharvest loss has a large impact on quantity of available food in the world; estimates say approximately 30% of food is lost to postharvest loss. Postharvest loss can be traced to many components of the supply chain including harvesting, drying, storage, processing, and transportation to markets. This paper discusses some of the technologies that were presented at the congress. Most of these technologies focus on improving methods of food storage and preservation techniques. This paper also will provide an overview of the presentations given at the congress regarding public-private partnerships that will hopefully lead to reductions in losses. Additionally, a summary of the "roadmap" document is provided. This document was created towards the end of the congress in order to describe specific short and long term goals regarding postharvest loss prevention.

INTRODUCTION

The term postharvest loss is relatively self-explanatory; however, few people probably have an idea of how large in scale this problem is. Most estimates suggest approximately 30% of food is lost before it can even reach the consumer. While it would be nearly impossible to completely eliminate losses that occur after harvest, a number this high is not acceptable. Upon arriving at the First International Congress on Postharvest Loss in Rome, Italy, it quickly became clear how important this global problem is. There were top scientists, corporate leaders, and political figures from more than 62 countries in attendance. Joseph Taets, a senior vice president at Archer Daniels Midland, said that, with 80 million tons in losses each year, there is a need for an "increase in production as well as preserving what we have" (Taets 2015). This much food being lost is a difficult thing to comprehend, but one thing is certain: if this amount of food were saved, countless individuals would no longer have to worry about where their next meal is coming from. According to the World Food Programme, roughly one in nine people "do not have enough food to lead a healthy active life" (Hunger Statistics 2015). The ability to reduce postharvest loss would lead to a reduction of this shocking statistic.

There must be a reason why something significant has not been done before to reduce

the problem of postharvest loss. Dr. Peter Goldsmith, from the University of Illinois, posed an interesting question: "Why is loss allowed to occur?" (Goldsmith 2015). Whether the missing link is a lack of incentives, missing opportunities, or a mix of the two, a key portion of the congress was spent discussing what needs to happen in order for the 30% figure to start being reduced. Previous efforts have been made to fix this problem, but have not all been successful. For instance, the 1974 World Food Congress had the goal of reducing losses by 50% by 1985, but this goal was unfortunately not accomplished (Cousin 2015). However, a new sustainability agenda, adopted this year by the United Nations, aims to end undernourishment by 2030, which is an encouraging sign that we as a society have not given up. Despite this new goal being created, concrete actions will need to be taken in order to ensure that it is successful. Without advances in technology and the sharing of best practice information, a plan will never lead to real progress.

Contributing Factors to Postharvest Loss

One common theme among many sessions was that, especially in developing countries, lack of access to mature supply chains prevents postharvest loss from being reduced. Regarding postharvest loss of citrus in Nigeria, Ugoh (2015) explained the lack of processing facilities sometimes forces farmers to not harvest at the ideal time, contributing to increased losses. Also, the high number of middlemen, in a market consisting of nearly all smallholder farmers, prevents direct access to the market. This, in turn, creates more inefficiencies in the supply chain linking farmers and consumers. Hindrances such as middlemen slow the movement of crops from field to consumer, providing a longer time span in which losses can occur. Ugoh (2015) also stated that poor handling leads to deterioration and fungal rot of the citrus produce (Ugoh et al. 2015). Instead of improving handling, smallholder farmers focus more on increasing production to cope with the existing losses (Ugoh 2015). This suggests the lack of attention to postharvest loss is a combination of limited access to necessary resources as well as the lack of incentive to reduce loss, which leads to increasing production being the default solution.

Professor Kumar Mallikarjunan described the impact of the toxin aflatoxin, a product of a type of mold called *Aspergillus*. Various practices can lead to an increased risk of aflatoxin contamination that leads to postharvest loss by reducing quality of agricultural products. Professor Mallikarjunan discussed how limited drying procedures in developing countries force peanut growers to dry the nuts on the ground, where they are in direct contact with the mold. Then, peanuts with higher levels of contamination are sold to different groups for a lower price (Mallikarjunan 2015). Although this makes sense from an economic standpoint, it is surprising there are not more restrictions in place to prevent the sale of harmful products. Mallikarjunan (2015) mentioned the technique of soaking peanuts in water. While this makes them easier to shell, there is a secondary purpose of increasing weight for sales purposes, but also the additional consequence of increasing risk of aflatoxin. Again, Professor Mallikarjunan traced the common theme of lack of access to drying technology as well as an underdeveloped and loosely regulated supply chain.

This idea of limitations to the supply chain causing postharvest loss was presented in a speech given by Professor José Caixeta in which he discussed the need of improving transportation in Brazilian agriculture. In his

discussion of the transportation of fruits and vegetables in Brazil, Professor Caixeta said that 90% of the transportation of goods is done via trucks. (Caixeta 2015). Numerous factors play a role in how much of a product ends up being lost during transportation. Some of these factors include road quality, packaging type, and vehicle capacity. In his presentation, he displayed images of trucks filled to the brim with various agricultural products — far beyond the suggested capacity. Despite these losses that are occurring due to transportation issues, the common response is that increased production is sufficient to make up for anything that is lost. Where increased production is the seemingly easy answer, there will have to be a real economic incentive or some form of government regulation to reduce postharvest loss. Unless farmers know they will be better off attempting to reduce postharvest losses instead of planting extra acres of crop, they will not have the incentive to change their practices. Sometimes a farmer will even have to face the choice of selling their crop at a loss or letting it go to waste. While the goal of food production is to get food to consumers, a farmer cannot make a living by selling goods at a loss. Postharvest loss could be addressed by suggesting best practices to farmers and everyone else that handles a food product before it reaches the consumer, but at the end of the day, it comes down to whether the changes to be made are beneficial to those in charge of each part of the supply chain. In order for improvements to occur, collaboration between stakeholders is necessary and in the words of Michael Scuse of the USDA, "working together works" (Scuse 2015).

What Needs to be Done

If there is one positive from the startling statistics of postharvest loss, it is the increased attention to the topic from academia, government, and corporations. The next big step will be getting farmers and our global society as a whole invested into solving the problem. According to the United Nations, "the current world population of 7.2 billion is projected to increase by 1 billion over the next 12 years and reach 9.6 billion by 2050" (United Nations 2013). As the global population keeps increasing, issues surrounding food security will need to be pushed towards the forefront of matters actually being addressed. Glin (2015), from the Rockefeller Foundation, gave his insight on the ways that large organizations like the Rockefeller Foundation are able to assist in solving global problems like postharvest loss. He explained how projects are selected based on what will have the greatest impact. This makes sense from an organizational point of view. In order to increase the company's portfolio of things that have been accomplished, their best interest is to choose large-scale problems that can still realistically be improved. Glin discussed the potential of combining agricultural dealers of seeds, fertilizers and other products with the distribution of new technology because it would facilitate the spread of new technology that has the potential to drastically reduce losses. Glin (2015) suggested there cannot be "a tractor for everyone" due to the large capital investment that simply isn't possible for many individuals. Instead, Glin (2015) talked about the success that previous projects have had by allowing a community to share expenses of large investments like a tractor. Community purchases like this have the potential to provide the latest technology to smallholder farmer that previously needed to rely on older methods of harvest, which often contribute to greater losses. He also said that there is "no app for optimizing PHL prevention" (Glin 2015). This accurately describes how dynamic of an issue solving

postharvest loss will be. There is not a single cure-all solution. It will take a combination of brainpower from many individuals across the private and public sector to figure out the best ways to reduce loss for a variety of situations.

New Technologies

While discussing the potential relationships between academia, corporations, and government that will help reduce postharvest loss is important, concrete examples of new technology being developed to reduce losses are what will lead to tangible, quantifiable change. Most of the technologies being presented could be categorized into the following areas: harvest, storage, and processing.

With respect to harvest, one poster presentation differed from the rest and actually had nothing to do with crops. Instead, it dealt with the "harvest" of crabs in Thailand (Boutson et al. 2015). The presentation discussed how conventional crab traps unintentionally trap other species and lead to the death of these creatures. Also, if a conventional trap is lost, the amount of crabs that can be caught by fishermen is reduced because crabs caught in the lost trap will most likely die. This is referred to as "ghost fishing", the phenomenon that occurs when fishing gear that is abandoned and "continue[s] to induce mortality of aquatic organisms without human control". The aim of this project was to compare traditional traps to a new vented trap design. The new design significantly reduced the amount of "non-target species" and undersized crabs that remained trapped by allowing them to escape through specially designed escape vents. According to their data, using vented traps significantly reduced the amount of non-desired species that were trapped. The percentage of non-target species able to escape increased from 72% to 89% when vented traps were used. For the target species of the blue swimming crab, vented traps actually reduced the amount that was able to escape from 37% to 18%. The findings of this project were concluded with the following statement: vented traps "can reduce the negative impacts of ghost fishing by releasing the small size crab and non-target species" (Boutson et al. 2015). Even though most people will not think of fisheries when it comes to the word "harvest", this topic should not be disregarded because fisheries account for a portion of our food supply and must be taken into consideration when trying to figure out how to feed a growing global population.

The area of postharvest loss that received the most attention at this congress seemed to be drying and storage techniques. One such technology was PICS bags, which stands for Purdue Improved Crop Storage. This technology was explained through one of the session presentations given by Professor Corinne Alexander from Purdue, as well as a poster presentation given by Professor Alexander and her colleague Dieudonné Baributsa. PICS bags are an affordable hermetic storage option for farmers that preserve grains and lower the need for insecticides (Baributsa et al. 2015). During Professor Alexander's session presentation, she discussed the large variety in agricultural practices between regions in Africa. For instance, Uganda has the lowest chemical applications, but also stores food for the shortest amount of time. These data points vary country to country which is one reason why finding a single cure-all solution for postharvest loss is impossible. However, storage solutions can be more universal, a reason why PICS hermetic storage bags have been so successful. Both presenters said that a key aspect of providing

these bags to farmers is making sure that there are distributors close to each village. Having a manufacturer in-country facilitates distribution and adds jobs into the local economy. PICS technology has benefits across multiple levels of the supply chain. For instance this technology helps immediately after harvest because farmers have the option to store the crop in a safe manner and wait for the optimal time to sell for the best price. Additionally, the bags benefit the end user by reducing the physical degradation to the grain. Another unforeseen benefit of these bags is increased profitability of grains. According to the poster presentation, there is the following "average price increase after 4 to 6 months of storage in 3 districts in Uganda: beans 27%, maize 11%, sorghum 75%, pigeon peas 33%, peanuts 48%, soybeans 140%". With price increases this large, solutions like PICS are clearly beneficial and it becomes a matter of ensuring that distribution becomes more widespread and that the storage solutions can be sustainably and locally produced.

Another type of storage technology that was presented during one of the poster sessions was the Zero Energy Brick Cooler or ZEBC. Leafy vegetables have a very short shelf life of approximately one day. Using the ZEBC, "farmers and traders can store their vegetables temporarily for later marketing" (Ambuko et al. 2015b). Even without special packaging, "leafy vegetables can be maintained in their fresh state for up to 5 days" with the ZEBC technology. The most impressive thing about this technology is how economical it is. "The ZEBC is a simple low cost technology which can be built from locally available materials" and has an estimated cost of less than 200 USD. Another technology related to improving storage conditions was the Coolbot. "The Coolbot is an electronic gadget that overrides the temperature gauge of the air conditioner (AC) thereby 'tricking' it into working harder. This makes it possible for the temperatures to drop as low as 0°C" (Ambuko et al. 2015a). Building a four by four meter insulated room costs roughly 1,000 USD compared to the Coolbot device that costs 150 USD. While this is not a trivial amount of money, it is significantly more economical than paying for storage in a commercial refrigerated room. This is just one example of standard equipment being utilized for unintended tasks. With innovations like this and the ZEBC smallholder farmers will be able to safely store produce with an investment that can quickly be paid off because of the increase in profitability of their products.

A different category of technology that was presented was processing techniques. One such technology was called Edipeel. Edipeel is a safe, naturally derived formula that can be applied to produce in many ways such as a spray applicator or "paint-on" method. "When applied to the surface of plants, it provides a protective layer that prevents oxidation and transpiration that cause produce to wither and become discolored" (Apeel Sciences Edipeel Technology Description). There was a video presentation of this technology in which various types of produce were shown side by side over the span of multiple days. After 6 days of storage, strawberries may show signs of spoilage such as mold. However, with the Edipeel barrier, in the same time span of 6 days, the strawberries look freshly picked. The main concept behind Edipeel is that "fruits with a peel have a 500% longer shelf life than fruits without a peel" (Apeel Sciences Edipeel Technology Description). The thin naturally derived peel added to types of produce without a naturally thick peel mimics the protective nature of a thick citrus peel. Even on citrus fruits with pre-existing thick peels, Edipeel is able to increase shelf life.

While technologies such as Edipeel can increase shelf life of foods, problems such as insects can still damage crops postharvest. That is where new technologies such as Entostat® are invaluable. Typically, when pesticides are used to protect stored agricultural products, excess pesticide residues can remain on grains and lead to a variety of health problems. Entostat® is a powder "based on a carnauba wax blend" and carries a slight electrostatic charge (Exosect Pest Control Technology: Entostat). This allows the powder, which can be mixed with traditional pesticides, to stick to insects and reduce the total amount of chemicals needed. Freya Scoates, the presenter of the poster on Entostat® said that integrating insect-specific fungi into the powder could be a possible future variation of the technology (F. Scoates 2015). With technology like this, pesticide applications to prevent insect damage during crop storage will become much more sustainable and require a lower concentration of chemicals, thus reducing health and environmental risks. The potential to use insecticidal fungi combined with this powder could offer further improvements to the existing technology by completely eliminating the need for chemical pesticides.

Moving Forward and Final Thoughts

During the last day of the congress, everyone came together to create a "Roadmap" document that creates a plan on how to reduce postharvest loss in the short and long term. One topic that had a wide range of opinions was how much of a reduction is realistic to expect over the next few decades. Some of the congress attendees debated on whether the graphical curve depicting percentage reductions in postharvest loss over time would increase rapidly at first or follow a gradual "S-shape" curve. The following are some of the key points brought up during the roadmap discussion: the need to develop a standard metric to quantify losses, development of affordable and locally available technology, ensuring adequate access to markets, and looking at all portions of the supply chain.

Overall, this Congress was very successful, especially when taking into consideration that it was the first international congress of its kind. Even though a universal remedy to immediately solve the issue of postharvest loss was not discovered, the conversations that took place were a big step in the right direction towards addressing this global issue. One of the biggest advantages of an event like this is that individuals from all over the world can come together and share different perspectives. This type of global collaboration is what leads to the innovative solutions necessary for addressing large-scale global problems. The only critique I have is that the roadmap creating process seemed rushed. All the congress attendees had many things to say during the roadmap discussions, but were limited by time constraints. At the next international congress on postharvest loss prevention, a more in depth roadmap process could be useful to reflect on past progress and revise future plans.

As seen throughout the congress, many of the solutions seem to already exist. One might ask why the problem has not been solved by now if so many solutions have already been thought of. I think the answer to that question is that communicating these solutions on the global scale is no easy task. Even more challenging than simply communicating ideas is convincing people why these new ideas are necessary. People are creatures of habit and unless there is a clear benefit to an individual or their community, old habits will be preferred. That is where education is so important. If everyone was able to understand the impact reducing postharvest loss would have on their personal

economic success as well as reducing global hunger, I am certain that farmers, of both small and large operations, would make the effort to create change. Unfortunately, it is not feasible to have the entire global population learn about this issue overnight. This is why cooperation between government, academia, and corporations will make conveying information to people across the world a much more manageable task.

There were many great ideas and novel technologies presented at this conference. However, if these ideas only stay within the confines of a conference, they will not lead to any real improvements. Again, this is where education and communication of ideas to our global society is so important. Additionally, figuring out ways to make newly developed technology available to large farming operations as well as smallholders is a key component of preventing postharvest loss. I think the best way to go about this is to utilize components of the food supply infrastructure that are already in place. For instance, encouraging a pre-existing company to start integrating a new technology into their portfolio could be the first step. Then, product distributors could bring the new technology to farmers. This type of operation would be sustainable in the long term because there is no longer reliance on external support.

Many of the solutions to preventing postharvest loss already exist. How quickly these existing solutions can be employed to reduce and ultimately solve this global problem is still yet to be seen. I believe the best solution is to take pre-existing supply chains, integrate new technology, and educate people on the benefits of new technology. This is no easy task, especially because the cost of new technology can create economic barriers to progress. In order to make sure new technology is economical, public-private partnerships must provide assistance, which in the end will benefit everyone. Despite there not being a quick, easy solution, I am confident that if everyone works together to ensure the most efficient sharing of technology and information, it is well within our reach as a society to significantly reduce postharvest loss over the next few decades

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