Guest: Ms. Anju Biswas

Institution: University of Florida

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Ms. Biswas is a Ph.D student at the University of Florida focused on high-throughput phenotyping and genomic selection as applied in alfalfa.

She is an international student originally form Bangladesh. Growing up she saw people struggling for food. Agriculture is different in developing countries like Bangladesh. There is more subsistence farming, mostly rice and wheat near where she grew up. She wanted to make a difference in the world and completed an undergraduate degree in the agricultural sector.

She decided to go abroad to learn new skills and maybe make a more global impact. She started a Master’s degree in tomato tissue culture and defended rapidly to wrap up that work. She then transferred to Delaware State University in 2015 where she applied marker assisted selection and developed skills in phytochemical analysis. Hungry for knowledge she wanted to learn more.

The path in higher education is difficult for international students. She wanted to get a new job and received offers from three positions at: Alabama A&M, Purdue University and University of Florida. From there she had to decide where to focus. Based upon her previous experience in marker assisted selection and phytochemical analysis she considered working in strawberry but due to funding limitations she switched her emphasis to quantitative genetics/plant breeding focused on:

1. High-throughput phenotyping (HTP)
2. Genomic prediction/selection
3. Construction of crop growth models

Her goal is to explore HTP for genomic prediction. Her work focuses on use of UAS to collect in field data, generate field maps. Previous work has shown that UAS can increase genetic gain over time.

UAS also enables her program to save money on labor. They no longer need to collect as much data manually and can apply this data to genomic prediction models. One major goal is to predict harvest yield from one month to the next.

Another goal is the development of crop growth models through collaboration with the engineering department. They are building software to integrate many data types to predict yield or other characteristics from HTP data.

Ultimately their breeding goal is to develop alfalfa lines adapted to Florida that are non-dormant. They’d like to shorten the breeding cycle so they can release cultivars more quickly. She feels that crop growth and genomic predication models will really help accurately forecast performance based upon genotype x environment interactions. This can also be applied to phenomic selection.

Recently she wrote a grant to use UAS to collect hyperspectral data and use that to predict performance of alfalfa in response to abiotic stress. This is a cooperation between her and another PI to build the models and make the germplasm selections.

1. *What do you consider the biggest barriers to entry for implementing a UAS into a research program?*

There are many. Broadly speaking she can name a few.

You need the FAA Part 107 license. Many times students are not willing/do not have time to study and take the certification exam. Currently there are only 2 students on her campus that are licensed to fly drones. She is helping several other programs collect data unrelated to her primary focus. This is not a huge bottleneck but it is significant.

Second is knowing how to operate the drone and navigate the weather conditions. It is important to fly during the same time of day (usually between 10 AM – 3 PM) and high winds or rain are detrimental to high quality data collection.

Both the data collection and analysis require technical skills.

Data analysis and long term storage is a major challenge. Development of workflows/pipelines to extract data from UAS can be a challenge. She currently uses Agrisoft Metashape for generating orthomosaics and QGIS for plot level data extraction. It is necessary to have good coding skills in both R and Python. Data storage is another challenge. Generally it will need to be stored for more than 5 years.

Program budget is another important consideration. Think about what sensor types are suitable for the research question and affordable for the research program. Hyperspectral cameras are very, very expensive but multispectral cameras are more affordable.

As far as drone choice goes it is important to consider battery life. She typically uses 2 sets of batteries to fly her fields (20 minutes per flight). Windy conditions really reduce battery life quickly.

1. *What are some of the things you wish you had known before you began using a UAS for data collection?*

As mentioned earlier, knowing what time of day to fly and the importance of keeping the same time of day to fly. The important and usefulness of sensor calibration. She wishes there were more courses on HTP. It would have been helpful to take one from the beginning before she started her role at UF. Later she was able to take a course that clarified a lot of the questions he had.

Instructional resources for Pix4D and Agrisoft Metashape are good. At the time, she didn’t have much knowledge so she developed some of her own tools using Python. QGIS is a good tool but it takes a little bit of time investment to learn. A lot of her learning has been from scratch.

No real guidance on drone speed, overlap, capture rate, and altitude for data collection.

*4.      What educational resources have you found most useful when developing your own skillset with UAS-based imaging?*

She recommends John R. Jensen’s book titled: “Introductory Digital Image Processing: A Remote Sensing Perspective”.

She also recommends attending the North American Plant Phenotyping Network (NAPPN) conference. This has been really useful because she doesn’t know many other folks that are using this approach on her campus. She really enjoyed the conference. It is really good for connecting people with different skills and applications in HTP. Good to find experts, cooperators and recent articles.

There is no alternative to reading the current literature.

*5.      Are there other comments you believe would benefit an agricultural researcher considering implementation of a UAS into their research program?*

She thinks that UAS will be most useful for crop management/precision ag. applications and also for plant breeding as applied in genomic selection. She likes that there is no bias associated with the phenotypic measurements from UAS and you are able to collect a large number of phenotypes easily and rapidly. This helps characterize germplasm and inform selection.

They typically use 4 ground control points per field (one in each corner)

They typically perform data collection flights on a weekly basis and measure plant height the same day as each flight (as a back up, not primary measurement). They collect biomass measurements once a month through destructive harvest and fly directly before each harvest.

As far as guidance on drones and sensors she says that utility really depends upon the plant architecture.

Ultimately, you need to have a solid plan, budget, and goal before you purchase anything. You also need to have good collaborators or areas where you can access folks that have the technical skills outside of your knowledge area.