AN OPTICAL YIELD MONITOR FOR PEANUTS

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OBJECTIVE: Evaluate the potential of adapting a cotton optical yield monitor for accurately measuring yield in peanut.

FINDINGS:

During FY17, with funding from the Georgia Peanut Commission which was leveraged by funding from Kelley Manufacturing Company (KMC) we evaluated the potential of adapting an optical yield monitor (OYM) developed for use on cotton to peanut. The OYM was developed at Mississippi State University. The OYM consists of two mass-flow sensors, a data acquisition system, and a DGPS receiver. The mass-flow sensors are active optical sensors that contain the energy source and detectors in one single unit. Our colleagues loaned us their prototype OYM – the only one in existence.

To adapt the cotton mass-flow sensor for use with peanuts, three issues had to be considered: spectral similarity, sensor sensitivity, and sensor linearity. In addition, a suitable location for mounting the two mass-flow sensors had to be determined. The mass-flow sensors were used and mounted onto the duct which conveys the peanuts as shown in Figure 1. The sensors were installed on separate planes of the duct in order to capture the full range of peanut flow. Sensor placement was determined based on minimizing any interaction between sensors as well as ambient light. The sensors were mounted on the duct in the two locations thought to provide the best potential for the sensors to capture the mass of peanuts flowing by. However, there was concern that soil and pebbles carried through the duct with the peanut pods would abrade the lens of the sensors. Our intent was to evaluate several mounting locations during harvest.

With the assistance of KMC, we identified two growers who were willing to cooperate with us. One grower was located in Tift County and the other in Coffee County. The OYM system was first installed onto the Tift Co. producer's 6-row KMC 3386 peanut combine prior to the 2016 harvest season. Peanuts were harvested beginning 22 September 2016 in five fields located in Tift Co.

Calibration was performed by harvesting a range of peanut weights. Each load was emptied from the combine onto a 6-wheel peanut wagon. The peanut wagon was weighed using truck scales with one scale under each wheel. To clearly segregate the sensor data collected during each weighed load, it was necessary to create a separate data file for each load used. The total weight of the load was then compared to the sum of the sensor voltage outputs from the data file associated with that load. Each time calibration was performed, a minimum of four loads were weighed. For us to have useable files, it was necessary for a member of the project team to be in the tractor cab with the farmer in order to start and stop files. Additional team members were on the ground weighing the loads.

Several of the fields were predominantly Tifton loamy sand with large numbers of iron nodules (pebbles) on the soil surface. The pebbles abraded the lens of the sensors as shown in Figure 1. After the second field, we removed the sensors and fabricated deflector plates which we installed in the duct to deflect the airstream slightly away from the surface of the lenses. This reduced the number of impacts significantly.

Calibrating using all the calibration loads resulted in poor accuracy (Table 1). Creating individual calibrations for each field resulted in very good accuracy. This indicates that abraded lenses affected the performance of the sensors. To assess if the OYM with the abraded lenses was still able to capture yield variability in the field, we created yield maps of the fields. The map from Field 2 is presented in Figure 2. The farmer indicated that the yield patterns matched his field observations well and his explanations for the yield variability are shown on the map.

Our conclusion from the 2016 study is that the OYM has great potential to serve a peanut yield monitor if we can install the mass flow sensors so that the lenses are not abraded. The systems data

acquisition system failed after we completed harvest in Tifton Co. and we were not able to evaluate additional mass flow sensor locations.

Figure 1. Mounting location of the two mass flow sensors on the duct of a KMC 3386 combine (left) and lens of the sensor located at the lower position showing abrasion and pitting from the pebbles and other foreign material (right).

Table 1. Percent error of PYM based on the combined and individual calibration equations.

Field	Scale Load (kg)	Sensor Output (V)	Combined Equation		Individual Equations	
			Predicted Load (kg)	Percent Error (%)	Predicted Load (kg)	Percent Error (%)
1A	3273	2256	3341	2%	3294	1%
1A	2397	1637	2355	-2%	2349	-2%
1A	1650	1198	1656	0%	1679	2%
1B	1033	995	1331	29%	1104	7%
1B	792	728	908	15%	777	-2%
1B	2043	1772	2570	26%	2057	1%
1B	1432	1205	1667	16%	1362	-5%
2	3198	1713	2476	-23%	3198	0%
2	1698	924	1219	-28%	1698	0%

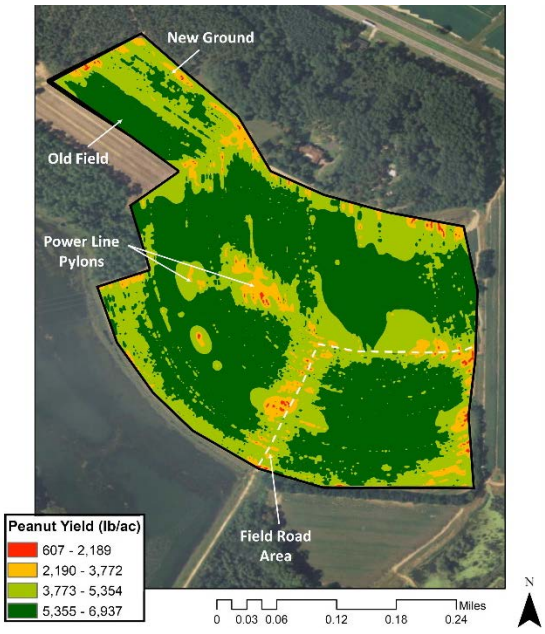

Figure 2. Peanut yield map of Field 2 located in Tift Co. just south of Hwy 82.