Final Report for CIG 68-0211-8-153: Using GPS and VRT for precise implement guidance and fertilizer application to reduce nutrient loading in the environment

This project began officially Sept 1, 2008 and concluded Dec 30, 2010 according to item "G" in the project abstract. But it really began years earlier in the recognition that crop yields varied greatly across the landscape of the Palouse region. We always wished there was an affordable way to increase production on the poorer soil types of the farm without wasting fertilizer where it wasn't needed. Early practices in high value crops such as grid soil sampling and variable applications were dismissed as too expensive for small grain, and besides that, GPS didn't work in hilly country. Rainfall was usually regarded as the main yield limiting factor.

Those obstacles really did exist then, and were reinforced with cheap fertilizer and a lack of technical and manufacturing support that made changing the accepted way of fertilizing a non-starter. Gradually, tools became available and affordable in flat farming, row crop country that showed promise of working in small grain farming on the Palouse.

The initial activities of the project focused on selecting and installing hardware on the seeding and fertilizing tractor that would reduce over application due to overlap both on straight runs (autosteer) and odd shaped end rows (accuboom). Both technologies were proving themselves on sprayers, but had not been adopted much in seeding and NH3 application.

Developing Soil Management Zones for Variable Rate Application was the other initial challenge. We had recently traded combines for ones that had Yield/Moisture Monitors, and felt that they would be capable of producing Zone Maps that would be valid tools for managing soil fertility according to yield potential. Diligent calibrations and a strong desire to achieve success were derailed by a summer frost and card memory failures that rendered most 2008 yield maps unusable. Fortunately the project was able to proceed with infared images available from SATSHOT.

The Project Funding Received to date has been $25,400.This was the total amount approved for the Grant. The Funding has been a 50% cost share, with a little over $50,800 total expenditures to date, that have all been submitted with receipts for Goods and Services.

The Project Results are best summarized by a slide in the attached Power Point Presentation, "Three Fields in One", and the slide "VRA Upper-Fall 2009." This field map, fertility recommendation, and Soil Test Result are proof of the yield variability we experience and the variation in recommended application rates of both N and P fertilizers. They also expose some challenges, such as not wanting to apply the maximum rate of 246 lbs N in a high yield zone. Also, we don't want to drop all the way to Zero in the Dry fertilizer mix that supplies the Phosphate, because of the Starter boost effect of having some mix with the seed.

I believe the results of this project are transferable to any operator on the Palouse with the right mind set. First, the farmer must believe there is a better way of doing things than in the past. If you don't accept change, it will be impossible to see any net benefits in a lot of work and investment required to manage fields this way. They must also acknowledge the production variability of a field. The higher the variability, the easier it is to see need to reallocate fertilizer to where it will do the most good. Some fields may be uniform enough that variable rates don't make sense.

The payoff to the initial investment will vary with farm size. The variable rate fertility tends to eat up savings of some nutrients by placing them where they can be better used, but still within the field. Analysis of one project field revealed that the total Ammonia savings was only 1.1 gallon per acre (about$1.25) based on yield goals for a VRA zone map. However, the total nutrient cost was about $55 per acre and the GPS autosteer and Accuboom savings average 10% for another $5.50 per acre savings. Assuming a five year technology life, $2 annual variable costs for Satellite Imagery, Omnistar subscription, and consulting fees, it appears that it takes about 2,100 acres per year to recoup the investment on our system. The higher the fertilizer cost, the faster the payoff.

Conclusion:
Since the start of this project, several articles have been published validating the process. The Nov 2010 issue of "The Progressive Farmer" article called "Reallocate Resources" has a very similar conclusion to our project results. A Precision Ag article in the Dec 2010 Idaho Farm Bureau Producer references similar conclusions. A third, but not the last article I've read since our Project began was in the Jan 2011 "Successful Farming" magazine and it also follows our process of 1: Gathering data about the field including yield and satellite imagery. 2: Identifying soil management zones using this data. 3: Establishing yield targets for each zone. 4: Preparing the VRA map.

A lot of the work in this project is definable, such as preparing a yield map, soil testing, programming a Variable Rate controller, or even selecting a satellite image to break down into zones. Establishing the yield target for each zone is one of the most subjective and difficult parts. With the strong yield response our wheat crops have to Nitrogen fertilizer, underestimating yield potential in a zone, thereby missing out on yield if conditions are more favorable than anticipated, could cost us more in one season than you could hope to save in the next 10 seasons. Our approach to this has been to be cautious in reducing rates or yield goals in a zone by more than what seems "safe".

The hardware for this project has proven acceptable, though not perfect. Numerous recalibrations of the Autosteer and an electric motor failure cost some productive field time, and GPS accuracy has been an ongoing issue. The very existence of software updates seems to acknowledge that we are sometimes on the "bleeding edge" of technology.