USING GPS-RTK IN CROP VARIETY AND HYBRID EVALUATIONS

Robert N. Klein and Jeffrey A. Golus

West Central Research and Extension Center
University of Nebraska - Lincoln
North Platte, Nebraska

ABSTRACT

Traditional methods used by many to conduct research in crop variety and hybrid evaluations, are to blank-plant the plot area, flag the plot area or use a physical marker. All of these methods have disadvantages. With blank-planting it may be difficult to plant exactly in the same rows and if soil water is limited the extra planter pass can further dry the soil, affecting seed germination. Blank-planting also destroys crop residue, which are critical to a successful crop in rainfed conditions. Plot rows must match the producer's rows for pesticide application, cultivation, ditching, irrigation, fertilization and any other operations performed by the cooperating producer. Often we have to wait for the producer to plant the field. Flagging a plot area takes considerable time and flags can be difficult to see and can be affected by wind. Large tape measures are difficult to use in windy conditions and can get tangled on crop residue in no-till conditions. A physical marker can plant weed seeds and be difficult to follow. Most of these methods have a problem with guess rows as well. Uneven spacing between rows decreases the accuracy of the research, especially with rainfed systems. GPS-RTK auto steering can plant crops with near perfect guess rows. It also greatly reduces the risk of cultivator blight. With small grain plots, a great amount of time is saved in laying out and flagging the individual planting passes, and greatly increases the accuracy of the guess row, making harvest easier and more accurate. Auto-steer with RTK accuracy addresses some of the shortcomings of traditional methods in establishing research plots. Another application of the RTK system is "tripping" of the plot planter or drill.

Keywords: GPS, RTK, Auto Steering, Crop Performance Evaluation

INTRODUCTION

One of the most important factors in crop production is selection of varieties and hybrids. Right or wrong decisions in this arena can enhance or negate all other factors. The goal of the Crop Variety Evaluation Program is to provide unbiased information to producers and seedsmen. At the University of Nebraska West Central Research and Extension Center in North Platte, Nebraska, trials are performed each year on several different crops including corn, winter wheat, soybeans, sunflowers, grain sorghum and dry edible beans. These trials are

located both at the center and in producer's fields throughout southwest and central Nebraska. Care is taken when selecting field locations for plots, with the main goal being as uniform a site as possible. Soil types, residue levels, slope, drainage and accessibility are a few of the factors that need to be considered when selecting an area for a plot. Although a completely uniform site is not possible, minimizing the effects of these factors makes for more accurate and statistically relevant data.

Another factor that comes into play is proper seeding of the plots. Plot equipment is usually much smaller than commercial equipment, for example a two row plot planter being used for row crops. A guess row exists every other row. For seeding small grain plots, a five foot drill is used. Wide or narrow guess rows can greatly affect the results of the plot, especially under rainfed conditions. A wide guess row will have more soil water and sunlight available to the rows on either side of it. Weeds may also grow in a wide guess row. Narrow guess rows make harvesting plots more difficult, especially in small grains when the row spacing is narrow to begin with.

POSSIBLE SOLUTIONS

When working in a producer's field, plot rows must match with the rest of the field to allow for cultivation, irrigation, fertilization, pesticide applications and any other field operations. One solution in row crop plots is to have the producer blank plant the plot area. The plot planter can then follow the rows without seed. One drawback to this method is waiting for the producer to plant in the field. Blank-planting also dries out the soil and can plant weed seeds, especially if a physical marker is used. If precipitation occurs after the field is blank-planted and before the plot is planted, finding the exact location of the blank-planted rows can be difficult if not impossible.

Another option is to flag each pass the plot planter or drill must make. This is done quite often in small grains research, as the plot is usually planted before the rest of the field. It is also done in rainfed row crop plots as well. A skilled operator is needed to center the tractor over the flags. This can be difficult when the wind is blowing, as is often the case, making it hard to see where the flag is rooted. Flags can also be hidden behind residue in no till situations. Conditions in no till can also make it difficult to place flags accurately, as corn and wheat residue that is present causes difficulty in stringing a tape measure precisely. All these factors can affect planting accuracy. Flagging does work well in tilled ground with a relatively calm wind.

A third option is to employ auto steer technology. At the one inch RTK level of accuracy, near perfect guess rows can be achieved.

SETTING UP AUTO STEER FOR PLOTS

A single auto steer system is used at the West Central Research and Extension Center on two tractors. One tractor is utilized with the row crop planter and another with a no-till wheat drill. Each tractor has its own hydraulic valve which controls the oil flow to the power steering rams. A dual receiver system is mounted overhead and a touchscreen computer contains the software to operate

the system. These components are moved from one tractor to the other as necessary, and are removed during equipment transport. A mobile base station is setup on site to provide corrected GPS signals. A mobile system is used as many trials are conducted at sites hundreds of miles from each other, making a subscription service unfeasible. The base station is necessary to achieve one inch (RTK) accuracy. With the mapping capabilities of the software, it is possible to return to a site and have the tractor run down the same rows, within one inch. This is possible only if the base station is located in the exact same location as when the map was made.

Setting up the system for a plot is relatively simple. For winter wheat plots, the dual receiver is placed in a bracket mounted above the tractor, and a cable is connected. The touchscreen computer is placed in a bracket near the driver's seat, and a cable connected. The base station is set up on a tripod and receives 12 volt dc electrical power from the pickup. The station is usually ready within a minute of being powered on. After getting a rough area to place the plot in the field, three flags are all that is needed to start. A right angle is made with the three flags in the lower left corner of the plot. With the tractor, two AB lines are made perpendicular to each other along either side of the right angle in the software. One line is for following when planting alleys between reps, the other for seeding the plots. Plots are 30 feet long, making the alleys 30 feet apart as well. In the software, the implement being pulled can be set to that width to first seed the alleys between replications. When finished, the AB line perpendicular to the alley line is followed to seed the individual plots. The implement width is set to 5.5 feet for these passes.

For row crop plots, the process is similar. First, select the area needed for the plot and the direction the rows are to go. Place a flag on one corner and another on the opposite corner. Set the AB line by driving the tractor directly over the two flags. When planting in a skip row pattern, the implement width must be set to account for the open space desired between the rows. If border rows are to be planted in several different passes, these can be done at the same time if the pass number is known. The planter can be set for these just once, saving time. It can also be done for different seeding populations.

GPS TRIPPING

A secondary use of the RTK system is that of "tripping" the row crop planter or small grain drill. Most row crop plot planters use utilize a check cable to trip the planter system for each new plot. This cable must first be laid out alongside the plot and lined up correctly with the ends of the plot area. Some problems can arise with using a check cable. First, the cable must be lined up for each pass with the end of the plot area (this is to ensure alleys throughout the plot line up). Stakes that hold the cable on each end can be difficult to set in the ground, and can pull out during a planting pass. The cable must also be wound up after planting is finished.

A system has been developed to utilize the corrected GPS signals from the steering system. A virtual grid is laid out, with lines existing in the center of the alley between plots. When the planter crosses a line, a trip signal is sent to the planter to start the next plot, replicating the effects of the check cable. The

system also works with the small grains drill. Previously tripping was done visually on the go. When the tractor and drill crossed a line representing the alley between plots, a switch was manually pressed to load the seed for the next plot. With the GPS system, this guesswork is removed. It also makes it much easier for the person loading seed packets to keep up and watch the operation of the drill (checking for residue plugs, seed tube detachments, etc).

CONCLUSIONS

Auto steer with RTK accuracy has made seeding and planting crop variety evaluations more efficient. Time is not spent setting out flags for each pass and windy conditions are not such a hindrance. Guess rows are near perfect, eliminating the problems associated with narrow or wide guess rows. It is also possible to plant after dark with auto steer, and is much easier to do than trying to see a blank planted row with inadequate lighting. This is sometimes necessary given weather conditions, cooperator schedules, etc. Time needed to setup the system when arriving at a site is ten minutes or less. One drawback to GPS auto steer is when the vehicle is near trees, buildings or other tall structures the GPS signal is lost. Care must be taken to not place plots too close to these potential obstructions.