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Figure 1. Four row 1tRIPr with Valmar box used at UIUC

The Crop Physiology Laboratory at University of Illinois, Urbana-Champaign has conducted experiments over the last 20 years to identify the principle factors that result in increased corn yields. The seven factors that were found to have the greatest impact on corn grain yields are weather, nitrogen, hybrid, previous crop, plant population, tillage, and growth regulators. Based on this information, an "***omission treatment***" experimental design was created to test five of the identified factors(nitrogen, other fertility, genetic traits population, and growth regulators) for their individual and cumulative effects on yield.

In 2011, scientists at UIUC added more factors (crop rotation, residue management, and reduced tillage) to the omission treatment experimental design in an effort to identify conservation practices that maintain or improve yields in high-yielding corn production systems.

Strip tillage is a relatively new reduced tillage system in the Eastern Corn Belt that protects soil from erosion, retains plant-available water longer into the growing season, maintains soil structure and retains soil organic matter, and allows banding of fertilizers for more efficient plant uptake. Because many strip tillage approaches can incorporate seedbed preparation and fertilizer application into a one-pass field operation, it substantially reduces soil compaction associated with multiple field operations for seedbed preparation. This method also minimizes residue mixing in the seedbed. Precision fertilizer applications are a stand-out portion of this tillage program and this represents cost savings as a result of big reductions in fuel, fewer hours of labor, and equipment wear associated with additional field passes.

Study Parameters:

The study was created as a split-split plot experimental design. Whole plots were Rotation (Continuous Corn or Corn-Soy) and split plots were Residue Management (Stover Retained or Stover Removed) and Tillage (Conventional Tillage or Strip Tillage). Figure 2 demonstrates one replication of the study, illustrating the quarter plot design. All treatments were replicated 4 times. A check plot with no nitrogen fertilizer application was included in the design to assess nitrogen use efficiency.

Due to the Rotation treatment, two locations are required for this study and the sites are alternated from year to year. Each year, one site is used to establish the previous crops for the following year. The 2011 study was located at a site previously planted to either 8th-year continuous corn or soybean in a 2-year corn-soybean rotation.

Stover removal, tillage, and fertilizer applications were made in spring 2011. Stover was removed during the first week of April in continuous corn split plots. Fifty percent of the corn stover was removed by flail

chopping all stover, raking into swaths, collecting and weighing it, and replacing 50% with a manure spreader and redistributing stover across the plots by hand. Strip tillage [ST] and conventional tillage[CT] (disking followed by light cultivation) occurred during the week of May 16th. MESZ fertilizer (12-40-0-10-1, N-P-K-S-Zn, Mosaic Company) was band-applied with the strip tiller or band-applied with a tool bar in conventionally tilled treatments. N was broadcast-applied by hand as either SuperU (Agrotain) or urea. The study was planted on June 4th with Syngenta hybrid (114 days). A side-dress N application of 60 lb N as urea was applied at V5 stage to the High Technology treatments. Strobilurin fungicide (trade name of Quadris or Headline are examples) was applied to select treatments at tassle. Corn grain was harvested in October.

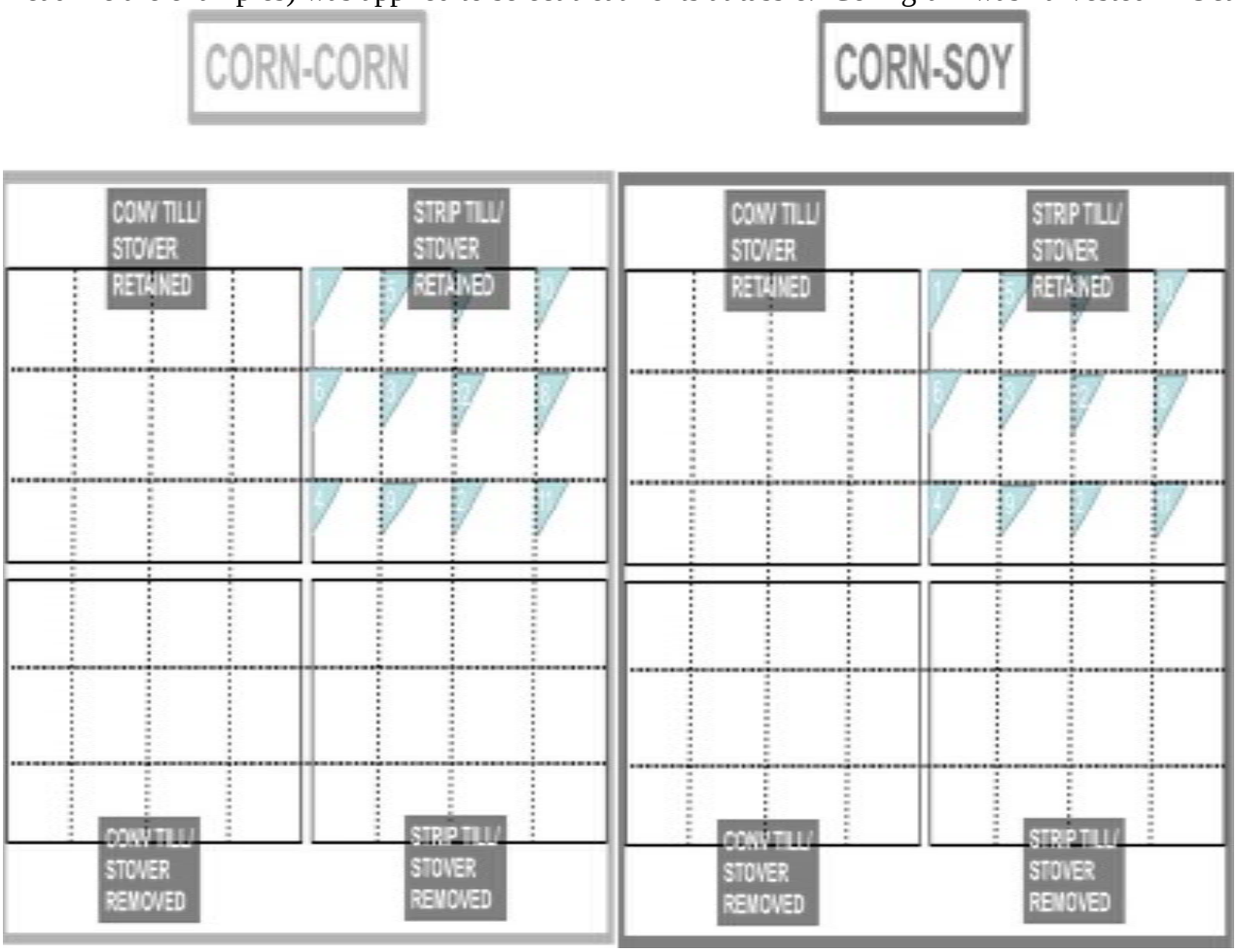

Figure 2. Experimental design of one replication of the 2011/2012 study. The 12 treatments are repeated in each quarter-plot of each rotation (corn-corn or corn-soy) plot. The four quarter-plots (conventional tillage+stover, conventional tillage-stover, strip tillage+stover, strip tillagestover) assess residue management concerns in high-yielding corn systems. The 12 split-split plot treatments are described in Table 2. A zero-N check plot (not shown) was included to assess nitrogen use efficiency.

Discussion of Results:

During the Illinois summer of 2011 corn production started off wet and with cold soils, then throughout the remainder of the summer growing season it was hot and dry. The averages for July, August, and September are normally 12.7 inches and only 6.2 inches of precipitation was recorded. The 2011 Illinois east-central region average yield for corn was 149bu/acre, as recorded by National Agricultural Statistical Service (NASS); this was also the same average yield obtained in this study for the Traditional treatment. In this study, the High Technology treatment displayed 14.1% greater yield than the Traditional treatment and the regional average. The greatest treatment effects resulted from Nitrogen fertilizer application as well as P, S & Zn; also, increasing plant population had a strong negative effect on crop yield due to the stressful weather conditions during development and grain fill. Fungicide application and corn hybrid treatments had smaller effects.

Continuous corn [CC] growers saw diminished yields across the board in Illinois compared to CS rotations, usually in the 10-25 bushel/acre range. In this study, we observed a non-significant yield increase with 50% of

the residues removed; corn yields increased to 157 bu/ac compared to 151 bu/ac with all stover left on the surface. The corn-soy [CS] rotation average yield was 182 bu/ac and the CC yield was 161bu/ac under the High Tech system. We believe that the reductions in yield are partly due to reduced N mineralization and a higher potential for N becoming immobile in the continuous corn. This bears out from previous research by the Crop Physiology Lab at U of IL-Champaign indicating that in the CC system the yield penalty is closely related to corn residues. This same penalty related to corn stover may also explain what we see in greater yields for strip-tillage in CS rotation relative to CC systems. In our studies we observed that adding N, P, S & Zn fertilizers have an overall positive effect. Banding of MESZ (a modified MAP fertilizer with added S and Zn) in both the strip-tillage and conventional till systems in the spring provides very good placement and availability of key nutrients to the corn. From the looks of this study thus far, yield response to additional fertilizer in the stover-retained treatments suggests that nutrient immobilization may be occurring as a result of the biomass left over in these systems.

Rotation was particularly important in strip-till systems as evidenced by a 15 and 36 bu/ac yield increase for strip-till between CC and CS systems for the Traditional and High Tech treatments. The effect of rotation was illustrated by the difference between strip-till and conventional tillage; strip-till yielded, on average, 27 bu/ac less than CT in the corn-soy rotation, however, ST yielded 5 bu/ac greater than CT system in the CS system under the High Tech program.

The study will be conducted again in the 2012 growing season. Monitoring of the below ground root biomass will again be conducted to help us determine if stover can be removed sustainably and, if so, will allow us to estimate sustainable stover removal levels. This study will offer information for growers in the Eastern Corn Belt which can provide more clues to tillage interaction in the corn-on-corn systems and corn-soybean rotations. The folks at Orthman Manufacturing are partners in this study and desire corn and soybean farmers to see how an integrated approach can work and has value to your, the grower's, bottom-line. We at Orthman applaud the scientists at University of Illinois in putting out information that looks at high sustainable crop production.

You can contact us at Orthman Manufacturing, Inc to get further information regarding this study.
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