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Corn population sensing for interpretation of yield-limiting factors

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Abstract
The goal of precision agriculture is to improve production efficiency by adjusting crop treatments to the localized conditions in the field. However, the full benefit of precision agriculture will only be realized if the spatial variation across the field is accurately determined, and the relationship between yield and important production-limiting factors is correctly identified.

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Crop yield maps are required for the evaluation of economic efficiency of spatial production systems and are an important closing link in the site-specific decision-making control loop. However, plant population has a significant effect on yield potential and with the exception of climatic conditions, plant population can be the predominant factor limiting crop yields. The interaction between yield and important production factors should be considered both in terms of yield per unit area and yield per plant. Therefore, the ability to map crop population provides important additional information for management decisions.

A combine-mounted corn population sensor has been developed and tested over a range of speeds (2, 3, and 5 mph) with errors of less than 5 percent in controlled plot tests, and up to 10 percent in field trials. The major cause of error is missed counts from closely spaced plants (less than 2 inches apart) and heavily lodged plants. The population sensor and a yield monitor have been used to simultaneously map corn population during harvest (Figure 1).

In preliminary tests, when population and yield data were integrated with other data layers (soil nutrients and topography) to determine possible yield-limiting factors, population accounted for more of the yield variance than all soil nutrient factors combined. In relatively short plots (600 feet), the population sensor also could be used to accurately predict yield monitor readings, based on the assumption that the total grain entering the combine was the number of plants harvested during each 1-second interval multiplied by the mean yield per plant (Figure 2). These results emphasize the significance of population on yield potential and final crop yield.

The simultaneous mapping of corn population and crop yield will be continued, to evaluate factors that affect plant stand establishment and the subsequent effect of population differences on the final yield. There is a significant body of knowledge on the relationship between mean plant population and total yield. However, there is less information on the effect of population variance on total yield. The fundamental premise of this work is that plant populations and population variance may exhibit spatial trends that could account for a significant portion of the yield variance in a field. The major difference between this work and traditional population studies is the ability to map both yield and population simultaneously,

which allows yield comparisons to be evaluated both in terms of the plant population mean and population variance.

Figure 1, below: **Maps of harvest population and crop yield developed from combine-mounted population sensor and yield monitor data collected at 1-second intervals (Missouri, 1996).**

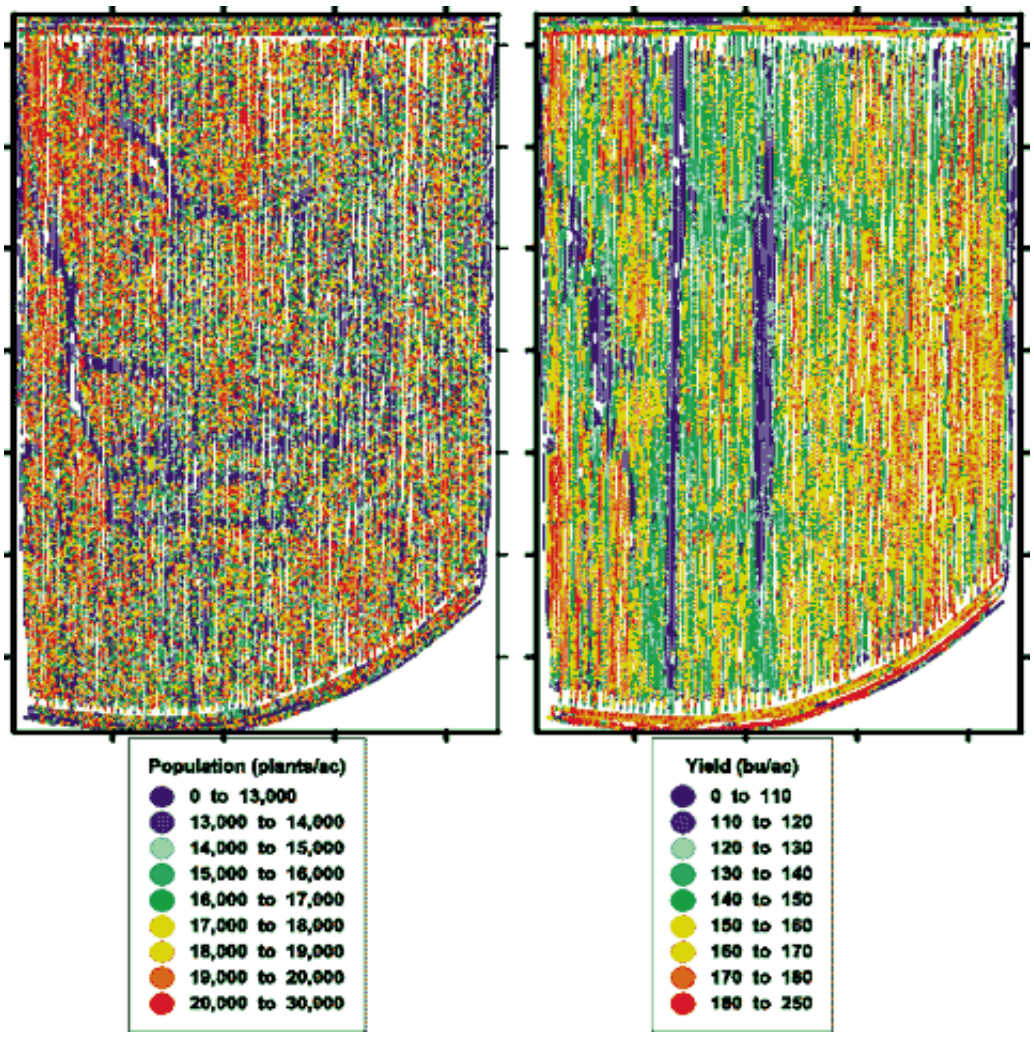
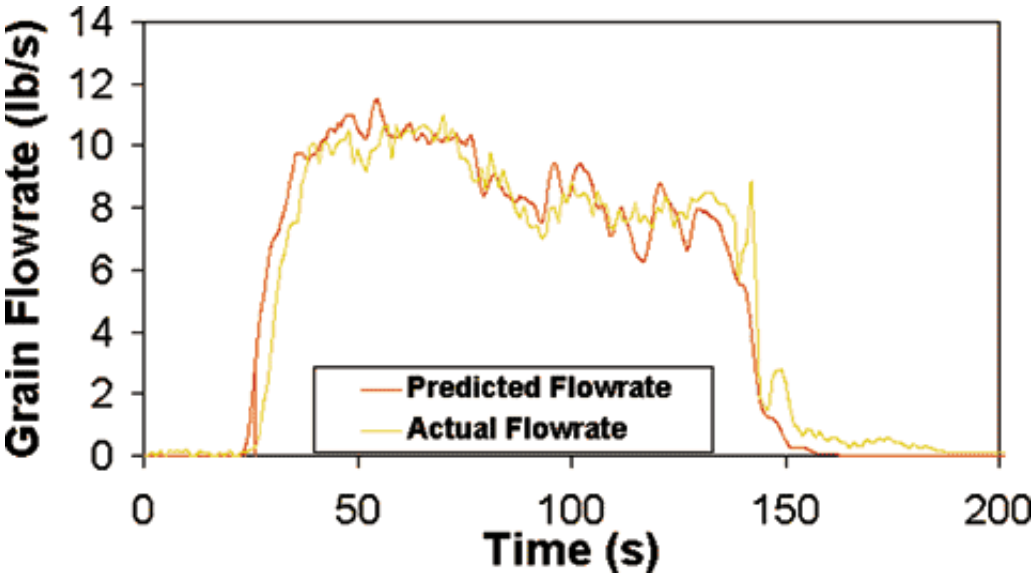


Figure 2, below: **Plot of actual measured grain flow and predicted grain flow at the yield monitor, based on the assumption that grain entering the combine head is equal to the number of plants times the mean yield per plant.**



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