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Precision agriculture in crop-livestock system in southern Brazil: use of yield maps as a guide for a site-specific management

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Introduction

Yield maps have been used in precision agriculture to site specific management in order to rationalize inputs, improved productivity and reduced environmental impact due to the better management of variability. As the crop-livestock system imposes greater complexity, due to the mobility of animals, selective grazing, trampling and dung, it is necessary to understand the spatio-temporal variability of productivity and verify its relations with economical variables.

Material and Methods

The trial is being conducted since 2008 in a crop-livestock system, using soybean during the summer (cultivated at a fixed rate of seeds and fertilizer) and ryegrass pasture in the winter. Soybean yield (dry weight) for the year 2012, 2013 and 2014 was obtained from infrared sensors productivity corrected by capacitive humidity and temperature sensors and the weighing performed at the receiving unit. Productivity surfaces, generated by interpolation (kriging), were subjected to classification by iterative minimum distance method with normalization of variables. The economic evaluation used the gross margin per productive class, average price per ton at harvest (US $ 356.74) and average cost of cultivation in the region (US $ 535.12), without considering opportunity cost of land.

Results and Conclusions

Classification using the productivity data of three years resulted in five classes (Figure 1) with different annual means and distinct temporal variability. Blue class (36 % of total area) always had good productivity. Red and orange classes (18 % of total area) always had the lowest productivities and show negative and zero gross margin respectively, while other classes were positive. Green class labeled as intermediate productivity, was affected by the effect of water restriction in 2012, resembling the most productive class in the following years, under better precipitation. The yellow class with poor performance in the first two years, similar to orange class, exceeded all yield classes in 2013, coinciding with the largest rainfall occurred in the grain filling in three years. Average productivity and gross margin were 1.93 tons and US$ 153.15 per hectare. The average return on disbursed capital was 22%, ranging from -53% to 33%. Improve productivity of classes below average for amounts equal to average imply in profitability rise to 27% representing an additional income of US$ 40.00 per hectare. Relationships between yield zones and climatic variations among years and economical impacts must be considered to build site-specific robust models.

Fig. 1. Soybean yield zones and temporal variation among three years