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Moving from average to maximum soybean yields - what will it take?

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The reported soybean yields from the contest winners are more than double, compared to the average soybean production in the US (3.3 Mg/ha). Understanding the reasons behind this gap is very important but difficult. Soybean yield is the final product of many interactive processes within the soil-crop-atmosphere system that are influenced by management and genetics. In this study, we used the APSIM model (Agricultural Production Systems sIMulator) to simulate the growth and productivity of soybeans in high and average yielding environments in an effort to understand and quantify the reasons behind high yield. The APSIM model simulates many soil processes in addition to crop processes, which allowed a systems level analysis. Starting with a typical management system (35 plants/m^2, 76 cm row spacing, typical maturity and planting date per region) we adjusted management factors such as row spacing, added manure, and irrigation practices. We added or adjusted one management practice at a time in order to quantify yield increases by management practice. Irrigation had a substantial impact on yield increase by eliminating water stress and by cooling off high canopy temperatures which resulted in higher crop growth rates and therefore yields. Manure application provided all the necessary micro and macronutrients to maintain high photosynthetic capacity throughout the growing season but minimized the production of N-fixation, an energy expensive plant process. The narrow row spacing resulted in much higher light interception (+13%) with positive effects on grain yield. In conclusion, our model analysis indicated that higher than average grain yields will result from greater biomass production. A combination of practices will be required to move from average to high soybean yields but, most importantly, we have to manage for maximum light interception, green and healthy canopies throughout the season, and non-limiting P, K, and other micronutrients in the soil.