7. PARALLEL SESSION 8.1 – LOW INPUT AND ORGANIC FARMING

PS-8.1-01

Agronomic and Economic Performance of Maize, Soybean, and Wheat in Conventional and Organic Cropping Systems During the Transition to Organic Production

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Abstract: More growers contemplate transitioning from conventional to organic cropping systems. The USDA requires a 36-month period prohibiting use of GMOs, pesticides, etc. before certifying the land as organic. Growers must thus grow maize, soybean, and wheat during the transition with lower yield, higher cost, and no price premium. Identification of the best crop rotation is critical for profitability during the transition.

The experimental design is a split-split plot with cropping systems (conventional and organic) as whole plots, rotations (red clover-maize-soybean; soybean-wheat/red clover-maize; and maize-soybean-maize) as sub-plots, and management (recommended and high inputs) as sub-subplots.

We planted treated (fungicide and insecticide) GMO maize, soybean and wheat (non-GMO) varieties at recommended and high seeding rates; applied synthetic N at recommended and high rates to maize and wheat; applied herbicide for weed control; and applied a fungicide to the high input treatment in conventional. In organic, we planted maize and soybean isolines and the same wheat variety at the same seeding and N rates (maize and wheat), and cultivated maize and soybean for weed control.

We calculated partial returns using variable (seed, fertilizer, herbicide, fungicide, labor, repair/maintenance, fuel/lubricant, hauling) and fixed (tractor/equipment) costs. We used conventional prices to estimate revenue for 2015 and 2016.

Organic compared to conventional maize yielded 32% lower as an entry crop, similar in the 2nd year (red clover-maize), but 6% higher in the 3rd year (soybean-wheat/red clover-maize) when organic crops are eligible for the organic premium. Yield correlated with grain N% (r=0.81, n=48), weed (r=-0.78), and crop densities (r=0.42) in 2015, crop densities (r=0.46) in 2016, and grain N% (r=0.68, n=84)) and crop densities (r=0.42) in 2017.

Organic compared to conventional soybean yielded similarly as an entry crop and in the 2nd year (maize-soybean), but 8% lower in the 3rd year (red clover-maize-soybean). Yield correlated with weed (r=- 0.36) and crop densities (r=0.31) only in 2015. Organic compared with conventional wheat yielded 7% lower in the 2nd year (soybean-wheat). The organic red clover-maize rotation with recommended inputs had similar partial returns ($434/ha) as the conventional rotation ($379/ha). Most conventional growers, however, would continue a maize-soybean rotation with high inputs ($1568/ha), indicating a significant profit loss during the transition with this rotation. The organic compared with the conventional soybean-wheat rotation with recommended inputs compared more favorably ($229/ha lower partial returns). Furthermore, the subsequent organic compared with conventional maize crop in 2017, when maize is eligible for an organic premium, had 6% higher yield, lower production costs, and a 2.5x selling price. Greater partial returns for organic maize in 2017 would more than offset economic losses during the transition year.

PS-8.1-02

Yield Variability in Organic Versus Conventional Systems : a Meta-Analysis for Horticultural Systems

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Abstract: Organic agriculture has the potential to reduce the impacts of agriculture on humans and ecosystems but its productivity compared to conventional agriculture remains a contentious issue. Previous meta-analyses have shown that yields in organic systems are 10 to 25 % lower compared with conventional systems. However, those meta-analysis estimated the average yield gap of organic versus conventional farming systems but did not consider yields spatio-temporal variability. Although it is a major concern for farmers and food chains, only few studies analysed the relative variability of organic systems compared to conventional ones. Two contrary hypotheses exist in the literature. On the one hand, because of its reliance on biological and ecological processes, organic production can be assumed to be more vulnerable to pests and diseases outbreaks. On the other hand, organic farming systems are known to have a greater structural diversity and to optimize nutrient cycling and biological pest regulation, which may hence induce a higher resilience of the system and yields.

Here we focus on horticulture crops (fruits and vegetables) and make progress by estimating the variability of organic to conventional yield ratio across experiments and across years for a series of horticultural species from a meta-analysis of published field experiments. We define horticulture as production systems based on vegetables and/or fruit production, both in fields, market gardens or orchards. We analyse a dataset including the results of 52 papers reporting yield data for 37 horticultural species in 17 countries.

We find that yields in organic horticulture are on average 10 to 32 % lower than those in conventional horticulture. The variance of yields was not significantly different between organic and conventional systems, hence we find no evidence of a larger inter annual variability in organic versus conventional horticulture. However, the coefficient of variation is significantly higher for organic yields vs. conventional ones reflecting the yield gap between these systems.

We find no significant effect on yield ratios of type of crop, type of product nor type of climate. However, data on tropical zones were scarce.

As a conclusion, despite lower yields, productivity of organic systems is not more instable that productivity of conventional ones, an important result for farmers and future development of organic horticulture.

Keywords: Meta-analysis, organic farming, organic agriculture, horticulture, vegetable, fruit, yield ratio, yield variability

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