This demonstration project addressed two questions:
• Corn planted late in the growing season requires irrigation, but does irrigation water pumped from commercial channel catfish ponds contain enough nutrients to benefit corn production?
• Does the volume of replacement groundwater improve water quality or increase catfish production in a pond used for irrigation compared to a static pond?

Ponderosa Farms is located near Murray, in western Kentucky and produces corn, soybeans, wheat and channel catfish. In three fields with poorly drained soils that were not well suited for grain production, nine levee-type commercial catfish ponds were constructed, ranging from 1.6 to 2.0 ha. Each location contains three ponds that are filled with water from a 50-m deep well with a pumping capacity of 2.3 m³/min. Each pond is equipped with an electric, 10-hp, paddlewheel aerator.

During summer, one pond in each location is used to supply water for crop irrigation. A water pumping truck equipped with an irrigation pump with a 15-cm intake and a 7.6-cm discharge capacity was connected to a field irrigation system. The pump trailer is powered by a truck-mounted 99-hp, 4-cylinder diesel engine that provided power to the irrigation pump and a 480 V, 3-phase electric generator that supplied electricity to center pivot field irrigation systems. The portable pumping station was constructed to reduce water pumping cost and increase pumping efficiency by locating the source of irrigation water closer to crop fields. Otherwise, irrigation water would have to be pumped to fields located far from the well.

Late-summer corn was planted in the stubble of a harvested winter wheat crop in mid-June 2014. Irrigation water was pumped from a 1.7-ha commercial channel catfish pond and applied to 13.9 ha of an 18.7-ha field of yellow corn. A 247-m center-pivot irrigation system equipped with a terminal spray gun delivered pond water during seven watering trips between early July and mid-September. The system was calibrated to deliver 1.5 cm of water per ha of corn, or about 2,100 m³ per field application. One water application was estimated to be equivalent to approximately 8 percent of the catfish irrigation pond volume. Replacement water was pumped a short distance to the catfish irrigation pond from a nearby well. A 1.64-ha catfish pond located next to the irrigation pond was used as a comparison.

Weekly water samples were taken from both ponds during 11 weeks of irrigation. Comparisons were made between the irrigation and control pond to evaluate differences in water quality that may affect fish production and to estimate the amount of nutrients supplied to corn from pond water. Irrigation water suitability analyses were performed by a commercial agricultural laboratory. Rainfall was 17.8 cm between corn planting in mid-June and harvest in late October 2014. Ammonium nitrate (34-0-0) fertilizer was applied to emergent corn by spreader truck at 564 kg/ha in early July.

Both ponds were stocked with 14,800 channel catfish per ha and were harvested and restocked in a multiple batch production system. Catfish were fed a floating, 28-percent protein, commercial catfish feed at 84 kg/ha per day. Dissolved oxygen concentration was monitored daily and nighttime aeration was provided when dissolved oxygen concentration fell below 3 mg/L.

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RESULTS

Irrigation suitability test means were compared for the irrigation and control pond water parameters listed in Table 1. A two-tailed, Student’s t-test (P<0.05) was used to determine significant difference between parameter means.

Potassium and magnesium were more concentrated in catfish pond water than in the irrigation pond. Potassium was categorized as normal for irrigation purposes with concentrations of 5-20 mg/L, and magnesium concentrations were low (< 10 mg/L). Sodium concentration was greater in the irrigation pond as was Sodium Absorption Ratio (SAR), but both were evaluated at low concentrations of < 60 mg/L and < 3 mg/L, respectively. Water with an elevated SAR (>8.0 mg/L) displaces calcium and magnesium in soil and is less suitable for irrigation. Total ammonia nitrogen (TAN) and nitrite was tested weekly with a portable water quality test kit. TAN ranged from 0.5-1.6 mg/L and nitrite concentrations were 0-0.23 mg/L in both ponds.

Irrigation provided water essential to corn production during periods with little rainfall. During each irrigation trip, small amounts of nitrogen (754 g/ha), phosphorus (42 g/ha) and potassium (1.24 kg/ha) were delivered to the corn. Yellow corn was harvested during late October, 2014. Corn production for the 13.9 ha irrigated field was 8,047 bushels with an average yield of 579 bushels per ha. The corn crop likely benefitted little from the small amount of nutrients provided by catfish pond water.

Catfish were harvested from both ponds at 0.68-1.82 kg/fish and were sold to fee-fishing operations. No fish mortality or disease was observed in either pond during the project. During the July to mid-September irrigation period, 4,672 kg of catfish were harvested from the irrigation pond and 6,539 kg from the catfish pond. Total catfish harvested from March through September 2014 was 10,954 kg for the irrigation pond and 9,895 kg for the catfish pond. The difference in harvest yield (1,059 kg) between the irrigation and catfish only pond was likely the result of varied seining effort between the ponds and not the water exchange rate. Differences in water quality between the two ponds were slight, indicating that the small volume of well water added to replenish the irrigation pond had minimal effect on fish production.

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