EFFECT OF SYSTEM CAPACITY AND NOZZLE TYPE ON CORN PRODUCTION

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INTRODUCTION

In an earlier presentation, it was stated that not one sprinkler system is suited for all conditions. This important fact can not be over emphasized. In my discussions with irrigators, I always like to point out that **the options for a irrigator with a low capacity well are much different than for an irrigator with a less marginal well.** In the bleakest cases, the farmer with the low capacity well may only have two options, a return to nonirrigated conditions or the adoption of a highly efficient irrigation system while planning for yield reductions due to deficit irrigation. In contrast, the irrigator with the less marginal well may be able to obtain top crop yields using any one of several different sprinkler packages. **Of course in today's ecological and social climate where the Ogallala aquifer is being depleted and the urban population is becoming increasingly distressed by high agricultural water use, it becomes imperative that all irrigators use water efficiently. The main goal in irrigation is to produce crop yields that will return a profit. Unfortunately, there are times when efficient water use and profit conflict. A proper balance must be struck for irrigation to continue.** The problem an irrigator must face is how can I get the most *"bang for my buck"* in irrigation efficiency improvements. Is it in hardware or in management? Once again the answer for John Doe is probably not appropriate for James Smith. In my topic today, I will discuss the results from a 1991 study at Colby comparing spray nozzle types under various irrigation capacities for corn production. However, first let's revisit a study comparing impact sprinklers and spray nozzles conducted at Colby during 1983-1986.

A REVISIT OF AN EARLIER SPRINKLER COMPARISON STUDY

The project was initiated in 1983 at the KSU Northwest Research-Extension Center on a Keith silt loam soil with land slope of less than 0.5%. A 3-tower, 12.3 acre, high pressure (60 psi) center pivot system was converted to include both a high pressure impact system and a low pressure (20 psi) spray nozzle system. The spray system was equipped with drops, leaving the nozzles approximately 7 ft. above the soil surface. The nozzle was within the corn canopy after tasseling.

In the study, corn production was compared under four different tillage systems (Conventional chisel in fall followed by spring disking, Conventional plus corrugation at corn layby, Convention plus furrow dams at corn layby, and No tillage) for both impact and spray nozzles. Irrigation amounts were the same for each sprinkler package at 1.5 inches/event and the system capacity simulated a 575 gpm center pivot covering 125 acres.

The results from the study indicate controlling runoff is a key area in optimum management of center pivot systems. In general higher yields were obtained with the spray nozzle system as long as runoff was controlled by surface modification or residue management (Figure 1). However, in the absence of runoff control the impact sprinkler was much better. This was particularly evident in 1983, when secondary tillage was critical in attaining high yields under the low pressure spray system. Conventional yields of only 140 bu/acre as compared to 176 bu/acre for the furrow dam treatment were obtained under the spray nozzle system in 1983. **Furrow damming has increased yields by an average of 3 to 12 bu./acre for the impact and spray systems, respectively** (Figure 1).

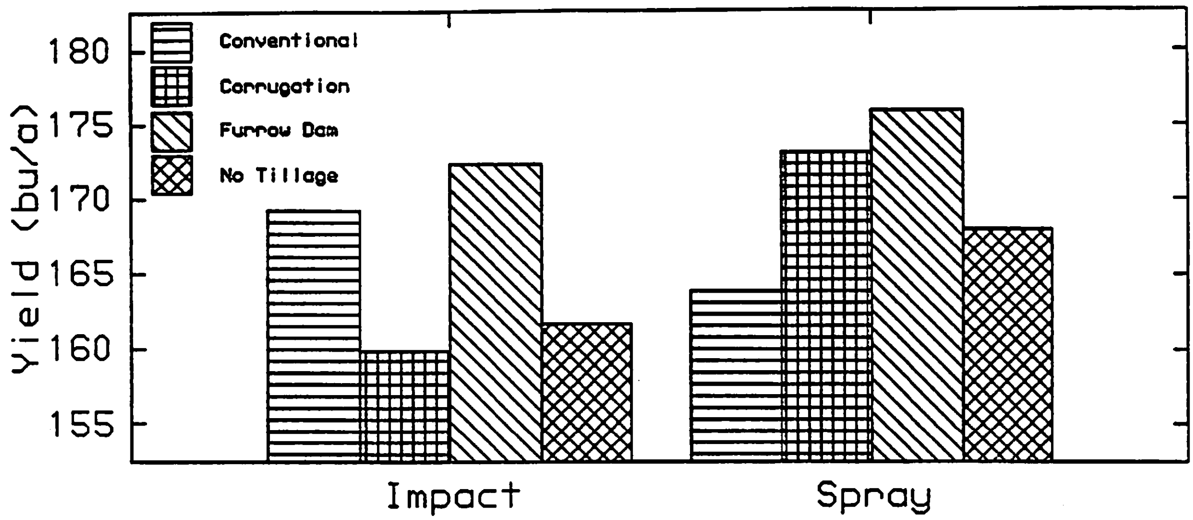

Figure 1. Corn grain yields as affected by irrigation system and tillage management. Colby, Kansas, 1983-1986.

SPRAY NOZZLE COMPARISON UNDER VARIOUS CAPACITIES

This project was initiated in 1991 at the KSU Northwest Research-Extension Center using the same center pivot system from the earlier study. Modifications were made to the center pivot so that any one of the following three sprinkler packages could be compared, **spray nozzles at truss height (14 ft), spray nozzles below the truss rod (7 ft) and LEPA nozzles operated in the bubble mode at 2 ft.** Irrigation amounts were the same for each sprinkler package at 1 inch/event. Runoff was not considered to be a factor or variable in the experiment because each plot area was corrugated and furrow dams were constructed. The corn was planted circularly to also restrict runoff. In addition ridging between plot areas also restricted runoff. **Irrigation capacities were restricted to 1 inch/4 days, 1 inch/6 days, 1 inch/8 days, or 1 inch/10 days. This corresponds to full size 126 acre center pivot capacities of 600, 450, 300, and 240 gpm. Irrigation was scheduled by a climatic-based water budget. In five cases this allowed the 4 day frequency to be shifted to a later date. A** 90-day irrigation season was used beginning not sooner than June 10th, nor later than September 8th. Irrigation events were alternated between day and night throughout the season to simulate actual field conditions. Evaporation losses are often reduced at night.

Timely precipitation allowed for delaying the irrigation season to June 27. Precipitation during the remainder of the season allowed for the shifting of 5 of the four-day frequency events to a later date. **However, the calculated water budgets for the remaining 6, 8 and 10-day frequencies allowed for no delays in irrigation. The 8 and 10 day frequencies in particular fell further and further behind as irrigation did not replenish the soil root zone.** Overall irrigation amounts were 15, 13, 9 and 8 inches for the 1 inch/4 days, 1 inch/6 days, 1 inch/8 days, and 1 inch/10 days irrigation capacities respectively.

Corn yields were reduced by spider mites, despite two timely aerial applications of insecticides. The south half of the field had a worse infestation and yields were also lower in this area. **Highest yields (192 bu/acre) were obtained by the spray nozzle below the truss rod (7 ft) at irrigation capacities of 1 inch/4 days or 1 inch/6 days. At these capacities, yields were appreciably lower (137 and 125 bu/acre) for the LEPA nozzles in the bubble mode at the 2 ft height** (Figure 2.) It is unknown why yields were lowered so much by the LEPA bubble mode. A visual field observation late in the season seemed to suggest the possibility of increased spider mites in the LEPA plots. However, an evaluation of the plots for spider mites by entomologists on September 6, 1991 did not confirm or deny this hypotheses. Another possibility may have been runoff occurring in the LEPA plots. However, this was not observed. **At the lowest capacities, 1 inch/8 days or 1 inch/10 days, there was some mixed indications that LEPA in the bubble mode was as good or better than the other two spray nozzle placements** (Figure 2).

Overall average yields were 167, 167, 137, and 127 bu/acre for the 1 inch/4 days, 1 inch/6 days, 1 inch/8 days, and 1 inch/10 days irrigation capacities respectively. Due to the spider mite problem, one should use caution in extending the results of this 1-year study to future years. However, the results do indicate there is likely to be an interaction between irrigation capacity and sprinkler package. Once again, *there should not be a <u>one-size-fits-all</u> approach to sprinkler irrigation.*

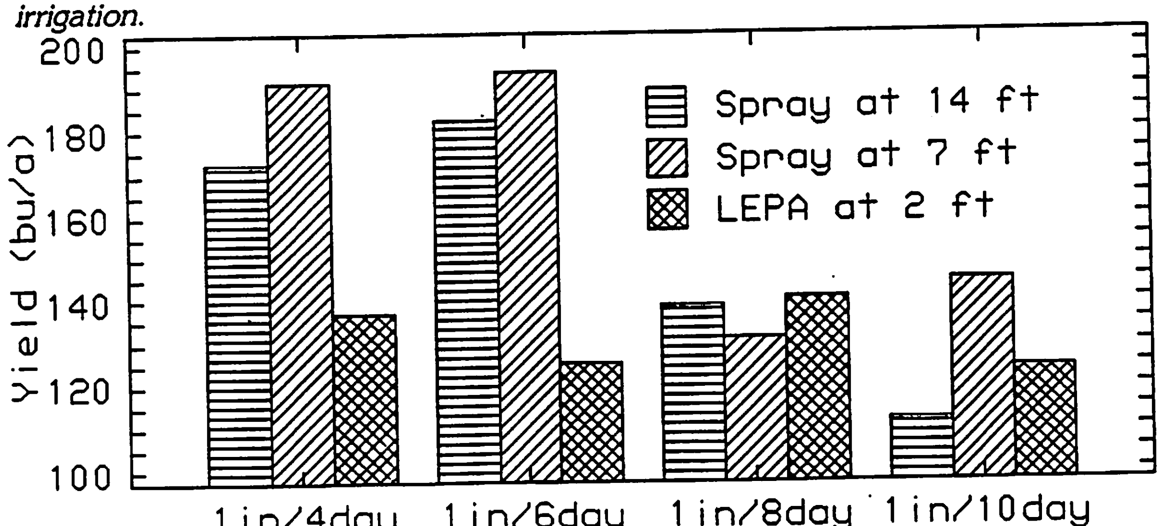

Figure 2. Corn grain yields as affected by irrigation capacity and spray nozzle package, Colby, Kansas, 1991.