CROP ROTATION OR CONTINUOUS CORN? AGRONOMIC CONSIDERATIONS

Joe Lauer and Trent Stanger [1]

Crop rotation is a universal management practice that has been recognized and exploited for centuries and is a proven process that increases crop yields (Bhowmik and Doll, 1982; Fahad et al., 1982; Baird and Benard, 1984; Dabney et al., 1988; Peterson and Varvel, 1989). Biennial rotation of two summer crops often improves the yield of both crops. In the Midwestern U.S., a biennial rotation of corn (*Zea mays* L.) and soybean [*Glycine max* (L.) Merr.] produced significant increases in the yields of both crops (Crookston and Kurle, 1989; Meese et al., 1991). Crookston et al. (1988) concluded that the rotation effect is not due to some lingering positive effect of the previous crop. Rather, a rotated crop apparently serves to relieve the negative effect of continuous cropping, and does not make any positive, growth-regulatory contribution to the yield of a following crop. This paper summarizes some of the recent crop rotation data collected in Wisconsin.

Historical Perspective

Before the 1950s, farmers acknowledged the importance of rotation because of few options for fertility and pest management. During the 1950s and 1960s, the practice of corn and soybean monoculture became popular when it appeared that chemical fertilizers and pesticides could be used as a substitute for rotation (Crookston et al., 1991). Agricultural productivity gains since the 1950s resulted from the development of farming systems that relied heavily on external inputs of energy and chemicals to replace management and on-farm resources (Oberle, 1994).

In a 1964 article entitled "Are Crop Rotations Out Of Date?" Aldrich, a soil scientist from the University of Illinois, concluded that chemical fertilizers, herbicides, and insecticides could be used as a substitute for rotation. He also reported that on some soils continuous corn could be maintained at 95 to 100% of the yield of corn in rotation. In a 1985 report, Benson stated that the attitude of many crop scientists during the 1950s and 1960s was that "continuous corn yields just as well, if not better than rotated corn."

Research evidence then began mounting in the 1970s, which indicated that in spite of all the management inputs a farmer might impose, there was still a yield advantage to be obtained from rotations (Crookston, 1984). These studies showed that the corn yields are usually higher when the crop is rotated with some other crop rather than grown continuously (Hicks and Peterson, 1981; Langer and Randall, 1981; Robinson, 1966; Sundquist et al., 1982). University of Minnesota reported the yield advantage to corn from rotating with some other crop to be at least 10%. In addition, their research suggests that soybean yields are also improved by 10% when the crop is rotated out of a continuous pattern (Crookston, 1984).

More recent research has shown this increase to be even greater than expected with responses up to 19% (Figure 1). Porter et al. (1997b) showed corn and soybean grown in annual rotation yielded 13% and 10% more, respectively, than when grown as a continuous crop. However, the yield increase for first year corn and soybean following 5 years of the other crop was 15 and 18% more, respectively, than under continuous cropping. They found that the average reported yield decrease from continuous cropping was 10 to 15%. Crookston et al. (1988) obtained an average 26% decrease in their study. If the corn acreage that is cropped continuously in the U.S. could be spared such yield reductions, the impact on total corn production would be substantial.

[1] Agronomist and Graduate Student, Dept. of Agronomy, Univ. of Wisconsin-Madison, 1575 Linden Dr., Madison, WI 53706.

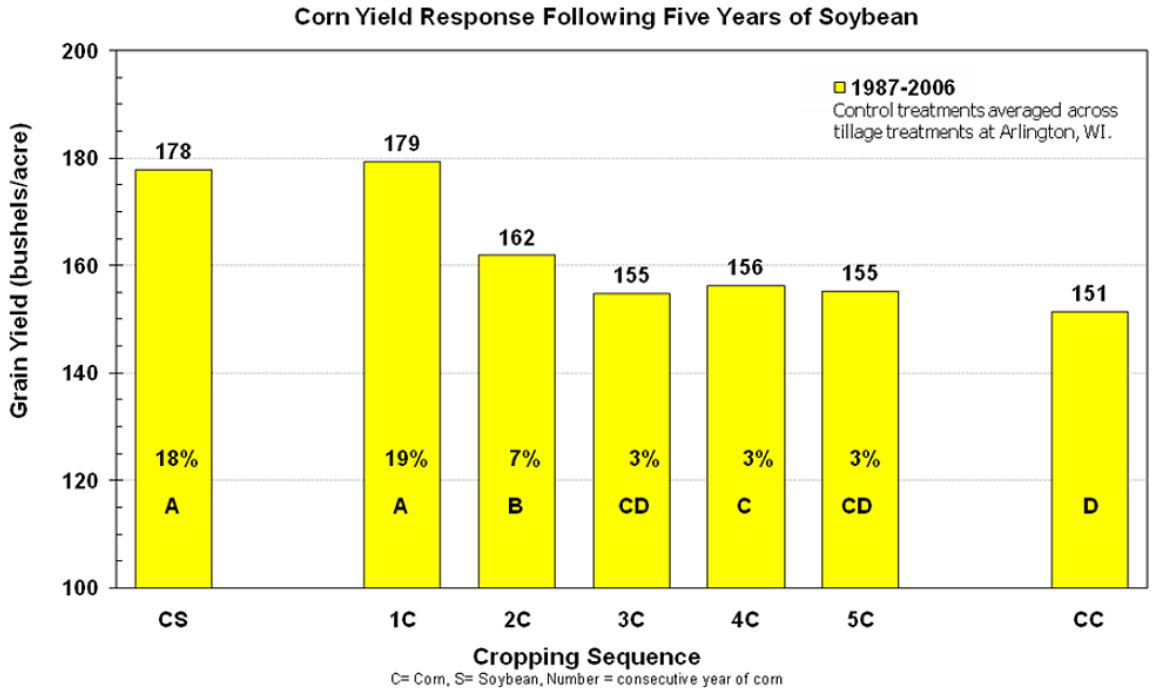

Figure 1. Corn yield response to rotation following 5 years of soybean during 1987 to 2006 at Arlington, WI. Letters indicate statistical differences at $P \leq 0.05$. Percentage values indicate relative differences compared to continuous corn.

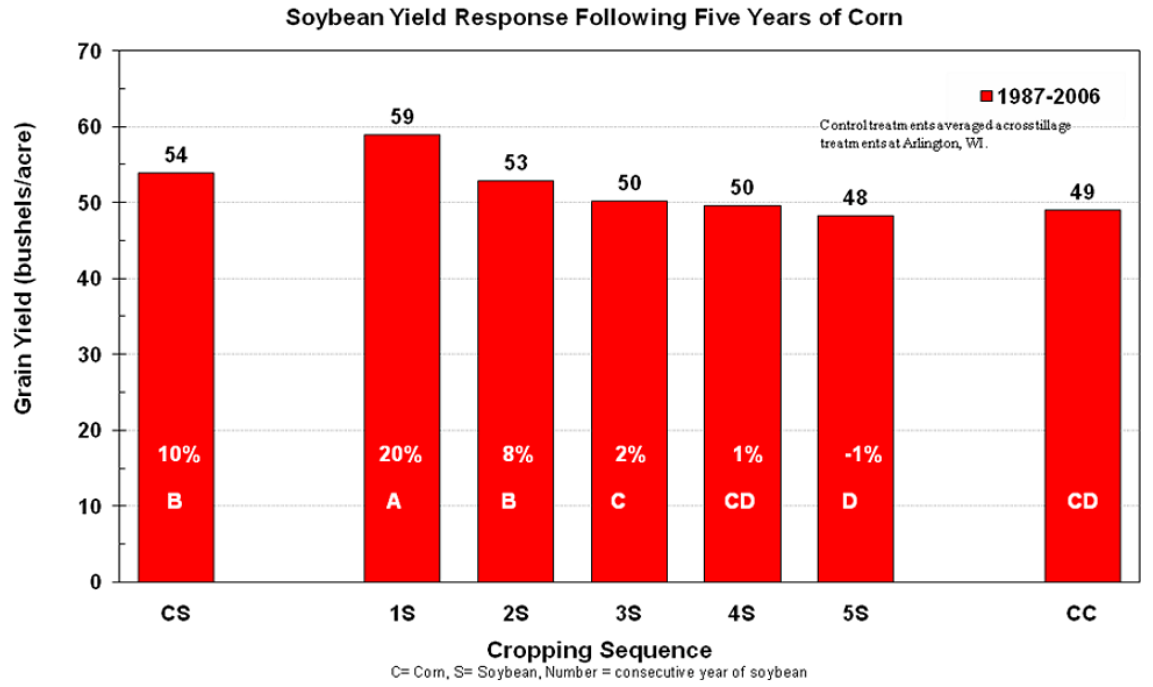

Figure 2. Soybean yield response to rotation following 5 years of soybean during 1987 to 2006 at Arlington, WI. Letters indicate statistical differences at $P \leq 0.05$. Percentage values indicate relative differences compared to continuous soybean.

Similar responses are observed with soybean responses to rotation (Figure 2). Soybean (10%) in a corn-soybean rotation responds less than corn (18%) in a corn-soybean rotation compared to continuous corn. By the third year of continuous cropping, yield levels are similar to continuous cropping for 20+ years (Figures 1 and 2).

The length of the break from the previous crop is important for first and second year corn (Figure 1 and 3). If the break is 1 year the rotation response of first year corn is less than longer breaks of 5 years. No response is measured in the second year when there is only one break year compared to continuous corn (Figure 3).

Compared with monoculture, grain yields were improved when corn was grown in a 2-year rotation with wheat (Triticum aestivum L.) and over an 11-year period, at optimum N rates, average corn yields were 14% higher for corn alternated with wheat than for continuous corn (Randall et al., 1985). Under conditions of limited fertility, Robinson (1966) found that corn yields were significantly improved in 1 of 3 years when rotated with grain sorghum [Sorghum bicolor (L.) Moench].

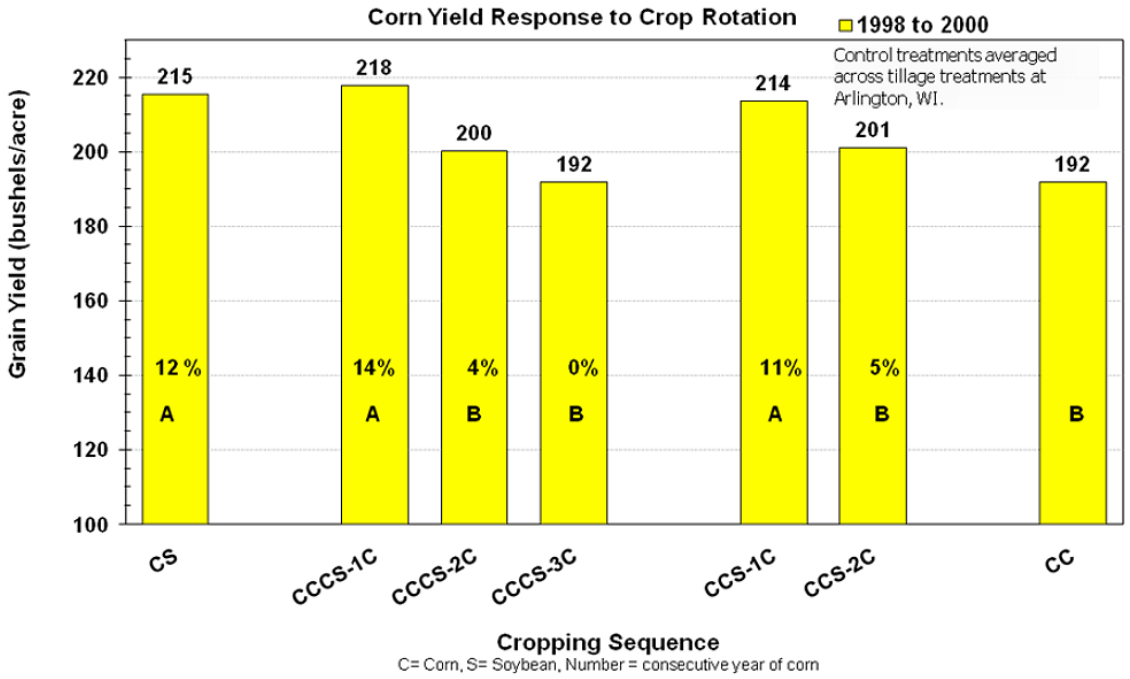

Figure 3. Corn yield response to various rotations during 1998 to 2000 at Arlington, WI. Letters indicate statistical differences at $P \leq 0.05$. Percentage values indicate relative differences compared to continuous corn.

At Arlington, less corn yield response is measured when wheat is added to the cropping system (Figure 4). Wheat appears to be much more important for soybean in a corn-soybean-wheat rotation.

It should be emphasized that even though scientists cannot yet satisfactorily explain the rotation effect, farmers can exploit it every year. It is interesting that the age-old practice of rotating crops, which was, for a while, considered unnecessary, has returned to today's agriculture with proven benefits.

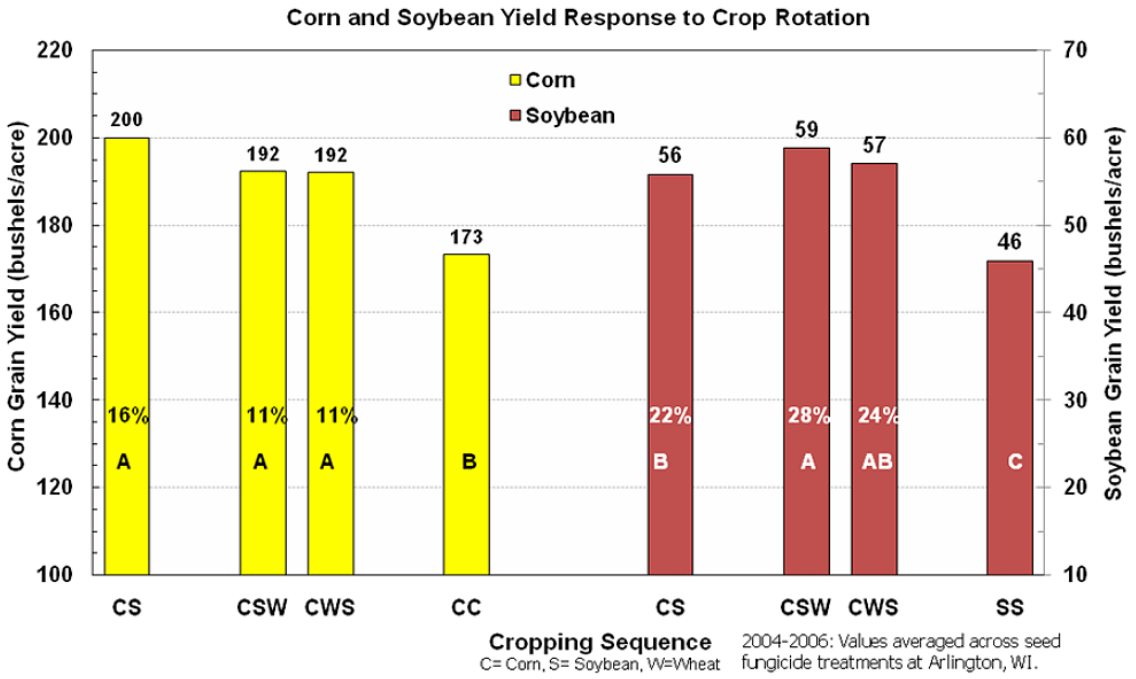

Figure 4. Corn and soybean yield response to various rotations during 2004 to 2006 at Arlington, WI. Letters indicate statistical differences at $P \leq 0.05$. Percentage values indicate relative differences compared to continuous corn or soybean.

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