Supporting Leopold Center research through on-farm trials and demonstrations

Background
This project addresses sustainable agriculture’s need for farmers who (1) can develop the skills to conduct research trials (some replicated) of various innovative practices, and (2) who are also willing to demonstrate practices and share results. In conjunction with university scientists, Practical Farmers of Iowa (a private, nonprofit, educational organization) has developed a procedure for generating statistically reliable information on working farms. From 1987 to 1993, they conducted approximately 340 trials. The scientists benefited from having data collected at multiple sites with particular soil characteristics, or where specific management abilities are employed (sustainable agriculture technologies frequently depend on superior management).

In turn, the scientists’ involvement enhanced the usefulness of the on-farm trials. Technologies such as intensive rotational grazing, starter fertilizers, fertilizer placement, tillage systems, cover crops, narrow strip intercropping, and nitrogen, manure, and weed management have all undergone study and refinement in this project.

Various surveys have shown that farmers base decisions on experience, scientific information, and face-to-face interaction with peers. Thus, this project was designed to (1) develop information on sustainable agricultural practices, and (2) disseminate this information to other farmers.

To develop information on sustainable agriculture practices, PFI collaborated with three Leopold Center issue teams: Cropping Systems (see p. 14), Manure Management (see p. 35), and Animal Management—intensive grazing (see p. 8). The project provided the teams with additional management and research sites and data. The project disseminated information via field days, personal communication, and newsletters. Profitability and conservation were emphasized equally.

Approach and methods
An on-farm coordinator (D. Exner) facilitated interaction between PFI cooperators and university scientists.

The Cropping Systems team benefited from six additional sites provided in this project. Because the sites varied in location, soils, and management options, they provided a broader base for data collection. Cooperators also conducted comparisons between their narrow strip intercropping (NSI) sites and conventional crop fields (via “field blocks”). Because the primary strength of the NSI system lies in the “border effect” (the higher yields resulting from extra sunlight on the outside rows of taller crops in the system), the strip rows were harvested individually in 1993 so this effect could be analyzed. Use of Iowa State University Extension Crop Enterprise Records (CER) allowed investigators to evaluate the economics of NSI in comparison to traditional crop production.

In work with the Manure Management team, PFI has conducted several replicated trials each year to compare livestock manure to purchased fertilizer. In addition, many PFI cooperators utilize manure in their farming operations. The team analyzed the economics of manure use; PFI assisted by providing sites and collecting data. The analysis depends on accurate records of time requirements for manure handling, the equipment used, application rates, nutrient analyses, and crop response.

Principal investigator
Derrick N. Exner
Iowa State University Extension/Practical Farmers of Iowa

Co-investigator
Richard L. Thompson
Practical Farmers of Iowa

Budget
$17,968 for year one
$18,336 for year two
PFI collected these data on ten farms in 1992 and four farms in 1993. Additionally, PFI annually conducted three replicated trials demonstrating the relative value of livestock manure and purchased fertilizer.

The Leopold Center’s Animal Management team has identified intensive grazing as a priority research topic. In 1991, nine PFI cooperators conducted demonstrations of the practice. Some of these farmers had used intensive grazing for as long as ten years. In this project, PFI conducted six trials of intensive rotational grazing in 1992 and five trials in 1993. On-farm evaluations of livestock practices are hampered by the difficulty of achieving comparison treatments and replications in working operations. To derive reliable data from these grazing trials, PFI cooperators used the ISU Beef Cow Business Record system (BCBR). This format is used by farmers across the state, so it provides a common evaluation tool and an established baseline for comparing these systems to other kinds of operations.

Findings from specific trials

Manure management trials: Manure field trials during the 1992 trials dealt with economics, timing, placement, comparisons with other fertilizers, and manure’s effect on soybeans. On an Audubon farm, 3,300 gallons of liquid hog manure were applied to soybeans at planting time. There was no significant yield response, even though the field had tested low in potassium. An Aurora cooperator sidedressed 2,500 gallons of hog manure on corn. There was no significant yield difference in 1992 over strips that received purchased nitrogen (N) fertilizer. In some years, manure has significantly raised yields in trials at this farm, and leaf testing has tied this effect to low potassium on this farm. The 1992 results showed a $1.51 per acre gain for the manure treatment when a $14 phosphorus and potassium fertilizer benefit to the field (a benefit that resulted from the manure) was included.

A second Alta Vista cooperator compared (1) manure at planting, (2) starter plus manure sidedress, and (3) manure sidedress alone. The starter-plus-manure yielded best, followed by manure at planting, followed by the sidedress treatment. For comparison purposes, the sidedress treatment was based at $0. In relative terms, starter-plus-manure produced a return of $58.37 per acre, and the manure at planting treatment produced a return of $55.07 per acre. These differences were credited to placement; the manure was between the rows and relatively unavailable to the crop.

A Harlan cooperator compared (1) manure at planting followed by sidedressed 28% N, (2) sidedressed N only, and (3) starter fertilizer followed by sidedressed N. The rates of 28% N were adjusted so amounts of crop-available N would be equal in all three treatments. The manure treatment yielded significantly better than the sidedress-only treatment. Yielding least was the starter-plus-sidedress treatment. The cooperator believed that the 17 gallons of 9-18-9 (nitrogen-phosphorus-potassium or N-P-K) starter fertilizer was too close to the seed, reducing the crop stand in 1992’s dry planting conditions.

In the 1993 trials, two cooperators continued manure trials from previous years. The Audubon farmer wanted to demonstrate that livestock manure is an asset to farm operation. Manured field strips there averaged 21.4 bushels per acre more corn than strips with no fertilizer input, which easily justified the cost of proper application.

The Aurora cooperator compared manure to 28% N solution. Corn sidedressed with manure yielded as well as corn receiving the N solution. Economically, purchased N was less expensive—until other manure nutrients were taken into account. Those other nutrients were needed on this farm; in dry years, corn fields had shown potassium deficiency symptoms.
Economics for manure N-P-K do not reflect ancillary benefits like improved tilth, micronutrients, and food for soil biota such as earthworms.

Intensive rotational grazing study: Business records for this part of the project were kept for 1992 and 1993 calendar years. Group averages were of limited usefulness; for example, the average of six PFI producers showed a negative return to management on a per-cow basis, but a positive return to management on a whole-enterprise basis. While the PFI average return to management in 1992 was about one-quarter that of the 78-herd average, two PFI producers actually showed returns to management greater than the 78-herd average. These 78 herds dwindled to 26 in 1993 as the Beef Cow Records were de-emphasized in favor of the Standardized Performance Analysis (SPA) accounting system. There was a concomitant drop in the cow herd from 85.5 to 63; other parameters also changed. The cooperator and state averages for profitability in 1993 were similar.

Compared to other producers, PFI producers were able to limit many production costs: operating cost per cow, hired labor cost per cow, feed cost per hundredweight (cwt) of beef produced, operator cost per cwt beef produced, depreciation, tax, and insurance cost per cwt beef produced. However, despite hiring less labor, PFI farmers’ overall labor costs per cwt beef produced were greater due to their greater labor input. Two years is generally necessary to establish a baseline and achieve basic competence with the record-keeping system.

In terms of pasture utilization, there was little difference between the groups in total feed fed per cow; pasture acres per cow in 1992 were 1.7 for PFI farmers and 2.5 for the state average. In 1993, pasture acres per cow for both groups was 2.0; pasture days per cow were somewhat less for PFI herds in 1992 and considerably more than other herds in 1993. The BCBR does not reflect fluctuations in the herd during the year; it merely asks the producer for herd numbers at the beginning and end of the year. Thus, a farmer who acquires and later sells cattle during the year records pasture grazing days and purchased feed costs and counts these against the cow herd size at year's end. The SPA system is thought to track more accurately these within-year transactions and to adjust cow-calf units to a standardized weight.

Narrow strip intercropping: In two 1992 agronomic trials, winter cover crops competed severely with corn in the narrow strips. Even so, two cooperators saw corn yields increase considerably. A Sutherland cooperator is comparing three different strip crop rotations and using single-crop field blocks for additional comparison. This cooperator harvested a four-bushel corn increase in 1992 over the field blocks. Soybeans in the strips yielded seven bushels better than those in the field blocks; the cooperator surmised that strip soybeans "lean over" after oats are harvested, allowing the soybeans more sunlight.

 Superior yields in NSI generally correspond to years of good yield potential. In 1993, crops were stressed not by drought, but by excess moisture and late planting. Strips relative to whole-field blocks varied; a Hampton cooperator enjoyed the greatest advantage to strips—a 27.8-bushel per acre advantage. Narrow-strip soybeans varied from a 3.9-bushel deficit on one farm to a 1.6-bushel advantage on another. A Boone cooperator found a 12-bushel benefit to narrow-strip soybeans, but the figure is not directly comparable because the systems differed.

Figure 1 shows crop yields. In most trials, corn yields were greater in narrow strips than in block plantings. When exceptions occurred, they were due to factors such as cover crop competition for moisture or frost damage.

By-row yields were gathered on eight cooperators' farms, four of whom had strips running north-south. Corn tended to yield more on the eastern edge of these corn strips. These east edges were usually next to oats, while lower-yielding west rows were next to soybean strips. No such tendency was evident for the east-west strips. In addition to five corn strips, yields for two soybean strips were mea-
sured for the east-west orientation. These row-by-row harvests in 1993 cannot provide conclusive information until bolstered by additional years of data.

**NSI economics:** Although PFI on-farm trials always include economic results in their reports, these are relative measures rather than total production costs. In the NSI trials, ISU Extension Crop Enterprise Records tracked performance. Use of CER means that results show economics in the context of specific farms, reflecting equipment inventory, land tenure arrangements, crop production inputs and yields, and other factors. The record system also provides a common measure that can be used to make tentative comparisons with other Iowa producers keeping such records during the same year.

Figure 2 shows that for farms where planting pattern (strips versus field block) was the only variable, net profit from NSI exceeded that from block plantings in both study years. In the systems comparison, net profit was slightly greater in the 1993 strips. In 1992 planting pattern comparisons, the average net from other corn/soybean producers using the CER was greater than the average net from the three-crop strips. This state average was less than the net from strips of the “systems comparison,” however. In 1993, average net profit from strips in both the planting comparison trials and the systems comparison trials was greater than the net from corresponding field blocks of separate crops. **NSI net** profit in both types of trials also exceeded the Iowa average net from corn/soybean producers in that year.

Even in 1992, the corn-soybean component of the corn-soybean-oats NSI rotation was more profitable than the average of corn and soybeans from the state survey of CER producers. The small-grain year of the NSI rotation brings down the profitability of the overall system, at least when the crop is considered in isolation. While immediate economic returns may not be forthcoming, contributions of the oats/green manure strip to other crops in the rotation—N fixation and interruption of pest cycles are just two—should be considered. Some PFI cooperators are using oats/berseem clover strips for green chopping or grazing, which considerably improves the system’s economics.

**Conclusions:** Six replicated manure trials demonstrated that livestock manure is a valuable input that can result in yields equal to those achieved with synthetic fertilizers. Although N value alone did not always justify manure use, phosphorus and potash content made manure more valuable than synthetic.
sources in these trials. No attempt was made to quantify manure effects on tilth and soil life—benefits that may also accrue in the long term.

While controlled grazing generally involved lower production costs than those incurred by other Iowa beef producers using the BCBR, labor costs were greater. Overall net return varied greatly among cooperators, making close comparisons with state averages unreliable. Both the number of producers in that state average and their net returns dropped considerably from 1992 to 1993.

The Business Records did document cost reduction as a central strategy of many farmers who practice controlled grazing, although the record system was not specific enough to quantify grazing efficiency itself.

Narrow strip intercropping generally produced higher corn yields than corn alone. Exceptions occurred chiefly when differences between the systems such as weeds caused problems. Soybean yields, unexpectedly, were not lower in NSI than for soybeans alone. Per-acre net return (calculated using the Crop Enterprise Record system) was higher in strips than in block plantings as long as those system differences did not occur. NSI net profit also compared well with corn-soybean rotations, despite the lack of profitability in the third-year oat/legume crop in the NSI system and the fact that most Iowa producers include government payments in their CER, while PFI cooperators did not.

**Implications**

Manure management is an important issue on crop-livestock farms. While its management can pose challenges, manure represents an asset to such operations. Many diversified producers do not understand how to take full advantage of their livestock manure; thus, the demonstrations conducted as part of this project helped to educate both the participating cooperators and their neighbors about the agronomic and economic values of livestock manure to crop production.

This project provided economists and Extension personnel with information about manure’s value and the time (labor) and equipment costs associated with it. This information will facilitate more accurate projections of manure's value.

Iowa farmers are currently very interested in controlled or intensive rotational grazing. Improved pasture productivity and cost reduction are the primary concerns of producers seeking to remain competitive and reduce risk. In addition, potential farmers may view grazing as a viable avenue for beginning an operation because of the limited capital requirements.

Although documenting pasture productivity is difficult, the project confirmed that by using the Beef Cow Business Records, cooperators reduced many of their capital, feed, and other production costs relative to other beef producers.

This project indicates that when cover crops function predictably, and weed and other management challenges are not unusual, overall economic performance of NSI is superior to conventional crop production. Further, refinements in planting population and choice of varieties/hybrids appropriate to narrow strips may better take advantage of the microenvironments NSI provides. However, because more profitable practices are sometimes
deemed not worth implementing because they do not fit with other aspects of a farm, the question becomes how much better NSI must be to win acceptance. The economic benefit of two-crop, corn-soybean NSI may not justify the practice, given the possibility of pest increases over time. The practice is most useful when viewed as a means to enhance the elements of diversified farming. NSI is more feasible economically when livestock are present so that the oats are consumed, the straw is used, and the third-crop strip is used for manure spreading or rotational grazing. Additional trials are under way to assess corn yields by row position and orientation (north-south versus east-west).

**Education, outreach, and cooperative efforts:** Farm field days were an important outreach element in this project, with a total attendance of 2,700 over the two years. The project was also described at meetings of various agricultural organizations and agencies.

Evaluations of the field days indicated that expectations were met or exceeded (95% in 1992; 94% in 1993). More than half of farmers attending said they considered changing one practice as a result of field day information.

This project involved collaboration among PFI, ISU Extension, three Leopold Center issue teams, and the local Soil Conservation Service where possible.