



LEOPOLD CENTER

Demonstration of an annual forage crop integrated with crop and livestock enterprises

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Budget:

\$30,000 for year one
\$30,000 for year two
\$30,000 for year three

Abstract: Using a more diverse cropping system, such as strip intercropping, to produce forages for feeding livestock can create a more sustainable, environmentally friendly farming system. Strip intercropping of corn, soybeans, and oats underseeded with berseem clover was used to demonstrate agronomic and environmental benefits of a more varied cropping system. This system produces oat/berseem clover soilage (green-chop) that can be utilized to feed beef cattle.

Background

The goal of this project is to evaluate the economic and biological benefits of an oat/berseem clover companion seeded cropping system and to demonstrate the use of small grains underseeded with an annual legume (berseem clover) to diversify agriculture, conserve soil, and add profit to an integrated crop and livestock operation.

The objectives are to:

- demonstrate a three-crop strip intercropping system as an alternative cropping system,
- study the impact of strip direction and crop orientation on yields, and
- evaluate steer production utilizing soilage from the oat-berseem strips.

Approach and methods

Strip intercropping. This study was conducted at ISU's Armstrong Research Farm in south-

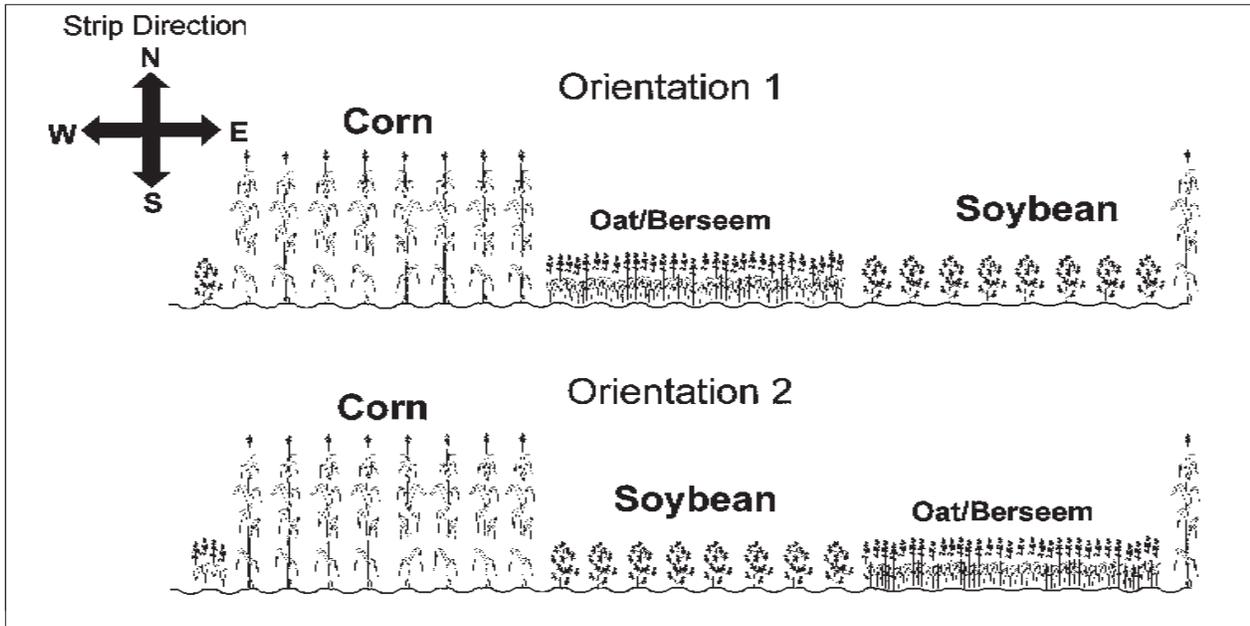
west Iowa which features hilly topography well-suited for livestock enterprises. In spring 1994, a 30-acre field was established with 20-foot strips suitable for easy forage harvesting. Strips followed the natural contour line of the watershed and as a result were aligned in various directions. Crops were rotated annually (corn/soybeans/oats). Two crop orientations were selected to show different crop arrangement alternatives and their impact on yields. In 1995, an oat/berseem clover field was established as a backup to ensure sufficient forage supplies during the study.

Corn and soybean grain yields were determined and adjusted to appropriate moisture levels. Soilage from oat/berseem strips was harvested daily according to the livestock demand after the oats reached boot stage. Total daily harvest and amount of soilage refused by the livestock were measured. On days when inclement weather prevented green chopping of the oat/berseem clover strips, either borders or the backup field were green-chopped, or previously harvested hay was fed.

Berseem clover intercropping. This study features a randomized split block with four replications. The main plots are three crop treatments: sole seeded oats, sole seeded berseem clover, and oats/berseem clover companion seeded. The split plots tested five harvesting management treatments. All main plot treatments followed soybeans in the three-crop (corn-soybean-oat) rotation. Split plot treatments consisted of different forage cut-



Armstrong
Research Farm,
Lewis, Iowa



ting times. Harvest times were 45 days, 60 days, 75 days, and 90 days after planting. Forage in the subplots was allowed to grow, was measured, and was recut two more times. The last regrowth remained on the subplots and aboveground biomass nitrogen content was determined. Forage quality (digestible dry matter and crude protein) was determined when samples were taken and total potential biomass production was calculated for each harvesting scheme.

Analysis of variance was used to determine crop and harvest treatment effects on both forage yield and quality. Collected data were also used to calculate the land equivalent ratio (LER) allowing for evaluation of intercropping effects for grain or forage production.

Livestock. In May 1994, 30 steers were placed on a 41-acre cool-season grass pasture divided into eight paddocks to rotationally graze for 35 days. The steers were moved every three to four days to ensure that each paddock was grazed within a two-week period. To estimate forage yield, sward heights were checked when the animals entered and exited each paddock. On June 1, 24 cow-calf pairs were introduced into the rotational grazing cycle. The steers were then removed from the pasture on June 15, placed in a drylot, and fed berseem clover/oat soilage (green-chopped).

Fifty-five steers were placed on pastures to graze for 32 days in 1995. The animals were rotated among paddocks daily from May 11 to May 31 and every two to four days thereafter. Thirty-six cow-calf pairs followed the steers in the rotational grazing pattern beginning June 5. Steers were removed from pasture June 13, placed in a drylot, and fed berseem clover/oat soilage (green-chopped). Cows were rotated among paddocks on the basis of available forage.

On May 17, 1996, 32 steers began 28 days of pasture grazing. They were switched among paddocks every two to four days from May 17 to June 14 when they were removed from the pasture to begin green chop feedings. A preliminary study including four different production treatments was initiated then.

Measurements. Steers were weighed unshrunk before going onto pasture, when they were

Three-crop striping with different orientations (above)



Berseem clover



Steers being fed.

removed from pasture, and at 14-day intervals while they were in the drylot. Cows and calves were weighed monthly until the end of the experiment. Total dry-matter yields of the pasture were calculated at 24 locations. Sward heights were measured at 10 locations as animals moved on or off of the paddocks. Each load of harvested silage and previously harvested hay was weighed and subsampled for dry matter concentration. Average daily gain (ADG) of steers was determined for each year.

Results and discussion

Strip intercropping. Corn and soybean yields for 1994 matched county averages. However, this field had been under continuous corn production since the 1970s and rotation is expected to have a positive effect on the yields. Crop strips with Orientation 1 (corn to the south or east of soybean strips) yielded less corn than strips with Orientation 2 (corn to the west or north of soybean strips). Corn grain yield was higher for strips running N-S than for strips running E-W for both crop orientations. Outside corn rows outperformed center rows in crop strip Orientation 1, but showed no difference for crop Orientation 2.

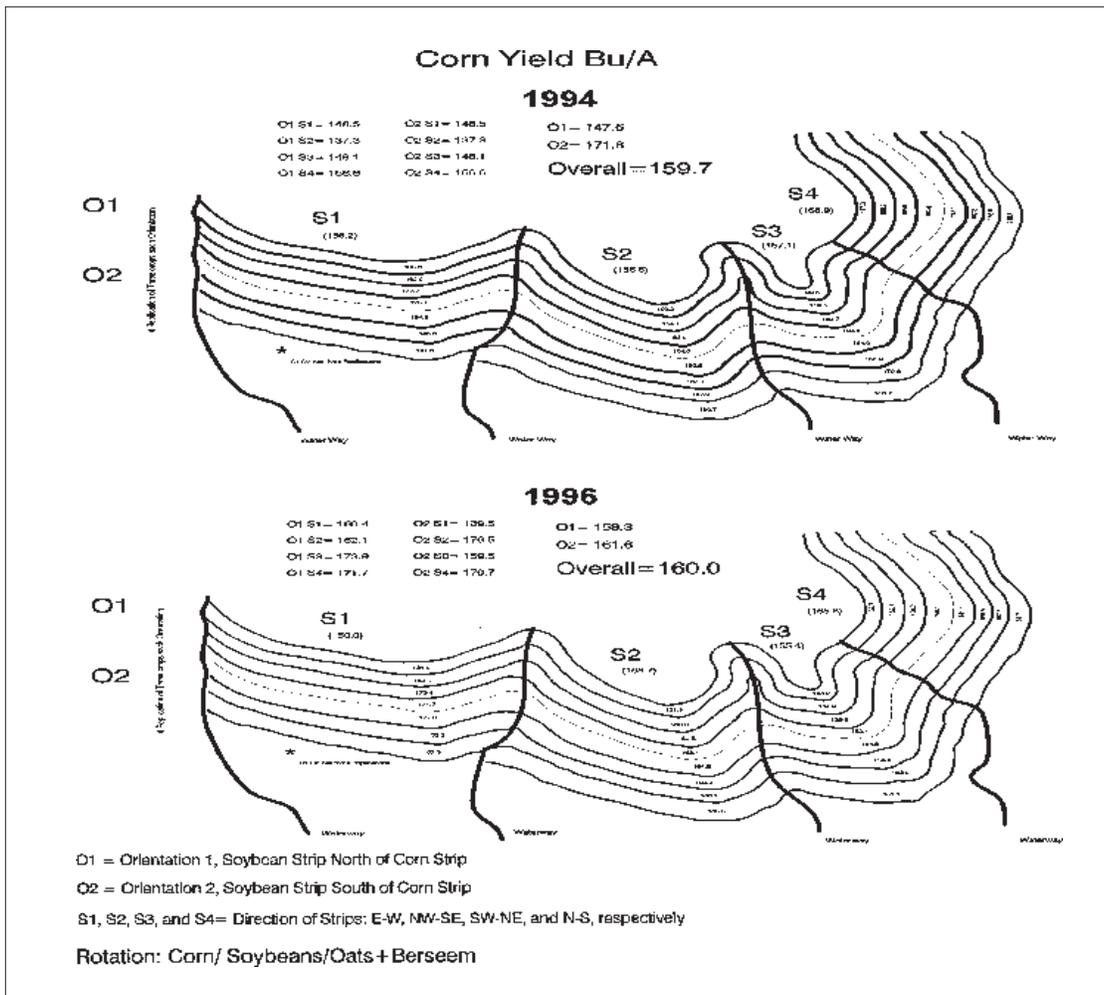
In 1995, wet conditions delayed planting. The corn crop was not planted, and the soybean crop was drilled late and yield was very low. Strip direction and crop orientation were not factors in the yield outcome.

Corn yields in 1996 were above the county average and border rows averaged 3 percent higher than center rows. Soybeans showed no difference by system and yields were similar to county averages. With Crop Orientation 1 (soybean to the N or E of corn strip and S or W of the oat strip) having an E-W strip direction, the soybean rows next to the corn strips yielded lower than the center rows because of shading by the tall corn. However, this effect was less pronounced when the strip ran N-S. With Crop Orientation 2 (soybean to the S or W of the corn strip and N or E of the oat strip) having an E-W strip direction, the soybean rows next to the oat strips yielded less than center rows because of competition with the oat strips; the shading effects from the corn border were less significant. Crop Orientation 2 showed less shading effect from the corn on the soybean bordering row when the strip ran E-W than when it ran N-S. However with Crop Orientation 1, corn had more impact on the bordering soybean row when the strips had a N-S direction than when they faced E-W.

Livestock performance (on pasture). In 1994, average daily gain (ADG) of steers was 1.8 lbs., resulting in 46 pounds of steer production per acre over 35 grazing days. During the 140 days that cows and calves grazed, average cow weight increased 46 pounds and calves gained an average of 1.87 lbs. per day.

Over 33 days of grazing in 1995, ADG of steers was .67 pounds for 29.5 pounds of steer production per acre. Average cow weights rose 42 pounds during 100 days of grazing while ADG for calves was 1.57 lbs. a day.

During 28 days of 1996 grazing, steers gained an average of 0.27 pounds per day, registering 5.9 pounds of steer production per acre.



Livestock performance (feedlot). Forage production (soilage harvested from oat/berseem strips) for 1994 was 2.84 tons of dry matter per acre. In addition, 15,000 pounds of hay and soilage from the field border were fed on days when berseem regrowth was inadequate or when rain prevented harvest of soilage. Steer ADG for the 92-days of soilage feeding was 1.9 pounds with no grain supplementation. This means that the soilage harvest produced 524 pounds of steer with a feed efficiency of 9.0 pounds feed per pound of gain.

The forage/soilage production for 1995 was 3.05 tons of dry matter per acre, with an additional 7.6 tons of berseem clover dry matter harvested from a bulk field. Researchers

fed 13.6 tons of alfalfa hay on days when berseem regrowth faltered or rain impeded soilage harvest. Steer ADG for 71 days of soilage feeding was 2.2 pounds with no grain supplementation. In effect, the soilage harvest from strips, the bulk field, and alfalfa yielded 580 pounds of steer at a feed efficiency of 10.5 pounds feed per pound of gain

The soilage harvested for forages in 1996 totaled 2.5 tons of dry matter per acre. And an additional 16 acres of a berseem clover bulk field were used to provide adequate feed during the study. Steer ADG for the 147 days of soilage feeding was 1.05 pounds without grain supplementation.

Corn grain yields for the Armstrong Research Farm.

Oat/berseem clover intercropping. In 1994 and 1995, berseem clover intercropped with oats did not affect oat grain yield or oat test weight at the Armstrong site. Biomass of the intercropped treatment was greatest both as grain production and as forage.

In 1994, optimum biomass production was accomplished when the first cut occurred near the time of oat maturity (at about 90 days), with the second cut made after another 45 days. The highest biomass yield of 1995 was produced when the first cut was made 75 days after planting and the second cut was in 45 days.

A nitrogen contribution estimation, using corn grain yield response to N fertilizer after berseem clover, was obtained only in 1996 since no corn was planted in 1995. However, nitrogen estimation by the amount of cover crop biomass (only one cut at oat maturity) occurred each year. The researchers noted that if corn is planted following oats/berseem, 60 to 65 lb/acre N credit should be given.

Conclusions

For farming operations with a diverse mix of available pasture and crop ground, adding a cow herd to the enterprise would greatly increase the efficient use of land, labor, and management. Practices such as rotational grazing and strip intercropping allow highly erodible land to achieve higher production without increasing erosion risk. Intercropping berseem clover with oat increased total biomass production without reducing oat grain yield. Soil-

age feeding of oat/berseem or berseem clover alone can be a viable feeding option. Drought conditions reduced berseem clover's biomass production potential. Stress caused by frequent weighing operations reduced the steers' performance resulting in lower ADG, particularly in 1996.

Impact of results

Successful cooperation was achieved among two Leopold Center Issue Teams—Cropping Systems and Animal Management—and the NRCS, ISU Extension, and Practical Farmers of Iowa on this project. The Wallace Foundation for Rural Research and Development members (owners of the Armstrong Farm demonstration site) referred to this project as “an essence of a sustainable agriculture system” and made plans to have the cropping systems demonstration become a permanent feature at the research farm.

Education and outreach

Educational activities in 1994 included two field days at the Armstrong site, along with presentations to the PFI annual meeting and the Management Intensive Grazing Symposium. Two more field days were held in 1995 and the potential of uses of berseem clover in livestock production were discussed at the Management Intensive Grazing Symposium in February. Field days occurred at the demonstration location in June and September 1996.

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