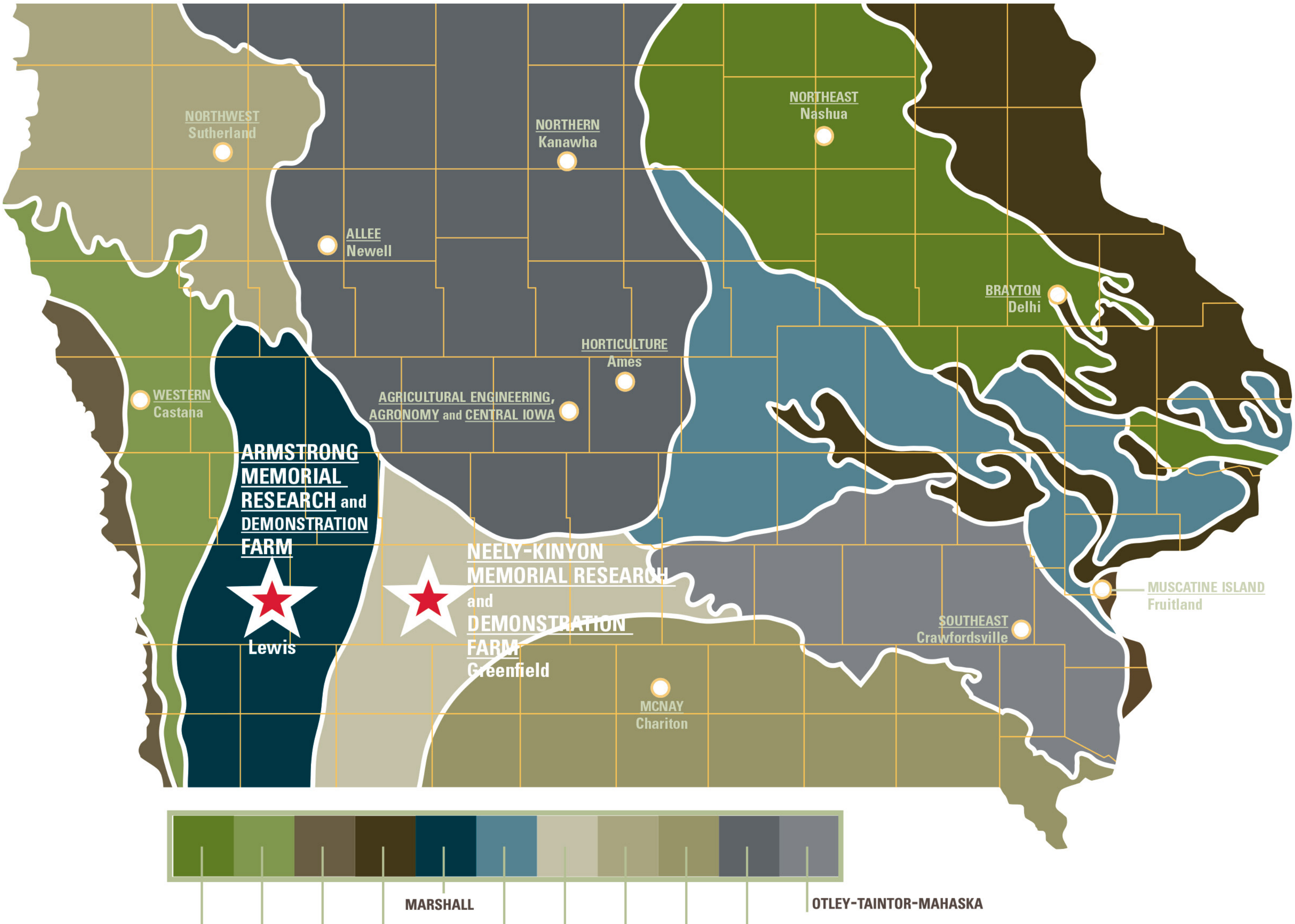
IOWA STATE UNIVERSITY
College of Agriculture and Life Sciences

Research and Demonstration Farms

Armstrong Memorial Research and Demonstration Farm
Neely-Kinyon Memorial Research and Demonstration Farm

2022 SUMMARY



ISRF22A February 2023

Research and Demonstration Farms

In 1858, the Iowa Legislature chartered the Iowa Agricultural College and Model Farm. Today, the College of Agriculture and Life Sciences at Iowa State University is one of the world's leading institutions of agriculture, providing leadership in science, education, and extension.

Southwest Iowa is typified by loess, or wind-blown, soils covering rolling hills. The primary soil types are Marshall, Shelby, Sharpsburg, and Macksburg. Agricultural interests from 19 counties in southwest Iowa formed the Wallace Foundation for Rural Research and Development (WFRRD) to address agricultural issues in 1987 they and incorporated in 1990. In 1993, WFRRD acquired a 400-acre tract in eastern Pottawattamie County, six miles northwest of Griswold, from Gail and Glendale Armstrong by way of a gift./ purchase agreement. The Armstrong Memorial Research and Demonstration Farm serves as the hub farm for activities across the region. WFRRD provides advice and leadership on current agricultural research, education, and development activities.

In 1994, Wayne and Margaret Neely gift.ed their 160-acre home farm south of Greenfield in Adair County to the Wallace Foundation and established the Neely-Kinyon Memorial Research and Demonstration Farm as a satellite site located in the Shelby-Sharpsburg-Macksburg soil association.

In 1997, the Wallace Foundation built the Wallace Learning Center at the Armstrong Farm. The center includes meeting and conference rooms, extension offices, research farm offices, and rural development incubator office space. The center is named for Henry A. Wallace, former vice-president and secretary of agriculture and commerce, who was born on a farm near Orient in Adair County. Wallace was a member of a leading Iowa agricultural family, who started the Wallaces Farmer magazine. He also was an active scientist, developer of hybrid seed corn, and founder of the Pioneer Hi-Bred company.

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STAFF

Matt Groves—superintendent

RaeLyn Barkley—administrative specialist

Randy Breach—agricultural specialist

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Farm, Weather, and Research Summary

Matt Groves—farm superintendent

Farm Comments

Developments. In June, Ryan Farmer resigned and a search is underway to find the best candidate for the crop specialist position. Corn and soybean yields were significantly less than last year due to the lack of rain in the last half of the year. Plans for a new shop/machine shed at the Armstrong farm still are being discussed.

Field days and tours. A summer field day that focused on soil health was held with Iowa State University Extension and Outreach and the NRCS's SWISH group. An evening field day in July focused on forages and participants were able to tour the forage plot. A field day in September focused on beef and highlighted the pea feeding study. The farm also hosted several plot days, a district FFA soils contest, and numerous meetings throughout the year. RaeLyn Barkley continued to promote the Wallace Learning Center for events such as weddings and graduation parties. The farms had about 1,800 visitors this year.

Livestock. The Armstrong farm again fed out the steer calves from the Iowa State cow herd at the McNay Memorial Research and Demonstration Farm in Chariton. Part of these steers were used in the pea feeding trial that was done on the individual intake feed bunks. A group of yearling steers were fed for an intake study as well. The McNay fall heifer calves again grazed the pasture until the pasture dried up; they were moved to another research farm to be finished.

Crop Season Comments

Planting was completed in a timely matter. The growing season started with adequate moisture, but started falling behind average in the summer months. As expected, the lack of timely rains affected the crop yields. Armstrong corn averaged 151 bushels/acre and soybean averaged 51 bushels/acre. Yields at Neely-Kinyon were 125 bushels/acre on corn and 49 bushels/acre on soybean.

Weather Comments

Winter 2021-2022. The winter was fairly mild with little snow and above average temperatures. It was a good winter for cattle feeding.

Spring 2022. Spring operations started in early April with planting starting April 27.

Summer. Stretches of hot weather and the lack of timely rains took a toll on pasture conditions as well as corn and soybean.

Fall. The dry weather continued into the fall, making for ideal harvest conditions. Harvest started September 28 and completed October 27. There were no issues with grain dry-down, and the farm eventually harvested the crops below the preferred moisture. Fall field work was finished by mid-November.

Table 1. Armstrong Memorial Research and Demonstration Farm monthly rainfall and average temperatures.

	Rainfall, inches		Temperature, °F		Days
Month	2022	Deviation from normal	2021	Deviation from normal	90°F or above
January	0.57	-0.26	31.02	0.02	0
February	0.27	-0.82	39.53	2.53	0
March	4.34	2.15	50.13	0.13	0
April	3.10	-0.68	59.27	-3.73	0
May	5.72	0.83	72.63	-0.37	4
June	2.60	-3.25	84.80	1.80	9
July	2.41	-2.46	85.84	-0.16	6
August	2.21	-1.60	85.86	1.86	7
September	1.70	-1.75	79.47	2.47	2
October	0.98	-1.97	67.53	3.53	0
November	0.91	-0.81	47.93	-0.07	0
December	1.24	-0.22	32.34	-1.66	0
Totals	26.05	-10.84			28

Research Summary

Project	Project Lead
Long-term nitrogen/crop rotation study	S. Archontoulis
BASF soybean trials	BASF
Corteva soybean demonstration	Corteva
Long-term organic rotation study	K. Delate
Organic control of thistles	
Organic grape study	
Organic vegetable production with cover crops	
Sorghum as a biomass crop	M. Fernandez
STRIPS bowl (ARF and N-K)	M. Helmers
Milkweed species demo	R. Hellmich
Oat variety trial	
Weather station	D. Herzmann
AdvanSix	M. Licht
BiOWISH	
Long-term tillage/crop rotation study	
Forage test plot research (ARF, N-K)	E. Lundy-Woolfolk
Hybrid rye yield trial	
Yearling intake study FIMS	
Statewide fungicide trial soybeans	D. Mueller/S. Wiggs
Field pea study FIMS	Practical Farmers of Iowa
Monarch habitat (ARF,N-K)	
Corn fungicide–Cardinal trial	A. Robertson
Iowa Crop Performance test trial–soybean	J. Rouse/G. Marzen
Black cutworm moth monitoring	A. Sisson
Corn rootworm research	
On-farm corn and soybean management studies	M. Witt
Iowa Soybean Association trial	

Acknowledgements

Tony Leighton, Atlantic News Telegraph, Atlantic Chamber of Commerce, KMA Radio, KJAN Radio, HTS Ag, Landus Cooperative, East Pottawattamie SWCD, Practical Farmers of Iowa, Cass County Master Gardeners, Iowa Beef Center, Iowa Farmer Today, Leopold Center for Sustainable Agriculture, Scoular Grain, Farm Bureau, Fox Welding, Tri-County Steer Carcass Futurity, Farm Credit Services, Anita Vet Clinic, 21st Century Coop, Wyffels Hybrids, Mike Muhlbauer, Marlin Rossell, Waters Farm Supply, AgriVision, Lindeman Ford Tractor, Pioneer Seed Co., BASF/ASA, Sandbothe Firestone, Cass County NRCS, Iowa Western Community College, Lamb Tiling, Glen Jones, Weirich Welding, Southwest Iowa Tiling, Stine Seed, Adam Johnson, Farm Service Cooperative.

Comparison of Organic and Conventional Crops at the Neely-Kinyon Long-Term Agroecological Research Site

Kathleen Delate—professor, Department of Horticulture and Agronomy

Josiah Pollock—program specialist, Department of Horticulture and Agronomy

Karenna Petersen—research assistant, Department of Horticulture and Agronomy

Randy Breach—agricultural specialist, Neely-Kinyon Long-Term Agroecological Research Site

Materials and Methods

The Neely-Kinyon long term agroecological research site (LTAR) was established in 1998 to study the long-term effects of organic production in Iowa. Treatments at the LTAR site, replicated four times in a completely randomized design, include the following rotations: conventional Corn-Soybean (C-S), organic Corn-Soybean-Oat/Alfalfa, (C-S-O/A), organic Corn-Soybean-Oat/Alfalfa-Alfalfa (C-S-O/A-A), and organic Corn-Soybean-Corn-Oat/Alfalfa (C-S-C-O/A). Oat/Alfalfa plots were field cultivated March 29. On April 4, Reins oats were underseeded with Viking 3800 alfalfa (Albert Lea Seed) at a rate of 90 lbs./acre and 15 lbs./acre, respectively. Plots were cultipacked on the same day as planting. Following harvest of the organic corn plots in 2021, winter rye was drilled at a rate of 75 lbs./acre on October 18, 2021.

In conventional corn plots, Monoammonium Phosphate (MAP) at 125 lbs./acre and potash at 150 lbs./acre were applied March 28. Plots were cultivated and planted May 16 at 35,000 seeds/acre and sprayed May 18 with Corvis™ at 5.6 oz./acre, Atrizine™ at 1 qt./acre, Round-up™ at 32 oz./acre, and 2,4-D at 16 oz./acre. In conventional soybean plots, MAP at 125 lbs./acre and potash at 150 lbs./acre were applied March 28. On May 18, fields were sprayed with Authority Edge™ at 10 oz./acre, Round-up™ at 20 oz./acre, and AMS™ at 2 lbs./acre. The soybeans were planted May 19 at 190,000 seeds/acre. On June 22, the plots were sprayed with Flexstar™ at 1.33 pts/acre MSO™ at 1 pt/acre, NIS™ at 1 pt/acre and AMS™ at 6 lbs./acre. Plots were cultivated July 11 to manage weeds still emerging after herbicides.

In the organic plots, chicken manure (SW Iowa Egg Cooperative) was applied at a rate of 3,105 lbs./plot April 5, in the C-S-O/A and C-S-O/A-A rotations. In the C-S-C-O/A rotation, manure was applied on the same day at a rate of 1,290 lbs./plot. The alfalfa plots with composted manure were plowed under April 12, disked May 15 and field cultivated May 16. Organic corn plots were rotary hoed May 19 and June 1, and field cultivated June 14, 16 and 22. Corn and soybean variety selection and planting methods were: Viking 0.18-06 UP (Albert Lea Seed) corn was planted at a depth of 2.5 in. as untreated seed at a rate of 35,000 seeds/acre May 16, 2022. Soybean BR29DC5 (Blue River/Albert Lea Seed) was planted at a depth of 2 in. at a rate of 190,000 seeds/acre May 16.

Rye was disked twice in organic soybean plots May 16 and 19 before soybean planting on May 19. Organic soybean plots were rotary hoed May 23 (eight days after planting), June 1 and 10, and field cultivated June 16, 22, July 11, 20, and 28. The organic soybean plots were walked July 9. There was a problem with weeds in the conventional plots, even after repeated herbicide applications, but these were not walked in, keeping with the protocol of herbicide applications only in conventional plots. Corn and soybean stands were counted June 23, and weeds were counted within square meter quadrants at three randomly selected areas within a plot. Corn borer populations and damage were estimated July 12 by examining three randomly selected plants per plot. On July 13, insect populations were censused by sweeping with a 15 in. net 20 times across three random areas of the plot. Corn stalk nitrate samples were collected October 5 by cutting corn stalks at the 6-14 in. height from three randomly selected corn plants per plot. Soybean cyst nematode sampling occurred in all soybean plots October 13 by sampling at a

6-in. depth in three randomly selected areas in soybean rows in each plot. Nematode analysis was conducted at the Iowa State University Plant and Insect Diagnostic Clinic. Soybean staining was analyzed in the Iowa State organic program laboratory from a random sample of 100 g of soybean from each plot. Soil quality sampling occurs each fall in the LTAR experiment, after harvest and before tillage or cover crop planting, by sampling soil at a 6 in. depth in three randomly selected areas in each plot, on October 11 and 27. Samples were delivered to the M. McDaniel lab at the Iowa State Department of Agronomy and are being processed.

Alfalfa was harvested by mowing, raking and baling June 1-3, July 5-12 and August 23-28. Oats were combined with a plot combine July 22, then plots were mowed for straw July 23 and raked and baled July 26. Soybean and corn plots were harvested October 6 and 25, respectively. Grain samples were collected from each plot for grain quality analysis, which was conducted at the Iowa State Grain Quality Laboratory.

Results and Discussion

The weather this year was challenging, with spring temperatures 4.13°F below the 30-year average and April temperatures averaging 44.37°F, 6°F below the 30-year average (Table 1). Above average temperatures in June were 2.16°F above the 30-year average. During the harvest season, the weather cooled considerably with October 2.11°F below the 30-year average. Drought continued during the year with total precipitation through October of 24.14 in., which was 8.81 in. below the 30-year average. From April to September, precipitation totals were 7.45 in. below the 30-year average.

Similar corn plant populations, averaging 32,000 plants/acre, were observed in the organic C-S-C-O/A and the conventional C-S rotations June 23 (Table 2). The organic rotations averaged 30,444 plants/acre compared with greater conventional corn populations of 33,333 plants/acre. Grass weed populations were lower in the conventional and organic C-S-O/A rotations, averaging one grass weed/m^2, compared with the other organic rotations, which averaged seven grass weeds/m^2. Broadleaf weeds were equivalent in the conventional and organic C-S-O/A and C-S-O/A-A rotations, averaging two broadleaf weeds/m^2 compared with four broadleaf weeds/m^2 in the organic C-S-C-O/A rotation.

Soybean plant populations averaged 97,555 plants/acre, with no significant differences across the organic rotations, but a significantly greater population of 124,667 plants/acre in the conventional C-S rotation (Table 3). Grass weed populations were greater in the organic rotations, averaging 5 weeds/m^2, compared with the conventional rotation, which averaged 1 grass weed/m^2. Broadleaf weed populations were greater in the organic rotations, averaging 6 broadleaf weeds/m^2, compared with the conventional C-S rotation, which averaged 1 broadleaf weed/m^2.

No corn borer damage or corn borers were detected in corn plants on July 12. Soybean cyst nematodes (SCN) averaged 283.33 eggs/100cc of soil in the C-S-C-O/A rotation, with no statistical differences with the other rotations, which averaged 37.5 eggs/100cc of soil in the conventional C-S and 100 eggs/100cc in the C-S-O/A. No

Table 1. Precipitation and temperature, 2022.

Month	Rainfall, inches		Difference from 30-year average	Average air temperature (F)		Difference from 30-year average
	2022	30-year average		2022	30-year average	
January	0.99	0.87	0.12	16.18	22.08	-5.90
February	0.19	1.21	-1.02	22.88	25.71	-2.83
March	3.69	2.07	1.62	36.95	38.76	-1.81
April	2.83	3.66	-1.28	44.37	50.35	-5.98
May	4.54	5.14	-0.6	61.48	61.22	0.26
June	3.05	4.68	-1.63	73.35	71.19	2.16
July	1.71	3.90	-2.19	75.72	74.95	0.77
August	3.75	4.24	-0.49	74.52	73.04	1.48
September	2.62	3.88	-1.26	65.58	65.67	-0.09
October	0.77	2.85	-2.08	51.00	53.11	-2.11
Totals	24.14	32.50	-8.81	52.20	53.61	-14.10

Table 2. LTAR experiment, June 23: corn plant and weed populations.

Treatment (plants/acre)	Population (plants/m^2)	Broadleaf weeds	Grass weeds (plants/m^2)
Conv. C-S[x]	33,333a[y]	1.33b	0.17b
Org. C-S-O/A	30,500b	1.83ab	1.00b
Org. C-S-O/A-A	30166b	2.33ab	5.17ab
Org. C-S-C-O/A	30,666ab	4.17a	8.00a
p value (a=0.05)	0.0107	0.0308	0.0008

[x] Conv=conventional, Org=organic, C=corn, S=soybean, O=oats, A=alfalfa
[y]Means followed by the same letter down the column are not significantly different at P≤0.05 or not significant (NS) (Fisher's Protected LSD Test).

Table 3. LTAR experiment, June 23: soybean plant and weed populations .

Treatment	Population (plants/acre)	Broadleaf weeds (plants/m^2)	Grass weeds (plants/m^2)
Conv. C-Sx	124667a[y]	1.17b	1.00b
Org. C-S-O/A	95,333b	5.00ab	4.67ab
Org. C-S-O/A-A	94,333b	8.00a	6.67a
Org. C-S-C-O/A	103,000b	5.50a	5.00ab
p value (a=0.05)	<0.0001	0.0010	0.0050

[x]Conv=conventional, Org=organic, C=corn, S=soybean, O=oats, A=alfalfa
[y]Means followed by the same letter down the column are not significantly different at P≤0.05 or not significant (NS) (Fisher's Protected LSD Test).

SCN were recovered in the C-S-O/A-A rotation (Table 4). The percentage of stained soybeans, representing damage from bean leaf beetle feeding was lower than in 2021, with an overall average of 1.76%. There was a higher percentage of stained soybean in the organic C-S-O/A rotation, at 2.8%, compared with the 1% stained in the organic C-S-C-O/A-A rotation. Corn yields were affected by the drought this year, and were equivalent across all rotations, averaging 109 bushels/acre. The C-S-O/A rotation averaged 116 bushels/acre, compared with 105 bushels/acre in the conventional C-S rotation. The organic C-S-O/A-A and C-S-C-O/A rotations averaged 107 bushels/acre. Corn stalk nitrate (CSN) levels were low, also affected by drought conditions. The average CSN was 684 ppm in the organic rotations and 1,758 ppm in the conventional corn, with no significant differences between treatments (Table 4). The organic soybean yield in the C-S-O/A-A rotation (55 bushels/acre) was statistically greater than the conventional soybean yield (47 bushels/acre), which received multiple herbicides and cultivations (Table 4), representing a yield increase from longer rotations. The other organic rotations averaged 52 bushels/acre.

Oat plots yielded 102 bushels/acre in the three-year rotation, and 106 bushels/acre in the four-year rotation, which was 14 bushels/acre less than in 2021 (Table 5). Alfalfa yields, at 3.57 tons/acre were greater than 2021's yields, which averaged 2.75 tons/acre. The June and August harvests were the highest, with an average of 1.4 tons/acre, but the July cutting, at 0.58 tons/acre, suffered from dry weather.

If crops were sold as certified organic, as they were in previous years (and can continue to be since the fields are certified every year), premium organic corn prices would have brought in $1,259.11/acre in the organic C-S-O/A rotation, compared with the $678.86/acre for conventional corn. Organic soybean could have been sold for $1,595.84/acre in the organic C-S-O/A-A rotation, compared with $669.06/acre for conventional soybean.

Corn protein levels, averaging 7.4%, were greatest in the C-S-O/A and C-S-O/A-A rotations, compared with conventional corn, at 6.6% (Table 6). The corn protein level in the C-S-C-O/A rotation, at 6.03%, was equivalent to the conventional corn. Comparing the organic rotations with a small grain in the third year of the rotation, the average organic protein was 0.37% greater than conventional corn protein levels. The longer period between corn crops in the organic system lent an additional 1.5% in protein content, as evidenced by the 6% protein in the corn intensive C-S-C-O/A rotation compared with the 7.5% in the C-S-O/A-A rotation. Corn density was greater in the organic system, averaging 1.29 g/cc, compared with the 1.23 g/cc in the conventional rotation. Corn starch was highest in the organic C-S-C-O/A rotation, averaging 62% compared with conventional corn, which averaged 61%. The other organic rotations also averaged 61%. Oil content averaged 3.5% across all rotations, with no significant differences between conventional and organic rotations (Table 6).

Soybean protein levels were significantly greater in the organic rotations, with the organic rotations averaging 36.3%, compared with the 34.6% in the conventional rotation (Table 7). Soybean carbohydrate levels averaged 22.9% in the organic rotations compared with a greater level of 23.8% in the conventional C-S rotation. Oil levels were greater in the conventional rotation, averaging 18.8%, compared with the organic rotations, which averaged 18%. Fiber content averaged 4.8% in the organic rotations, which was less than the 4.9% in the conventional C-S rotation (Table 7).

Table 4. LTAR experiment: corn and soybean yields, stained soybean, corn stalk nitrate, and soybean cyst nematodes.

Treatment	Corn yield, bushels/ac	Soybean yield, bushels/acre	Stained soybeans %	Corn stalk nitrate, ppm	Soybean cyst nematodes, eggs/ 100cc soil
Conv. C-S[x]	105.25a[y]	47.25b	1.23ab	1,757.50a	37.50a
Org. C-S-O/A	115.94a	50.22ab	2.83a	754.25a	100.00a
Org. C-S-O/A-A	110.30a	55.01a	0.90b	1,248.75a	0.00a
Org. C-S-C-O/A	103.48a	53.83ab	2.08ab	50.25a	283.33a
p value (α=0.05)	0.7599	0.0282	0.0162	0.0897	0.1289

[x]Means followed by the same letter down the column are not significantly different at P ≤ 0.05 or not significant (NS) (Fisher's Protected LSD Test).

Table 5. LTAR experiment: oat and alfalfa yields.

Treatment	Yield, bushels/acre	Harvest date, tons/acre		
		Jun1-3	Jul-12	Aug 23-28
Org. C-S-O/A [x]	101.88			
Org. C-S-O/A-A	106.42	1.67	0.58	1.32

[x]Conv=conventional, Org=organic, C=corn, S=soybean, O=oats, A=alfalfa

Table 6. LTAR experiment: corn grain quality.

Treatment	Moisture %	Protein %	Oil %	Starch %	Density, g/cc	Ethanol yield (gal/bu.)
Conv. C-S[x]	13.70a[y]	6.55b	3.50a	61.15b	1.23c	2.83b
Org. C-S-O/A	13.38a	7.33a	3.58a	60.80b	1.31a	2.81b
Org. C-S-O/A-A	13.40a	7.49a	3.58a	60.70b	1.31a	2.80b
Org. C-S-C-O/A	13.40a	6.03b	3.48a	61.88a	1.26b	2.88a
p value (α=0.05)	0.2849	0.0001	0.0470	0.0008	<0.0001	0.0006

[x]Conv=conventional, Org=organic, C=corn, S=soybean, O=oats, A=alfalfa
[y]Means followed by the same letter down the column are not significantly different at P ≤ 0.05 or not significant (NS) (Fisher's Protected LSD Test).

Table 7. LTAR experiment: soybean grain quality.

Treatment	Moisture%	Protein%	Oil%	Fiber%	Carbohydrates%
Conv. C-S[x]	11.35a[y]	34.55b	18.77a	4.9a	23.78a
Org. C-S-O/A	11.47a	36.43a	18.03b	4.78b	22.78b
Org. C-S-O/A-A	12.68a	36.23a	18.03b	4.83b	22.93b
Org. C-S-C-O/A	12.33a	36.33a	17.9b	4.8b	22.98b
p value (α=0.05)	0.0908	<0.0001	<0.0001	0.0018	0.0012

[x]Conv=conventional, Org=organic, C=corn, S=soybean, O=oats, A=alfalfa

Table 8. LTAR experiment: Soybean pest insect populations.

Treatment	Bean Leaf Beetle	Thrips	Leaf hopper	Flies	Minute pirate bug	Spring tail	Tarnished plant bug	Grass hoppers	Northern corn rootworm	Flea beetle	Spider mite	Stink bug
Conv. C-S	0.25a	2.00a	0.25a	0.00a	0.50a	0.00a	0.00a	0.75a	0.00a	0.00a	0.00a	0.25a
Org. C-S-O/A	0.50a	0.50a	0.75a	1.25ab	0.25a	5.75a	0.50a	0.00a	0.00a	0.00a	0.25a	0.00a
Org. C-S-O/A-A	0.50a	0.75a	0.75a	3.25a	0.00a	10.25a	0.25a	0.25a	0.50a	0.25a	0.00a	0.00a
Org. C-S-C-O/A	2.00a	0.50a	1.25a	1.25ab	0.25a	0.50a	0.00a	0.00a	0.00a	0.25a	0.25a	0.00a
p value (a=0.05)	0.1558	0.6399	0.6681	0.0208	0.5174	0.0781	0.2476	0.2170	0.4262	0.5885	0.5885	0.4262

[x]Conv=conventional, Org=organic, C=corn, S=soybean, O=oats, A=alfalfa
[y]Means followed by the same letter down the column are not significantly different at P≤0.05 or not significant (NS) (Fisher's Protected LSD Test).

Table 9. LTAR experiment: Soybean beneficial and neutral insect populations.

Treatment	Lightning bug	Lace wing	Ground beetle	Ant	Ladybug (larva)	Spider	Flies	Minute pirate bug	Parasitic wasp	Damsel bug
Conv. C-S	0.00a	0.33a	0.00a	0.00a	0.25a	0.50a	0.00a	0.50a	0.00a	0.00a
Org. C-S-O/A	0.50a	0.00a	0.00a	0.00a	0.00a	0.75a	1.25ab	0.25a	0.50a	0.00a
Org. C-S-O/A-A	0.25a	0.25a	0.25a	0.25a	0.00a	0.50a	3.25a	0.00a	0.00a	0.00a
Org. C-S-C-O/A	0.00a	0.00a	0.00a	0.00a	0.00a	1.00a	1.25ab	0.25a	0.00a	0.25a
p value (a=0.05)	0.5519	0.5097	0.4262	0.4262	0.4262	0.6399	0.0208	0.5174	0.0728	0.4262

[x]Conv=conventional, Org=organic, C=corn, S=soybean, O=oats, A=alfalfa
[y]Means followed by the same letter down the column are not significantly different at P≤0.05 or not significant (NS) (Fisher's Protected LSD Test).

Soybean insect pest populations were relatively low with few statistical differences between the rotations. Pest insects included bean leaf beetles, thrips, leafhoppers, corn rootworm beetles, and stink bugs. Bean leaf beetle populations were equivalent across rotations (Table 8). The organic C-S-C-O/A rotation averaged two beetles/20 sweeps, with the other organic rotations and the conventional C-S rotation averaging one beetle/20 sweeps. Beneficial insects collected from these plots included spiders, parasitic wasps, ladybug larvae and lacewings, with spiders the most abundant, averaging one per plot (Table 9). There were no significant differences in beneficial insect populations between conventional and organic rotations.

Acknowledgments

We would like to thank the Rodale Institute for their support of the Neely-Kinyon LTAR site. Thanks also to Bob Turnbull for his help in production, data collection and analytical aspects of this project. We also thank Charles Hurburgh and Connie Hardy of the Iowa State Grain Quality Lab, Albert Lea Seed, and Blue River Hybrids for their support.

Small Grain Variety Trials

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Randy Breach—agricultural specialist, Neely-Kinyon Long-Term Agroecological Research Site

Careful management and proper variety selection can make small grains profitable in crop rotations due to their low input requirements and beneficial effects on succeeding crops. When grown as a cash crop, cereal rye and oats can be marketed for cover crop seed, grain, straw, forage, hay, or haylage. Their mid-summer harvest allows for a myriad of field management options for the remainder of the season, such as mid-season manure application or the establishment of a perennial forage crop.

Practical Farmers of Iowa has been collaborating with Iowa State Research Farms to trial small grain varieties since 2015. This past year, cereal rye and oats were trialed at the Armstrong and Neely-Kinyon Research and Demonstration Farms. This was the second-year cereal rye was trialed, and the third-year oat was trialed in this location.

Materials and Methods

Ten varieties of cereal rye (and one triticale variety) and 17 varieties of oats were trialed this year. Management information for each trial can be found in Table 1. No herbicides or insecticides were applied. Seed samples of non-hybrid varieties of rye and triticale from each location were sent to the Iowa State Seed Testing Laboratory for germination testing. Germination seed samples were pooled across replicates at each site, and therefore, germination data are not analyzed statistically. Data were analyzed using JMP Pro 15 (SAS Institute Inc). Statistical significance is determined at $P \leq 0.10$ level (unless otherwise noted) and means separations are reported using Tukey's least significant difference (LSD).

Results and Discussion

Table 1. Management information for small grain variety trials.

	Cereal rye and triticale trial	Oat trial
Previous crop	Soybean	Soybean
Replications	3	3
Harvested plot size	5 ft × 50 ft.	5 ft × 50 ft.
Fertilizer applied	30 lb. N/acre as Urea, March 28	30 lb. N/acre as Urea, March 28
Tillage	None	Disked on March 28
Planting date	Oct. 8, 2021	April 6 followed by cultipacker
Row spacing	7.5 in.	7.5 in.
Seeding rate	Variable to achieve target planting population of 23 seeds/ft.^{2}	4 bushels/acre
Seeding depth	1.25 in.	1 in.
Harvest date	July 22	July 22

Rye yields ranged from 55 to 113 bushels/acre with an average of 85. The three hybrid rye varieties (Bono, Serafino, Tayo) had the highest yield. Rye and triticale seed germination ranged from 89% to 96% with an average of 94% (Table 2).

Oat yields ranged from 104 to 149 bushels/acre with an average of 124. Test weight ranged from 33.6 to 39.8 lb./bushel. Three varieties had a test weight above the milling threshold: 38 lb./bushel. The highest yielding variety was Reins. Antigo had the highest test weight (Table 3).

Further information about the trials, such as the characteristic of each variety and their source, can be found on the Practical Farmers of Iowa website:

[Cereal Rye and Triticale Variety Trial 2022]
practicalfarmers.org/research/cereal-rye-and-triticale-variety-trial-2022

[Oat Variety Trial 2022]
practicalfarmers.org/research/oat-variety-trial-2022

Acknowledgements

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Table 2. Yield, test weight, plant height, percent lodging, and germination of cereal rye and triticale varieties.

Variety	Yield		Test weight, lb./bu.	Plant height at harvest, in.	Lodging at harvest (%)[b]	Seed germination (%)
	bu./ac.	% site av.				
Aroostook	79	92	56	52	5	94
Bono	111	129	57	45	0	0
Danko	83	97	57	48	0	94
Elbon	55	65	55	54	7	96
Hazlet	87	101	58	48	2	95
ND Dylan	67	78	56	52	8	94
ND Gardner	63	74	55	54	10	94
Serafino	113	132	57	47	0	0
Spooner	65	76	56	54	0	94
Tayo	116	135	56	45	0	0
Tulus (trit.)	102	119	49	37	0	89
LSD(90%)	12	0	3	6	4	0
MEAN	85	0	56	50	3	94

By response variable, if the difference between any two entries is greater than the least significant difference (LSD), the entries are considered statistically different with 90% confidence.

Table 3. Yield, test weight, plant height, and percent lodging of oat varieties.

Variety	Yield		3-year average, bu./ac.	Test weight lb./bu.	Harvest plant height, in.	Lodging at harvest, %
	bu./ac.	% of site average				
Antigo	120	97	112	39.8	38	12
CS Camden	116	93	106	33.6	38	2
Deon	118	95	115	36.0	39	0
Esker 2020	114	92	124	33.6	40	7
Goliath	107	86	91	37.9	43	5
Hayden	136	109	125	37.6	41	0
Jerry	117	94	92	37.3	40	0
MN Pearl	119	96	130	36.5	38	2
Morton	104	84	101	35.5	45	0
Natty	132	106	125	37.8	37	3
Reins	149	120	144	38.5	34	0
Rushmore	129	103	134	37.6	39	0
Saddle	133	107	136	36.8	36	0
SD Buffalo	136	110	0	36.4	41	0
Shelby 427	134	108	128	37.7	39	0
Sumo	105	85	113	38.7	37	0
Warrior	144	116	124	36.8	40	0
MEAN	124	0	0	34.7	39	0
LSD(90%)	31	0	0	2.1	6	0

By response variable, if the difference between any two entries is greater than the least significant difference (LSD), the entries are considered statistically different with 90% confidence.
three-year average yields are listed for varieties trialed in the past two years at this location.

Long-Term Tillage and Crop Rotation Trial

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Fernando Marcos—research scientist, Department of Agronomy

Objective

To evaluate the long-term effects of tillage systems and crop rotations on grain yields and soil health.

Materials and Methods

Site-Year 1: Southwest Research Farm, Lewis | Crop Year–2021

Soil type	Marshall, Exira
Previous crop	varied by crop rotation
Hybrid/variety	corn–P0592AM; soybean–P29T37E
Planting date	corn–April 28; soybean–May 11
Row spacing	30 in.
Seeding rate	corn at 35,077 seeds/acre; soybean at 161,355 seeds/acre
Tillage	fall ST, CP, DR and MP November 3, 2020; spring lightly disced and then field cultivated, CC and SC, April 8, 2021. CCS field cultivated April 1, 2021. All plots except NT and ST.
Fertilizer	5 lbs. P_2O_5/acre and 28 lbs. K_2O/acre on all plots March 4, 2020
Nitrogen	All corn plots received 200 lbs. N/acre as 32% UAN solution
Harvest date	soybean–October 9, 2021; corn–October 18, 2021
Experimental design	randomized complete block design
Replications	4
Treatments	no-tillage (NT), strip-tillage (ST), chisel plow (CP), deep rip (DR), moldboard plow (MP)

Site-Year 2: Southwest Research Farm, Lewis | Crop Year–2022

Soil type	Marshall, Exira
Previous crop	varied by crop rotation
Hybrid/variety	corn–Stine 9752-32; soybean–Stine 3131
Planting date	corn–April 25, 2022; soybean–April 28, 202
Row spacing	30 in.
Seeding rate	corn at 35,077 seeds/acre; soybean at 161,355 seeds/acre
Tillage	fall ST, CP, DR and MP November 8, 2021; spring lightly disced and then field cultivated, CC and SC, April 6, 2022. All plots except NT and ST.
Fertilizer	92 lbs./ha of potash and 158 lbs./ha of MAP on all plots on December 8, 2021.
Nitrogen	all corn plots received 140 lbs. N/acre as 32% UAN solution on December 8, 2021.
Harvest date	soybean:–October 1, 2022; corn–October 10, 2022
Experimental design	randomized complete block design
Replications	4
Treatments	No-tillage (NT), strip-tillage (ST), chisel plow (CP), deep rip (DR), moldboard plow (MP)

Results

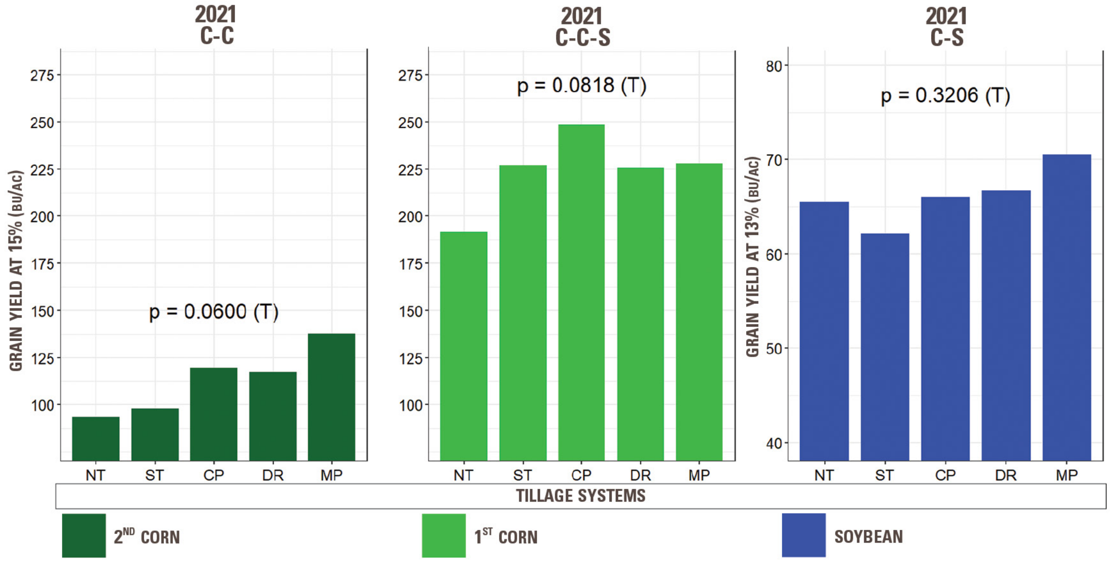

Figure 1. Grain yield in 2021 from the tillage systems within each crop rotation.

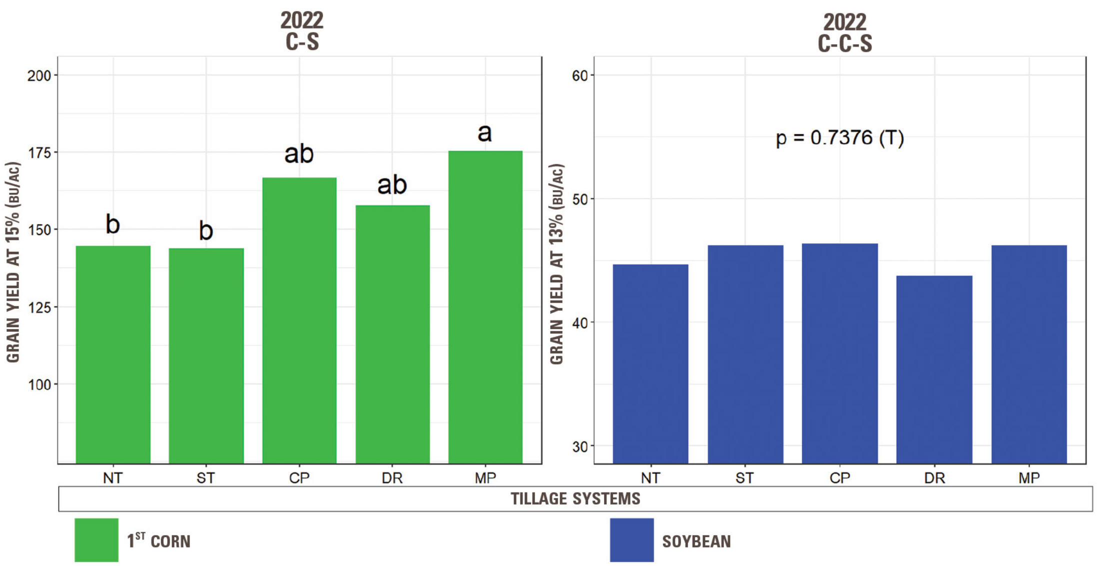

Figure 2. Grain yield in 2022 from the tillage systems within each crop rotation.

Key Takeaways

- In 2021, tillage systems did not significantly affect corn or soybean yields in any of the crop rotations. However, there was marginal significance for continuous corn and corn-corn-soybean yields where more intensive tillage had higher yields.
- In 2021, a continuous corn yield drag of 111.1 bushels/acre (50%) was observed compared with the first-year corn yields from the corn-corn-soybean rotation.
- In 2022, corn yields seemed to increase with increased tillage intensity. MP yielded statistically higher than NT and ST in the corn-soybean rotation.
- There were no statistical differences between tillage systems on soybean yield in the corn-corn-soybean.
- The corn-corn rotation in 2022 was severely lodged and data was not analyzed.

Acknowledgements

This project would not have been possible without help from Matt Groves at the Southwest Research and Demonstration Farm.

Adding Annual Forages Into Southern Iowa Farm Enterprises: A Forage Plot Demonstration Project

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Randy Breach—agricultural specialist, Armstrong Memorial Research and Demonstration Farm

Matt Groves—superintendent, Armstrong Memorial Research and Demonstration Farm

Incorporating annual forages into the farming operation provides the opportunity to fill in forage production gaps and extend the grazing season. However, many questions remain regarding species selection, forage quality and quantity, and application on the farm level. The objective of this forage plot demonstration project is to compare feed value and yield potential of various cool and warm season annual forages.

Materials and Methods

Five species of cool-season annual forages: cereal rye (Hazlet Rye), hybrid rye (KWS Progas), forage wheat (Willow Creek), winter wheat (Certified Oahe Hard Red), and triticale (Fridge) were no-till drilled September 21, 2020 with a harvest date of May 24, 2021; then drilled October 7, 2021, and harvested May 20, 2022. Five species of warm-season: German millet, pearl millet, sorghum sudangrass BMR hybrid, sudangrass hybrid, and teff (Moxie) were no-till drilled June 18, 2021 and harvested August 10 and September 24, 2021. Because German millet is a single-cut species compared with the other species, which are multi-cut species, the German millet was only harvested August 10, 2021.

For both cool- and warm-season species, individual species were seeded into 1,050 sq. ft.. forage plots at the Armstrong Research and Demonstration Farm and Neely-Kinyon Memorial Research and Demonstration Farm. Target seeding rates for cool seasons were 100 lbs./acre with the exception of hybrid rye, which was seeded at the recommended rate of 50 lbs./acre. Target seeding rates for warm seasons were 35 lbs./acre for sorghum sudangrass, 30 lbs./acre for German and pearl millet, 20 lbs./acre for sudangrass and 10 lbs./acre for teff. Eight replicates of each species were seeded with half of the plots receiving 0 lb. of Nitrogen (N) fertilization per acre, and half receiving 50 lb. of N/acre early in the growing season and (n=4/species). For cool-season species, forage samples were taken at random throughout individual plots and compiled for nutrient analysis based on species and N treatment. Yield data also were collected on individual plots and compiled for final species yield data. For warm-season species, forage samples were taken to determine nutrition analysis and yield data were collected at each cutting. Results from both cuttings were compiled and reported in the tables. The target for harvesting both cool and warm season species were near boot stage, or the reproductive stage when the seed head became present, mimicking when forages would be grazed and optimizing yield potential without hindering feed quality.

Results and Discussion

Forage nutrient value of the cool and warm season species are found in Table 1. While targeting harvest at boot stage for both cool and warm season species, individual variation in forage maturity at the time of harvest influenced forage quality. Cereal rye and hybrid rye were the first to reach reproductive maturity and tended to have the lowest forage quality as expressed by crude protein and energy (total digestible nutrients). Triticale reached reproductive maturity intermediate of the rye varieties and the two wheat varieties. As expected, nitrogen application tended to boost forage quality for both cool and warm season species.

Forage yield results are found in Table 2. For both cool and warm season annuals, N application resulted in an approximately 25% yield boost, demonstrating if producers are targeting annual forages as a forage source, fertilization is advantageous. Based on available equipment, cutting height of warm season forages was too low: approximately 3-4 in. instead of the desired 6-8 in. to favor adequate regrowth, therefore limited second cutting and total yield for the summer. Additionally, dry conditions over the span of the trial likely also limited forage growth.

Key Takeaways

Annual forages are a high-quality forage resource that can be a valuable addition to the cow herd. Incorporating annual forages into the grazing rotation can help fill in forage production gaps and extend the grazing season. Results of this forage plot project demonstrated an added 2.5-5 tons of forage on a dry matter per acre basis available for feed.

Table 1. Nutrient value of various cool and warm season species[1].

Species		year	0 lbs.N					50 lbs.N				
			DM%	CP%	ADF%	NDF%	TDN%	DM%	CP%	ADF %	NDF %	TDN %
Cool season[2]	Cereal rye	2021	17.54	11.23	42.91	66.32	55.48	21.67	12.70	43.37	66.28	55.12
		2022	25.02	11.77	36.20	57.48	60.70	17.69	13.45	33.68	54.62	62.67
	Hybrid rye	2022	17.50	13.14	37.69	58.89	59.54	18.12	14.72	35.86	55.60	60.97
	Triticale	2021	17.65	13.44	40.58	61.69	57.29	16.87	16.87	39.27	59.91	58.31
		2022	16.19	14.17	32.89	51.75	63.29	16.43	15.31	34.92	53.53	61.70
	Forage wheat	2021	22.18	12.10	37.60	58.45	59.61	19.67	15.66	39.47	60.46	58.16
		2022	18.67	16.82	33.50	48.25	62.81	18.07	17.66	31.47	49.75	64.39
	Winter wheat	2021	24.26	11.68	38.97	60.47	58.54	22.65	14.84	40.38	60.51	57.45
		2022	18.39	14.69	32.29	50.62	63.75	17.66	17.36	34.62	48.77	61.94
Warm season[3]	German Millet	2021	23.02	8.38	44.59	67.42	54.17	21.56	11.77	44.08	65.03	54.57
	Pearl Millet		19.06	7.78	38.68	61.73	58.80	18.12	9.89	39.46	62.79	58.16
	Sorghum Sudangrass		22.14	7.66	36.55	59.63	61.63	20.29	8.65	36.49	59.58	60.48
	Sudangrass		21.04	9.07	37.54	61.89	60.25	19.29	9.80	37.17	60.32	60.66
	Teff		34.37	9.21	40.67	64.87	57.22	32.29	10.72	38.57	63.40	58.86

[1]Abbreviations: DM=dry matter, CP=crude protein, ADF=acid detergent fiber, NDF=neutral detergent fiber, TDN=total digestible nutrients.
[2]2021= drilled 9/21/20, harvested 5/24/21. 2022=drilled 10/7/21, harvested 5/20/22.
[3]2021=drilled 6/18/21, harvested 8/10/21 and 9/24/22. Results of both cuttings were compiled with the average reported.

Table 2. Yield of various cool and warm season species, tons of dry matter/acre.

Species		Year	Armstrong Research Farm		Neely Kinyon Research Farm	
			0N	50N	0N	50N
Cool season[2]	Cereal rye	2021	0.49	0.86	1.63	1.83
		2022	0.98	1.04	1.01	1.28
	Hybrid rye	2022	1.44	1.35	0.91	1.15
	Triticale	2021	0.25	0.41	0.89	1.22
		2022	0.77	1.20	0.51	0.91
	Forage wheat	2021	0.31	0.78	1.20	1.46
		2022	0.54	0.44	0.29	0.64
	Winter wheat	2021	0.67	0.83	0.94	1.40
		2022	0.51	1.07	0.48	0.91
Warm season[3]	German Millet	2021	2.85	2.07	2.39	3.07
	Pearl Millet		1.58	2.93	1.54	2.14
	Sorghum Sudangrass		0.76	1.75	1.98	2.14
	Sudangrass		2.69	4.12	2.78	3.67
	Teff		2.68	3.33	3.14	2.64

[1]2021=drilled 9/21/20, harvested 5/24/21. 2022=drilled 10/7/21, harvested 5/20/22.
[2]2021=drilled 6/18/21, harvested 8/10/21 and 9/24/22. Results of both cuttings were compiled with the total yield reported. 2022 data currently unavailable.

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Influence of Feed Intake Management System on Cattle Intake and Growth Performance

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Dan Loy—professor, Department of Animal Science

Garland Dahlke—research scientist, Iowa Beef Center

Matt Groves—superintendent, Armstrong Research and Demonstration Farm

Individual animal feed intake systems such as the Feed Intake Monitoring System (FIMS) at the Armstrong Research Farm have become standard technology for beef cattle research. While these systems greatly increase the statistical power and efficiency of research facilities, an ad libitum feed management approach is necessary to allow cattle to have unlimited feed accessibility to express their desired intake.

In the industry, cattle feeders have been adopting a slick or clean bunk feeding system, targeting no feed remaining 3-5 days each week prior to the initial feed delivery for the day. Research has shown that when using this approach, feed conversion can be improved by approximately 2-3% compared with an ad libitum management approach in open bunks.

Despite the need for both feed management application systems in the beef industry, a comparison of feed intake, cattle intake behavior, and growth performance between cattle fed in an open bunk system compared with an individual intake system has not been conducted. Therefore, the objective of this study was to evaluate feed intake, growth performance, and carcass characteristics of steers fed in an individual feed intake bunk system (FIMS) compared with a traditional, open bunk system.

Materials and Methods

Based on source, hide color, and initial body weight (BW), 112 crossbred yearling steers (n = 28 hd/pen) were randomly assigned to one of two treatment groups: 1) fed in individual feed intake systems (FIMS), or 2) fed in traditional open bunk system (OPEN) with two pens per treatment.

Steers in the FIMS were managed to allow for ad libitum feed access. Steers fed in concrete open bunks were managed using the South Dakota State University 4-point bunk scoring system, targeting slick bunks or bunk score of 0 (no feed remaining) 3-5 days per week with the remainder of the days being bunk scores of ½ (scattered feed present, but most of bottom of bunk exposed) to 1 (thin uniform layer of feed across bottom of bunk–typically, about one corn kernel deep). Based on pen density and bunk space, steers fed in FIMS had 1 linear inch per head in comparison to 9 linear inches per head for steers fed in OPEN.

Individual animal BW were collected on consecutive days at the beginning of the trial and on day 56. A final carcass adjusted BW was calculated using hot carcass weight and a standard dressing percentage of 63% and utilized in performance calculations. All steers received a common implant at the beginning of the trial (Revalor-200, Merck) and were fed a finishing diet containing 57% whole shelled corn, 30% modified distillers grains, 10% hay, and 3% supplement on a dry matter basis (Table 1).

Table 1. Ingredient composition of diet fed (%, dry matter basis).[1]

	Diet
Whole shelled corn	57.0
Modified distillers grains	30.0
Ground hay	10.0
Supplement	3.0
Analyzed composition	
Dietary dry matter	75.7
Crude protein	16.1
NEg, Mcal/lb	0.62

After 103 days on feed, steers were harvested at a commercial packing plant where individual carcass data were collected. For statistical analysis, pen was the experimental unit.

No differences in BW were observed due to bunk management system between OPEN vs. FIMS ($P \leq 0.19$; Table 2). Over the duration of the trial, ADG, DMI, and feed conversion were not different ($P \leq 0.14$) between the two treatment groups. However, during the first feeding period, steers fed in OPEN bunks consumed less feed compared with steers fed in FIMS. Worthy of noting is the wide variation of individual performance within pen. The difference in social behaviors between steers fed within the open bunk system (where bunk space was adequate for all animals to eat at the same time) compared with steers fed in the individual intake bunks (where only one steer can eat at a time) may influence performance. Additional research is needed to further evaluate animal behavior in varying bunk management systems.

Bunk management system did not influence hot carcass weight, backfat thickness, marbling score, or yield grade ($P \leq 0.11$; Table 3). However, steers fed in OPEN tended to have larger ribeye area ($P=0.09$) in comparison to steers fed FIMS, likely a reflection of the numerical difference in hot carcass weights.

Key Takeaways

Results of this study demonstrated minimal differences in performance and carcass characteristics of steers fed in an open bunk system in comparison to an individual intake bunk system. However, additional research is needed to determine the impact of bunk feeding systems on individual steer social behavior to account for variation within the pen.

Table 2. Growth performance of steers fed in a traditional, open bunk system (OPEN) compared with an individual feed intake monitoring system (FIMS).

		OPEN	FIMS	SEM	P-value
Body weight[1], lbs./hd/d	d 0	896	899	5.6	0.63
	d 56	1193	1185	9.7	0.47
	d 103	1374	1360	7.7	0.19
Average daily gain, lbs./hd/d	d 0 – 56	5.40	5.19	0.140	0.27
	d 57-103	3.86	3.66	0.085	0.14
	d 0-103	4.60	4.43	0.070	0.14
Dry matter intake, lbs./hd/d	d 0 -56	31.56	31.74	0.019	0.01
	d 57- 103	34.14	34.42	0.876	0.78
	d 0 -103	32.40	32.63	0.401	0.64
Feed to gain (F:G), lbs./hd/d	d 0 -56	6.212	6.508	0.2130	0.30
	d 57-103	8.523	8.747	0.2354	0.44
	d 0 -103	7.137	7.448	0.1776	0.22

[1]d0 and d56 = live body weights with 4% shrink applied. d103 = Carcass adjusted final body weight utilizing hot carcass weight and standard 63% dressing percentage.

Table 3. Carcass characteristics of steers fed in a traditional, open bunk system (OPEN) compared with an individual feed intake monitoring system (FIMS).

	OPEN	FIMS	SEM	P-value
Hot carcass weight, lbs.	866	851	5.29	0.11
Ribeye area, sq. in.	13.07	12.69	0.117	0.09
12th rib backfat, in.	0.65	0.65	0.036	0.93
Marbling score[1]	1105	1104	34.9	0.99
Calculated yield grade	3.6	3.7	0.14	0.60

[1]1000 = low Choice; 1100 = average Choice; 1200 = high Choice

Integrating Field Peas into Feedlot Cattle Diets

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Dan Loy—professor, Department of Animal Science

Matt Groves—superintendent, Armstrong Memorial Research and Demonstration Farm

Interest in yellow peas as a grain product in Iowa and the Upper Midwest has been on the rise due to the added farm diversity and the potential for double cropping. Adding peas into the cropping system also provides the beef industry with a novel grain to be used in diets. This study was designed to evaluate the effect on steer growth performance, carcass characteristics, and meat quality of replacing corn in the traditional Iowa finishing diet with field peas.

Materials and Methods

Fifty-four purebred Angus steers were fed for 117 days at the Armstrong farm. Steers were fed in open pens equipped with bunks capable of monitoring individual feed disappearance (Feed Intake Monitoring System, FIMS). Steers were assigned to treatment groups based on age, marbling expected progeny difference (EPD), and body weight (BW) to one of two dietary treatments (n = 27 hd/trt): 1) a finishing diet composed of 66% corn, 20% modified distillers grains, 10% ground hay, and 4% supplement on a dry matter (DM) basis (CON), or 2) a finishing diet composed of 36% corn, 30% field peas, 20% modified distillers grains, 10% ground hay, and 4% supplement (PEA; Table 1). The comparison of nutrient profile of peas to whole shelled corn used in this study is found in Table 2.

Individual BW were collected on consecutive days at the beginning of the trial with a single day, midpoint yearling weight collected on day 56. A final carcass adjusted BW was calculated using hot carcass weight and a standard dressing percentage of 63% used in performance calculations. Dry matter intake (DMI), average daily gain (ADG), and feed conversion (feed to gain, F:G) were calculated on an individual steer basis. On day one, all steers were implanted with Component TE-IS (Elanco). Steers were harvested at a commercial packing plant (Upper Iowa Beef) where individual carcass data including hot carcass weight, ribeye area, marbling score, yield grade, and backfat thickness was collected. A 3-in. rib section from each carcass was collected and transported back to the Iowa State Meats Laboratory for further analysis of meat characteristics including Warner-Bratzler Shear Force (WBSF, a measurement of tenderness) and fatty acid profiles.

Table 1. Ingredient composition of diet fed, % dry matter basis).[1]

	CON	PEA
Whole shelled corn	66	36
Peas	0	30
Modified distillers grains	20	20
Ground hay	10	10
Supplement	4	4
Analyzed composition		
Dietary dry matter	76.2	77.3
Crude protein	13.8	18.2
Starch	52.1	40.1

[1]Abbreviations: CON=corn-based diet; PEA=corn-based diet containing 30% peas.

Table 2. Nutrient profile of field peas and whole shelled corn used in the study (% dry matter basis).

	Pea	Corn
Dry matter	84.87	85.30
Crude protein	23.63	8.51
Acid detergent fiber	5.59	4.14
Neutral detergent fiber	8.22	7.86
Starch	48.33	73.22
Fat	1.32	4.30
Ash	3.20	2.78
Non-fiber carbohydrates	65.67	80.61
Total digestible nutrients	84.05	87.40
Net energy for gain	0.68	0.65
Calcium	0.16	0.03
Phosphorus	0.38	0.35
Magnesium	0.16	0.11
Potassium	0.10	0.36
Sulfur	0.23	0.14

Results

Throughout the trial, no differences in BW or ADG were observed between CON vs. PEA-fed steers ($P < 0.36$; Table 3). However, PEA-fed steers ate 4.8 lbs. of DM/hd/d less ($P < 0.01$) during the first 56 days on feed, leading to an improved F:G ($P < 0.01$) compared with their CON-fed counterparts. However, this advantage was lost during the second half of the feeding period. Overall, PEA-fed steers tended to have lower DMI ($P = 0.07$) with no difference in feed conversion ($P = 0.14$) compared with CON-fed steers.

Carcass characteristics were not impacted by dietary treatments ($P \leq 0.72$; Table 3). Overall, steers on this trial graded 100% Choice and higher, with 17% grading Prime and 30% Yield Grade 4s and 5s.

Individual ribeye sections were analyzed for pH and color and no differences were found ($P \leq 0.16$; Table 4). Warner-Bratzler Shear Force (WBSF) was not impacted ($P = 0.71$) by dietary treatment. These steaks being considerably more tender than consumer acceptability threshold of 4.1 kg (Huffman et al., 1996), likely due to the quality of the cattle used in this research project, as the McNay farm cow herd has been selected for marbling for more than two decades.

Meat samples were analyzed for fatty acid composition (Table 5). No differences were observed ($P \leq 0.39$) for total saturated, monosaturated, or polysaturated fatty acids from steaks from PEA-fed steers compared with steaks from CON-fed steers. Steaks from PEA-fed cattle had higher levels of total omega-3 fatty acids ($P < 0.01$) compared with steaks from CON-fed cattle. While the concentrations of omega-6 fatty acids were not impacted ($P = 0.85$), the ratio of omega-6 to omega-3 was lower and more desirable in steaks from PEA-fed cattle ($P < 0.01$). Although consuming beef from cattle fed PEA would only have a small impact on overall omega-3 intake, the higher levels of dietary omega-3 are advantageous to support various human health benefits. including cardiovascular health.

Table 3. Growth performance and carcass characteristics of steers fed a traditional corn-based finishing diet (CON) compared with finishing diet containing 30% field peas (PEA).

		CON	PEA	SEM	P-Value
Body weight[1], lbs.	d0	844	852	14.3	0.57
	d56	1075	1088	16.7	0.44
	d117	1284	1281	19.6	0.89
Dry matter intake, lbs./hd/d	d0-56	28.0	23.2	1.46	<0.01
	d57-117	27.5	27.1	1.36	0.77
	d0-117	27.8	25.4	1.33	0.07
Average daily gain, lbs./hd/d	d0-56	4.13	4.21	0.171	0.61
	d57-117	3.48	3.30	0.194	0.36
	d0-117	3.76	3.70	0.122	0.64
Feed to gain (F:G), lbs./hd/d	d0-56	6.955	5.535	0.4224	<0.01
	d57-117	8.373	8.637	0.8534	0.76
	d0 -117	7.494	6.858	0.4184	0.14
Carcass characteristics	Hot carcass weight, lbs.	809	805	12.3	0.73
	Marbling score[2]	795	802	23.0	0.76
	Ribeye area, sq. in.	13.06	13.16	0.270	0.72
	Rib fat thickness, in.	0.67	0.69	0.054	0.73
	Calculated yield grade	3.67	3.67	0.176	0.98

[1]d0 and d56 = live body weights with 4% shrink applied. d117 = Carcass adjusted final body weight using hot carcass weight and standard 63% dressing percentage.
[2]600 = average Choice; 700 = high Choice; 800 = Prime.

Key Takeaways

In this study, peas successfully replaced 30% of corn in finishing diets resulting in similar average daily gain and feed conversion, while tending to consume less feed compared with steers fed traditional corn-based diets. Dietary treatments resulted in similar carcass traits, meat quality, and fatty acid composition. Steaks from steers fed peas resulted in greater omega-3 content and a more favorable ratio of omega-6 to omega-3 than steers fed higher concentration of corn in the finishing diet. Since all beef is low in omega-3, the biological significance of this difference may be questioned.

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