AGRICULTURAL ECONOMICS

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Cornhusker Economics

Historical Perspective of Crop Rotations across Nebraska

Market Report	Year Ago	4 Wks Ago	7-28-17
Livestock and Products, Weekly Average			
Nebraska Slaughter Steers, 35-65% Choice, Live Weight.	117.50	NA	*
Nebraska Feeder Steers, Med. & Large Frame, 550-600 lb.	167.07	NA	180.04
Nebraska Feeder Steers, Med. & Large Frame 750-800 lb.	152.52	NA	161.18
Choice Boxed Beef, 600-750 lb. Carcass.	198.78	NA	206.96
Western Corn Belt Base Hog Price Carcass, Negotiated	66.74	NA	80.34
Pork Carcass Cutout, 185 lb. Carcass 51-52% Lean.	82.65	NA	99.67
Slaughter Lambs, wooled and shorn, 135-165 lb. National.	167.15	NA	177.67
National Carcass Lamb Cutout FOB.	346.84	NA	430.71
Crops, Daily Spot Prices			
Wheat, No. 1, H.W. Imperial, bu.	2.96	NA	3.70
Corn, No. 2, Yellow **Columbus**, bu.	3.08	NA	3.37
Soybeans, No. 1, Yellow **Columbus,** bu.	9.68	NA	9.19
Grain Sorghum, No.2, Yellow Dorchester, cwt.	4.63	NA	5.64
Oats, No. 2, Heavy Minneapolis, Mn, bu.	2.55	NA	3.14
Feed			
Alfalfa, Large Square Bales, Good to Premium, RFV 160-185 Northeast Nebraska, ton.	165.00	NA	165.00
Alfalfa, Large Rounds, Good Platte Valley, ton.	70.00	NA	85.50
Grass Hay, Large Rounds, Good Nebraska, ton.	*	NA	90.00
Dried Distillers Grains, 10% Moisture Nebraska Average.	120.00	NA	109.00
Wet Distillers Grains, 65-70% Moisture Nebraska Average.	34.00	NA	39.00

*** No Market**

Nebraska is a diverse state with a wide range of farm production environments, including irrigated and rain-fed systems. With this diversity, crop rotation has become a big factor. Recent Stanford University research, published in the March issue of the Agronomy Journal, examined the effects and yield penalties from thousands of corn/soybean rotations. [1]

The University of Nebraska-Lincoln used this research and historic yields to simulate possible historical net returns for four rotations across Nebraska. Historical annual corn and soybean yields for six of the eight United States Department of Agriculture National Agricultural Statistics Service crop reporting districts (CRD) in Nebraska (20, 30, 50, 60, 80, 90) were studied and found to have varying net returns by crop rotation type. CRDs 10 and 70 were excluded because of the lack of soybeans grown in the districts.

Four different rotations are compared economically from 2006 to 2016. Two corn/soybean rotations are compared to both continuous cropping of either corn or soybean. The four rotations are:

- R1-continuous corn (CCC)
- R2-continuous soybean (SSS)
- R3-two consecutive seasons of corn followed by a single season of soybeans (CCS)
- R4-annual switching of corn and soybeans

Each rotation used a series of historical yields, prices and costs randomly drawn from the 2006 to 2016 cropping seasons. For simplicity, each year's production was marketed at that year's December average price.

Table 1 summarizes the 48 simulated results. From this table, it is easily seen that R3 (CCS) rotation is found to dominate under the 24 irrigated scenarios while R4 (CSCS) does so under the 24 rain-fed comparisons. Each of the CRDs have varying net returns, with CRD 90 having the highest net return average for the irrigated group and 80 for the rain-fed CRD's. The irrigated net returns, not surprisingly, are generally larger, except for R2. Which is consistent with the fact that continuously cultured irrigated soybeans are expected to have a higher disease burden than rain-fed culture. In 9 of the 12 instances R1 (CCC) was superior to R2 (SSS) and in one instance is ranked higher than R4 (CSCS), but is never ranked as the most profitable rotation. This result is consistent with the fact that R1 (CCC) has a smaller yield penalty under irrigated versus rain-fed conditions due to the riskiness of rain-fed culture through inter- and intra-seasonal variability in water availability via rainfall.

The increased yields and reduced production costs of the corn soybean rotations translate into higher average profits for all six CRDs for both mixed rotations, R3 and R4 versus either (R1) or (R2) except in the one case noted--irrigated corn for CRD 90. For both the irrigated and rain-fed conditions CRD 20 had very similar net returns for R3 and R4. The offsetting effects of the added yield bump of R3 proved to outweigh the cost savings of the fertilizer costs in R4 making R3 more profitable under irrigated conditions. However, in rain-fed conditions the fertilizer expense dominated and R4 was superior to R3.

Since each rotation was simulated 500 times, minimum and maximum values are available for discussion. These are summarized in Tables 2 and 3. Under irrigated conditions, Table 2, R2 (SSS) is observed to have the lowest net return for all CRD's, while R1 (CCC) has the largest single net return for each of the CRDs. The rain-fed scenarios tell a different story. The maximum observed net returns by CRD are shared equally between R3 and R4. The lowest observed net returns are shared equally among CRD's between the R1 and R2 continuous cropping systems.

Conclusions

Producers are faced with many choices, the difficulty being making the correct series of choices that make their farm business a success. The use of crop rotations as a method to reduce costs, increase revenue and or both is only one small decision in the myriad of many worthwhile choices. This work indicates that alternating corn and soybeans in some fashion potentially increases net returns.

In this simulation cultural practices and environmental differences, irrigation versus rain fed, alter which rotation is most profitable. Rain-fed conditions favor the traditional annual alternating of corn and soybean; which is perhaps an explanation for its adoption further east in the Corn Belt where irrigation is not used. The irrigated production systems favor a three-year rotation of two consecutive years of corn and one year of soybean. While the individual CRD results have varying levels of net returns, the ranking of the rotations among the CRD's are surprisingly stable, with just a few exceptions.

What has not been shown here or discussed is the effect of combining marketing strategy with production strategy. It is likely with careful planning and judicious use of the productive advantages in having some type of corn/soybean crop mix that improvements to net returns may be gained above those suggested here, remembering that there may also be potential for loss. Decision makers should note that before committing to any rotation scheme, it is ideal to consider and test the possible outcomes as much as possible for the individual field or fields being considered. Producers have an advantage if they have farmed a piece of land for many seasons and know what to expect in terms of yields and fertility needs. As with any decision of this type, it is worth the effort to quantify, as much as possible, both the costs and benefits before committing resources in production.

References:

[1]Seifert et. al. 2017. Continuous Corn and Soybean Yield Penalties across Hundreds of Thousands of Fields. Agronomy Journal, Volume 109, Issue 2. https://dl.sciencesocieties.org/publications/aj/pdfs/109/2/541

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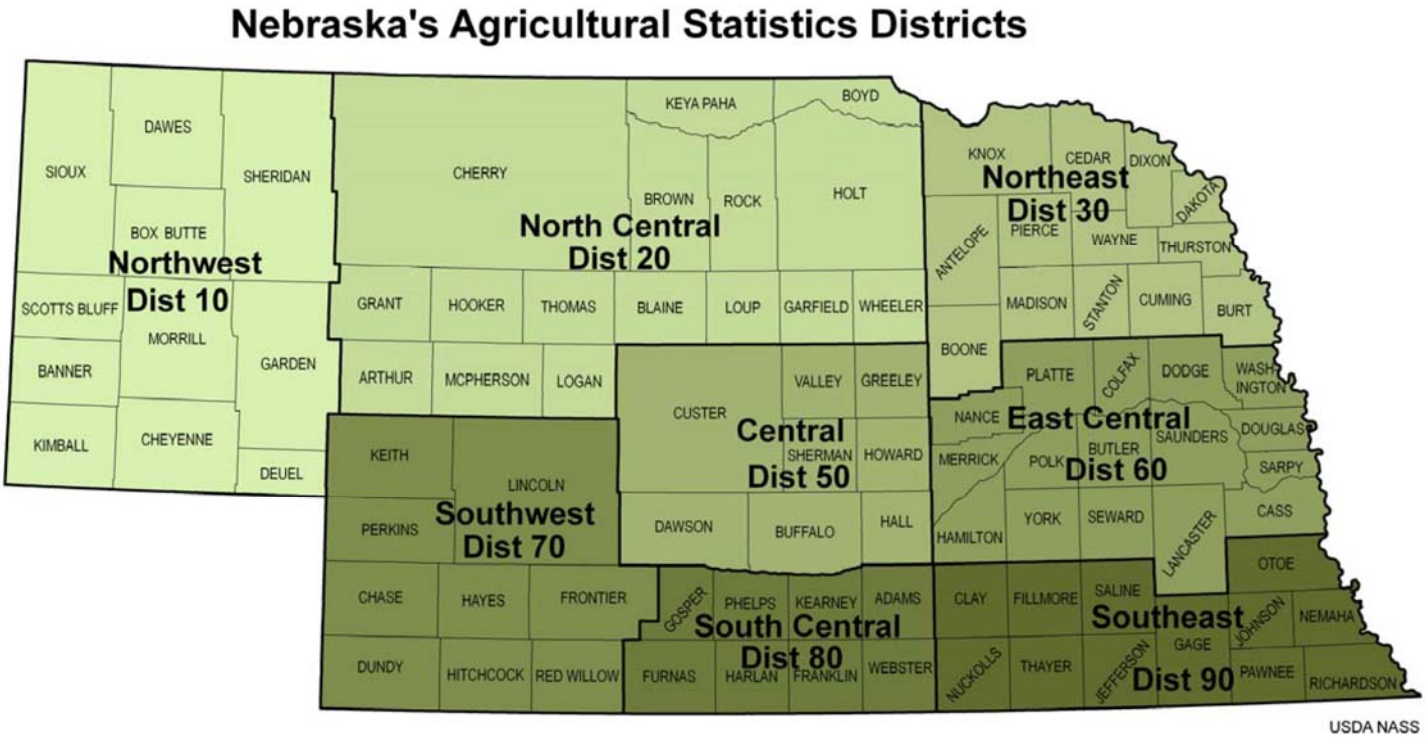

Figure 1.

Table 1. Simulated average net returns by rotation for each of the 6 CRD's by water regime--irrigated or rain fed.

Irrigated Simulated Average Net Returns				
Crop Reporting District	R1	R2	R3	R4
20	52.78	-42.71	84.63	83.37
30	56.21	-4.83	83.74	68.85
50	52.03	-12.79	99.19	86.11
60	59.93	-25.36	88.37	75.72
80	54.25	-30.26	95.64	81.63
90	69.10	-28.14	99.28	68.59

Rain-Fed Simulated Average Net Returns				
Crop Reporting District	R1	R2	R3	R4
20	-16.75	-103.79	58.53	61.92
30	-62.31	6.72	39.24	59.63
50	11.57	2.87	52.81	58.98
60	-2.72	6.41	48.35	58.46
80	-2.11	-15.18	60.31	75.98
90	-44.40	5.67	38.66	60.48

Table 2. Observed maximum and minimum net returns for the 4 rotations for the 6 CRD's from the 500 simulated net returns for irrigated conditions

Irrigated Simulated Maximum Observed Net Returns				
Crop Reporting District	R1	R2	R3	R4
20	434.55	121.40	426.49	378.12
30	414.13	118.00	372.81	320.32
50	458.23	155.75	450.46	389.72
60	475.36	120.25	422.13	368.84
80	517.56	139.34	480.27	430.04
90	514.16	126.16	465.35	384.49

Irrigated Simulated Minimum Observed Net Returns				
Crop Reporting District	R1	R2	R3	R4
20	-174.24	-205.93	-97.66	-82.07
30	-140.93	-164.35	-95.02	-101.70
50	-152.80	-196.08	-76.80	-83.61
60	-167.14	-197.32	-92.84	-107.60
80	-182.76	-203.26	-86.01	-95.49
90	-170.69	-214.44	-106.85	-127.72

Colored cells indicate the largest or smallest net returns

Table 3. Observed maximum and minimum net returns for the 4 rotations for the 6 CRD's from the 500 simulated net returns for rain-fed conditions.

Rain-Fed Simulated Maximum Observed Net Returns				
Crop Reporting District	R1	R2	R3	R4
20	187.08	73.60	276.43	249.70
30	181.25	159.82	263.32	266.82
50	254.71	183.15	275.84	262.89
60	243.13	181.15	254.25	236.04
80	238.52	176.07	303.64	307.95
90	134.09	161.46	208.17	211.24

Rain-Fed Simulated Minimum Observed Net Returns				
Crop Reporting District	R1	R2	R3	R4
20	-273.90	-307.75	-218.13	-209.70
30	-362.57	-219.02	-253.91	-223.24
50	-254.19	-257.39	-223.18	-214.30
60	-172.90	-174.64	-125.34	-113.73
80	-235.25	-177.78	-155.36	-124.11
90	-152.65	-137.54	-63.70	-48.02

Colored cells indicate the maximum or minimum net returns