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A CROPPING SYSTEM FOR INTENSIVE GRAIN PRODUCTION ON SLOPING LAND

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From the beginnings of Kentucky Agriculture, soil erosion and related losses in productivity have been major problems for Kentucky farmers. Improved soil conservation practices during the past forty years have been especially significant in the recovery and progress of our agricultural industry. No-tillage methods for crop production, which were pioneered in Kentucky, have proven useful in controlling erosion and holding production at high levels. During recent years, the marketplace has strongly encouraged grain production, with the unfortunate effect that many Kentucky hillsides have been returned to grain production without sufficient erosion control measures. This report describes innovations in use of no-tillage and other conservation practices to develop a system of grain production for sloping land, thus enabling increased income, and nearly eliminating erosion at the same time.

Land with little or no erosion hazard is scarce to most Kentucky farmers. Nearly 75 percent of Kentucky's agricultural land base has an erosion hazard of some degree. Except for bottomland along the larger streams and major rivers in the state, land with little or no erosion hazard rarely occurs in sizeable contiguous areas. Consequently, any promising cropping system which would enable production of such crops as corn and soybeans on land with an erosion hazard without undue erosion, would potentially be of great use in Kentucky.

Because of this important fact, we decided to take inventory of what cropping practices were of use to us in Kentucky and see if we could devise some system of grain production on sloping land which would minimize erosion. We settled on the system described below, which makes use of:

1/ Extension Specialists in the Agronomy Department, University of Kentucky College of Agriculture, and Dean, Ogden College of Science and Technology, Western Kentucky University, respectively.

(a) The standard midwestern corn-soybean rotation,
(b) seeding a small grain for winter cover.
(c) double-cropping
(d) no-till planting
(e) contour strip cropping, emphasizing relatively narrow strips.

In addition to these basic components, we also recognized the importance of establishing and maintaining sod waterways to serve as pathways for runnoff of excess rainfall.

Site and Procedures

We initiated our study of this system in the spring of 1977, on a moderately eroded Christian silt loam soil with 6-12 percent slope. We felt the site was representative of much of Kentucky's agricultural land. The field had been in a dense sod of tall fescue for the previous 12 years. Four successive strips, (replications) each 25 feet wide and 240 feet long, were established on the hillside, the length of each strip being roughly parallel to the contour across the slope. A composite soil test from the experimental area showed pH 7.1; Bray's 1 phosphorus of 8 lbs/A (very low); ammonium acetate extractable K, Ca, and Mg of 190 (medium), 3130 (sufficient) and 214 (sufficient) pounds per acre, respectively, in the top 6 inches of soil. Each main strip was split in half (12.5 feet wide) for four 30-inch rows of corn in one half and eight 15-inch rows of soybeans in the remaining half.

In the initial year, corn was no-till planted into the fescue sod in late April. At the same time, the half strip to be planted in soybeans was plowed and left fallow until mid-June when the initial planting of soybeans was made into a conventionally tilled seedbed. Corn was harvested near September 20, and soybeans harvested near October 25, after which the area was disced and planted to wheat. After the initial year, planting was performed according to the system outlined below. Phosphorus was spread uniformly over the entire area each year at the rate of 120 lbs. P_2O_5 per acre per year, and potassium was tested at either 0, 60, or 120 lbs. K_2O per acre per year. Ammonium nitrate was broadcast on the corn each year at planting at the rate of 150 lbs. N per acre. We planted Pioneer 3369-A variety of corn at the rate of 24,000 seeds per acre in 30-inch rows, with a row application of 10 lbs. of Furadan per acre. Mitchell variety soybeans were planted each year in 15-inch rows after inoculation with peat-based rhizobia inoculum. We seeded the wheat variety, Doublecrop, each fall at the rate of 1.5 bu/A with a grain drill.

Since both corn and soybeans were no-till planted we used chemical weed control. For corn we used a mixture of 1.5 pints Paraquat, 1.25 lbs. Aatrex, 2.5 quarts Lasso, 0.5 pint X-77 surfactant, and 40 gallons water per acre, uniformly spread across the corn strip by a planter-mounted tank and spray-rig. The soybean herbicide treatment consisted of a tank mix of 1.5 pints Paraquat, 2.5 lbs. Lasso, 1 lb. Lorox, 0.5 pint X-77 surfactant, and 40 gallons water per acre applied at planting by a planter-mounted tank and spray-rig.

The System Tested

Corn and soybeans were grown in alternate parallel strips, generally on slope contour; after corn and soybeans were harvested, the field was disced and seeded to wheat. The following spring, corn was no-till planted into the strip which produced soybeans the previous year (the wheat in this strip was killed in the no-till planting procedure to provide a mulch cover for the corn); wheat growing in the strip which produced corn the previous year was allowed to mature for harvest, and immediately following the combine, soybeans were no-till planted into wheat stubble. Relatively narrow strips (20 to 50 feet wide) are an important part of the scheme. After harvest, the field was disced, planted to wheat, and the above process repeated except for rotating the corn onto the previous year's soybean strip, and soybeans onto the previous year's corn strip.

Discussion

As can be seen from Table 1, yields have been exceptionally high, particularly in view of the soil and site characteristics and considering that soybeans were double-cropped. Double-cropping of soybeans was simulated in the initial year by delaying planting until June 16. During the second and third year of the study, the planting date for soybeans following wheat at this location was during the last week of June.

Wheat yields were obtained during the study only in 1978, measuring in the 30 to 34 bu/A range. We did not get an adequate stand of wheat from the fall 1978 seeding to justify grain harvest in 1979. Typical wheat yields from an adjacent field ranged from 35 to 50 bushels per acre during this time.

We reasoned that this system would:

(a) provide good erosion control since the field would never be cultivated except for a fall discing, and both corn and soybeans would be no-till planted. The weak link is obtaining enough fall growth of wheat to provide good overwinter cover. With normal fall weather in our latitude, we usually can complete soybean harvest by mid-to late-October, and seed wheat immediately thereafter. Abnormally cold weather by early November can prevent wheat from providing adequate cover.

Although we have tested these thoughts, we feel two safety valves could also be added by establishing and maintaining a sod strip (just wide enough to mow) between each crop strip, or in event that harvest is too late to justify seeding the small grain, simply leave the strips untilled overwinter. In this case there will be adequate corn residue to protect that strip, and there will be partial protection from soybean residues that remain on soybean strips. We feel that the worst which would likely happen under these circumstances would be sheet erosion across soybean strips with deposition at the next corn strip downhill.

(b) allow long-term production of corn and soybeans on sloping land.

(c) enable the use of sloping land to produce grain intensively while controlling erosion. In areas where small grains can be fall planted, this system would result in each acre used producing 1.5 acres of harvested crops (0.5 acre soybeans, 0.5 acres corn, and 0.5 acres small grain).

(d) result in better broad-spectrum weed control than that possible in fields used continuously for either crop alone.

In addition to yields, we were interested in erosion control resulting from use of this system. We did not include check systems of continuous soybeans or continuous corn, both with and without seeding a winter cover crop for the reason that we were on a farmer's field and did not want to take the risk of serious erosion losses from such plots. Because of this, we have no check plots against which to compare for effect of erosion control. All we can report in this respect is that we observed no appreciable erosion occurring on these strips during the 3-year period. The system was really put to the erosion test in the winter and spring of 1978-79. Approximately 80 inches of rain fell between December 1, 1978 and December 1, 1979. Despite lack of good cover from the wheat, there was essentially no sheet erosion during this period from the strips which had been in corn. There was slight sheet erosion on the strips which had been in soybeans, but this stopped as it reached the adjacent downhill strip which had been in corn. Since the odds of rainfall amounts such as fell during this period are on the order of one in a hundred, we feel the system offers adequate erosion protection to justify its use in intensifying grain production from sloping land.

As apparent from the description of our experimental procedure, strips only 12.5 feet wide are not practical for large commercial farms. More realistically, strip widths should be of some multiple of a combine width up to perhaps 50 feet. Strips of 20 to 25 feet width would enable one round per strip of 4-row equipment, or one through per strip of 8-row equipment. While we did not study effect of strip width, our best judgement is that strips over 50 feet in width would allow overwinter runoff of water from soybean strips to build up enough speed to potentially create erosion problems in those strips.

An apparent advantage for corn grown in narrow strips was less occurrence of leaf and stalk diseases and less lodging. Also, the differential heating produced by the alternating height of corn and soybeans possibly causes more desirable air flow patterns than is typical in separate fields of corn and soybeans.

Summary

We believe that the system permits better sunlight, water, soil and air management for maximum crop production and minimum erosion. This approach provides the farmer with a strong economic incentive to carry out good soil conservation practices. It should be especially helpful in meeting requirements of the Water Pollution Control Act for non-point source pollution.

Although it won't likely happen, if Kentucky farmers adapted the system to even half the 5 million acres of class IIIe and IVe land, an increase in gross income of at least 100 million dollars could be achieved with the primary erosion problem solved at the same time. The old adage of "two birds with one stone" seems appropriate in this case.

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Table 1. YIELD (bu/A) OF CORN AND SOYBEANS GROWN IN STRIP ROTATION

STRIP	CROP	1977	1978	1979	3-YR AV.
1	Corn	152	145	147	148
	Soybeans	63	49	43	52
2	Corn	157	139	157	151
	Soybeans	68	52	48	56
3	Corn	152	134	153	146
	Soybeans	50	44	55	50
4	Corn	147	135	159	147
	Soybeans	53	43	54	50
Av.	Corn	152	138	154	148
	Soybeans	59	47	50	52