

# Crop Rotations:

## Resurrected As Way To Drop Costs And Increase Yields

When commodity prices slide downward, a farmer is faced with two alternatives if he plans to maintain his profits — reduce production costs or increase yields.

By using parts of a program that was standard practice nearly 40 years ago, a number of producers have found a way to do both.

"Not long ago, crop rotations were the cornerstone of any crop production program," says Garren Benson, professor and Extension agronomist at Iowa State University. "Any textbook dealing with crop and soil management dealt with the subject in great length and extolled the benefits of rotation."

Among these benefits were the ability of one crop to provide nitrogen for the following crop, improved insect, weed and disease control and improved soil structure and tilth. Crop rotations also offered the potential to reduce erosion and spread labor demands in a time when farms were extremely labor intensive.

Because forage-consuming cattle and horses were part of the scene, hay and pasture played an important role.

However, as chemical fertilizers, insecticides and herbicides became available at reasonable prices, the yield benefits of rotation became less important. It appeared that chemicals could be used as a substitute for a rotation program.

Now evidence partly to the contrary is piling up as agronomists and soil scientists prove that crop rotation still can increase yields — even if all other factors are equal.

### Crop Rotation Changes

"During the 50s and early 60s, farmers were asking if crop rotations were really necessary," Benson notes. "But in reality, there were two parts to the question. One was the question of yield and profitability, and the other was the long-term effect on the soil."

In answer to those questions,

1950's studies showed that a wide range of cropping systems could produce high corn yields, but warned continuous corn should only be grown on land where erosion could be controlled. In fact, studies showed continuous corn on coarse and medium-textured soils could be maintained at 95 to 100 percent of the yield of corn in rotation. Thus, the opinion was that as long as adequate nitrogen was supplied and corn rootworm was controlled, corn yields were nearly identical, regardless of the previous crop.

"In some tests this was true," Benson adds. "But in others, it was not. Also, most of the earlier studies did not include soybeans, which has since become the major crop with which corn is rotated."

Whether the difference between then and now is attributable to cultural and cropping practices or years of repetition, no one is really sure. What is certain, according to Benson, is evidence that rotation does offer the majority of farmers a yield advantage.

### Advantages

"If one were to average studies in the Midwest in the last few years, a typical corn yield reduction for corn following corn versus corn following some other crop would be about 10 percent, with a five to 15 percent range being typical," he says. "This assumes recommended rates of nitrogen were used and other management practices were at a high level."

Although the exact reasons for yield increases associated with crop rotation are hard to pinpoint, there appear to be several factors which interact, including soil nutrient differences.

For example, soybeans are considered to be worth the equivalent of between 20 and 60 pounds of nitrogen per acre, depending on the location, soil type, yield, etc. Some experts simply recommend reducing the nitrogen application by one pound for every bushel of soybeans produced the previous fall.



The crop rotation concept is regaining its former popularity, helping producers reduce costs and increase yields.

Naturally, the equivalent value of nitrogen provided by a forage legume crop is even greater — up to 140 pounds per acre.

But recent studies also demonstrate high rates of nitrogen alone can not overcome the yield differential caused by rotation.

### Crop Benefits

"It's interesting to note that corn isn't the only crop to benefit from rotation," says Kent Crookston, professor of agronomy at the University of Minnesota.

In most cases, he explains, every crop in the rotation program produces higher yields. In other words, corn yields better when it is rotated with soybeans, and soybeans yield better when they are rotated with corn. Moreover, the phenomenon is not limited just to corn and soybeans. Corn yields also improve when the crop is preceded by sorghum, and soybeans yield better when they follow sunflowers.

"We've also just completed a study which shows corn will do as well when it is rotated with fallow as it will when rotated with soybeans," Crookston continues. "So we feel the yield increases have to be credited to something besides the nitrogen contribution of the previous crop. Corn is obviously not contributing any nitrogen to soybeans."

As Crookston points out, the theory for higher yields has changed directions. Instead of believing rotation produces positive influences, researchers now are theorizing that a change in crops simply prevents the negative influences which exist when a crop is repeated year after year.

"A few years ago, we were thinking soybeans were good for corn," he explains. "Well, in a sense they are. But to be more realistic, corn is bad for corn, or any crop is bad for itself."

### Rotation Mystery

The mystery surrounding yield differences runs even deeper some years, according to Iowa State's Benson. Quoting research conducted at the University of Minnesota, he says corn yields were reduced by 39 percent in 1975 and 1976 for corn following corn versus corn following soybeans. In contrast, the yield difference for the same tests averaged only 11 percent in 1977 and 1978. Similar differences have been observed at the University of Illinois and at Iowa State University.

"Even though we might suspect the benefits of nitrogen, soil

moisture, reduced disease and insect pressure for the typical yield increases, we're still not sure how important each factor is to the large yield differences," he says.

As a case in point, he notes that a high percentage of the severe corn following corn yield reductions came from areas where corn was stressed due to lack of moisture in July or August.

"Problems may be even worse when corn doesn't have an extensive root system when combined with low rainfall and high temperature," Benson says.

### Soil Properties Change

"If root expanse is a key, then anything that restricts roots must be considered," Benson says, referring to changes in soil tilth and the degree of compaction.

In addition to affecting the amount of moisture and nitrogen available to the plant, soil conditions appear to also affect the way the plant meets its carbohydrate needs. As a result, the plant may be stressed to the point it becomes more susceptible to stalk and root rots.

Another soil property which continues to be elusive to soil scientists is the possible toxic effects of leftover crop residue.

As Minnesota's Crookston explains, agronomists slowly are discovering both the residue and roots of a crop contain chemicals which either inhibit or stimulate seedling vigor. For instance, researchers at Iowa State University have shown soybean

(Turn to Page A38)

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