Crop Rotations Boost Corn, Soybean Yields

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Crop rotation is a practice that has been used for centuries in grain production around the world. In the northeast United States, crop rotations are used extensively. Generally, we know that better crop yields are achieved when we rotate, even in the absence of serious weed, insect, disease or fertility problems. Even so, the effects of crop rotation are still not completely understood. Greg Roth, Penn State agronomist, relays recent research from the University of Minnesota which sheds some new light on the effects of crop rotations and how they might be exploited even more.

In this series of studies, several corn and soybean rotation schemes were compared to continuous corn, continuous soybeans, and continuous corn and soybeans with alternating varieties each year. The objective of these experiments was to compare yield levels among the various cropping sequences.

The researchers found no advantage to alternating crop varieties each year under continuous corn or soybeans. With continuous cropping, second year corn and soybean yields were lower than first year corn and soybean yields. The pattern of yield decline after the first year differed, though, between the two crops. For corn, yields declined from 172 bushels per acre to 145 bushels per acre in the second year. Yields then increased slightly the following year to 151 bushels per acre and remained essentially the same in subsequent years. Soybean yields declined from 48 bushels per acre to 45 bushels per acre in the second year, and dropped again to 43 bushels per acre in the third year. Bean yields in subsequent years then remained at this level. Consequently, it appears that corn yields drop sharply at first in a continuous system and then recover somewhat, while soybean yields decline slowly, reach a bottom, and then stay there. It appears that soybeans would follow themselves better than corn in a rotation.

Yields of alternated corn and soybeans averaged 164 to 44 bushels per acre and were not as high as first year corn (172 bushels per acre) or soybeans (48 bushels per acre). Compared to monoculture, alternating crops improved yields by 10 percent for corn and 8 percent for soybeans. First year yields compared to monoculture were 15 percent higher for corn and 17 percent higher for soybeans. This indicates that both crops respond nearly the same to rotation and that the full rotation effect is not achieved with alternating crops. These results suggest that a three crop rotation might yield more than the two-crop corn-soybean rotation, commonly used in many areas today.

Researchers have documented similar crop rotation responses for corn in Pennsylvania. These responses may be even greater where specific pest problems associated with continuous corn are prevalent. In Pennsylvania, some of the most serious of these pests include corn rootworms, perennial weeds, shattercane and gray leaf spot. Where these pests are a problem, rotation should help to maintain or increase yields while reducing pest control and fertilizer expenses.

The Secondary Nutrients

While calcium, magnesium and sulphur are called secondary nutrients, they are essential for the growth and good health of all plants and animals.

Calcium (3.2 percent) is the fifth most abundant element in the earth's crust, while magnesium (2.5 percent) and sulphur (0.1 percent) are ranked eighth and thirteenth, respectively.

These plant nutrients occur naturally in soils, but are usually present in mineral or organic forms unavailable to plants. The growth of food and fiber crops is frequently limited by availability of these nutrients. The soil must be fertilized to provide amounts adequate for optimum plant nutrition.

Many factors can affect the availability of calcium, magnesium and sulphur to plants. The best estimates of availability of these nutrients can be determined by soil analysis or a combination of soil and plant analyses. However, field observations and deficiency symptoms are also important diagnostic tools.

Soil texture indicates the relative amounts of sand, silt, and clay present. Sandy soils are most often deficient in the secondary nutrients. Higher amounts of clay and organic matter enable soil to retain these nutrients against weathering (leaching) and to provide more nutrients as soil minerals decompose and organic matter is mineralized by soil microbes. Organic matter is particularly important as a source of sulphur for plants.

Low soil temperatures tend to limit the ability of plants to take up the secondary nutrients. Release of sulphur from organic matter is slowed by low temperature. This is one reason why supplemental sulphur may be beneficial to crops planted in cold, wet conditions.

Highly weathered, acid soils usually contain relatively low amounts of available calcium and magnesium because they have been leached. Soil acidity affects the availability of many nutrients.

Uptake of the secondary nutrients can be affected by the presence of large amounts of other nutrients in the soil. Magnesium absorption is particularly depressed by the presence of large amounts of available potassium. Uptake of calcium can also interfere with magnesium utilization. When magnesium uptake is depressed in grasses, cattle grazing that forage may suffer from "grass tetany," caused by low levels of blood serum magnesium. Recent data indicate high availability of phosphorus can boost magnesium uptake. Sulphur uptake can be depressed by the presence of large amounts of available nitrogen.

Crop plants get their requirements for calcium, magnesium and sulphur from one or more sources, including: soil clay, soil organic matter, soil minerals, commercial fertilizers, agricultural limestone, irrigation water, rainfall and snow, and kiln dust.

Sulphur in soils is present in a number of organic and inorganic forms. Soil bacteria and fungi play an important role in making sulphur available to plants.

Energy For Farming

The USDA's Economic Research Service offers the following observations and predictions about agricultural energy consumption:

If the world price of crude oil averages $30 per barrel this year, farm energy expenses for diesel fuel, gasoline, liquified natural gas, and electricity will probably rise 10-15 percent from 1990. An average price of $40 per barrel would raise farm energy expenses around one-fourth. In addition, the increase in the motor fuels tax will increase farm energy expenditures 1.5 percent.

With only a modest change in planted acreage forecast for 1991, energy use likely will remain about even with last year. Although rapid petroleum price increases tend to encourage energy conservation in the long run, short-run adjustments in energy consumption are often difficult to make because farmers tend to change their holdings of equipment slowly.

Farmers' consumption of petroleum products has been steadily declining since 1982, regardless of planted acreage. While acres planted influence energy use, other factors are more important. The switch from gasoline to diesel engines, reduced tillage operations, larger multi-function machines, and innovations in crop drying and irrigation have contributed to the decline in fuel consumption.

While no-till farming has not been widely adopted, reduced tillage systems are now as prevalent as conventional tillage systems in many parts of the country.

It is clear that crude oil prices dictate the price farmers pay for diesel fuel. As of November, the U.S. Department of Energy forecast that crude oil and diesel fuel prices would increase 30-40 percent in 1991, but unpredictable geopolitical forces will shape the final 1991 petroleum price structure.

Since agriculture directly consumes only 3-4 percent of all energy used in the U.S., changes in the farm sector's use will have little impact on petroleum prices.