BENEFITS AND MANAGEMENT OF CROP ROTATION

Crop rotation is a component of crop production and an implement for farm management, as it balances agronomy and economic market realities. From an agronomic perspective, crop rotation can increase nutrient cycling and nutrient use efficiency, decrease plant diseases and insect pests, assist in managing weeds, reduce soil erosion, and increase soil health. A common rotational system in many farming regions is corn followed by soybean for a two-year rotational program. Research at Iowa State University on extended multi-year rotations of three to four years found that although net economic returns did not differ between the cropping systems, corn and soybean yield potential increased, soil health improved, soil erosion decreased, herbicide and nitrogen (N) fertilizer use decreased, and some plant diseases were reduced.[1]

Managing Risk with Crop Rotation

Crop rotation can help reduce the risk of adverse environmental stress, such as drought, early frost, and wet springs that result in a delayed planting window. It can help reduce the risk of an economically significant infestation of insects that are specific to a crop for a part of their life cycle, such as the corn rootworm complex and soybean aphid. Most foliar plant diseases are also specific to a certain crop species and, therefore, rotation can help reduce the risk of economic loss as the result of plant diseases such as Northern corn leaf blight, brown stem rot of soybean, and tar spot in corn.

The cropping sequence of the rotational system should also be considered, as certain sequences may be detrimental and increase disease risk. For example, corn grown before wheat can increase the incidence of fusarium head blight (wheat scab) in wheat. Additionally, there are some root and crown diseases of wheat that can also increase in incidence in a corn-wheat rotation system, as corn can be infected by some wheat diseases as well.[2]

A tool to assist in determining the economic returns from a corn-soybean and a corn-soybean-wheat rotation has been developed at the University of Illinois and is available at https://farmdoc.illinois.edu/fast-tools/planting-decision-model.

Managing Resources with Crop Rotation

Crop rotation can help increase environmental resource use and producer time efficiency. Water use rates can be very different between crops. For example, corn is considered a high water-use crop compared to wheat and soybean.[2] Therefore, after drought, a crop with a lower water use rate should follow corn in rotation if soil moisture is not restored to full capacity during the off season.

Crop rotation can improve time management as well, as it allows farmers to spread the workload over a longer time. Equipment and labor can be more efficiently used because different crops are planted, managed during the growing season, and harvested at different times.

Managing Weeds with Crop Rotation

Many weed management plans include crop rotation as a tactic. A single crop in a continuous cropping system can become infested with a weed species that has adapted to the crop being grown and the management system being used. Alternatively, a diverse crop rotation changes the weeds' environment. The changing environmental conditions prevent any one weed species from becoming dominant, which helps to prevent the overreliance on a single herbicide that can lead to herbicide resistance in weeds.

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A survey of the scientific literature indicated that crop rotation resulted in lower weed densities in 21 cases, higher weed densities in 1 case, and equal weed densities in 5 cases compared to continuous cropping of a single crop. In 12 studies, the weed seed bank density was also reported for crop rotation and continuous cropping systems. In these studies, the weed seed bank density was lower with crop rotation in 9 cases and equivalent in 3 compared to continuous cropping.[3]

Carbon Sequestration with Crop Rotation

In a long-term study in Illinois, a continuous corn production system lost about 30% of the soil carbon when compared to a corn-oats-clover rotation system. However, recent studies have indicated that the tillage system, specifically no-till systems, in conjunction with crop rotation can play a major role in maintaining or increasing soil carbon content.[4]

Final Thoughts

Using cover crops is also a way to introduce diversity into the cropping system. Please see the Bayer ForGround Resource Library for more information adding cover crops into your cropping rotation.

Here are some things farmers should consider when deciding whether to add a rotational crop into their cropping system.

- Do I have a market for the crop I am adding to the rotation?
- Is the crop a grass or broadleaf, which would have implications for the herbicide program?
- Is the crop an annual, biennial, or perennial?
- Is the crop a cool-season plant or a warm-season plant?
- Does the seeding date require a fall seeded, early spring, or late spring planting window?
- Is the crop harvested once during the growing season or multiple times?
- What are the fertility and pH requirements of the rotational crop?
- Will my equipment match up with the what the crop requires for planting, maintenance, and harvesting?

Sources:

[1] Liebman, M.Z., Chase, C.A., Johanns, A.M., Sundberg, D.N. 2013. Agronomic and economic performance of three crop rotation systems in Central Iowa. Iowa State Research Farm Progress Reports. 1889. https://lib.dr.iastate.edu/farms_reports/1889/.

[2] Beck, R. 2021. Crop rotation in farm management. South Dakota State University Extension. https://extension.sdstate.edu/crop-rotation-farm-management.

[3] Liebman, M. and Dyck, E. 1993. Crop rotation and intercropping strategies for weed management. Ecological Applications. 3:92-122. https://doi.org/10.2307/1941795

[4] Al-Kaisi, M. 2008. Impact of tillage and crop rotation systems on soil carbon sequestration. Iowa State University Extension. https://store.extension.iastate.edu/product/5453

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