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Costs and Benefits of Cover Crops: An Example with Cereal Rye

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Cover crops are considered one of the most effective in-field practice farmers can use to reduce nitrogen and phosphorus losses, keeping those nutrients out of streams and lakes. This article takes an initial look at the costs associated with cover crops for a specific example of drilling cereal rye into corn stalks. Potential benefits from cover crops also are discussed.

Costs Associated with Cover Crops

The costs associated with a cover crop will depend on many factors including the previous crop, next crop, tillage system, pesticide practices, cover crop species planted, and cover crop planting method. Regardless of the specific production choices, most of the costs associated with the cover crop will be in its establishment, which includes planting and seed costs.

In the following example, cereal rye is drilled into standing corn stalks with the next crop being soybeans. This practice is chosen because it is relatively straightforward to implement and is often one of the first cover crop practices to be adopted by farmers (Eileen Kladivko, et al., *Managing Cover Crops: An Introduction to Integrating Cover Crops into a Corn-Soybean Rotation*). Drilling costs are taken from the *2015 Machinery Cost Estimates* and equal $13.10 per acre. In this example, 30 pounds of rye are planted and the cost of the rye is $.25 per pound. Given these parameters, the costs of establishing the cover crop are $20.60 per acre:

$13.10 per acre for drilling

$7.50 per acre in seed costs (30 pounds x .25 per pound)

$20.60 per acre cost of establishing the cover crop.

These costs will vary. Aerial applying seed into standing corn likely is costlier than drilling, but may reduce timing concerns associated with drilling after harvest. Seed costs will increase with higher seeding rates or by planting different species. Cereal rye is one of the lowest cost seed alternatives for cover crops. Use of legume cover crops can increase seed costs.

Costs other than establishment costs will depend on current tillage and herbicide practices. Two examples are given below which give a wide range of costs associated with the cover crops: one for no-till and one for minimum tillage. Additional costs occur when changes are made to the underlying tillage system.

No-till: In a no-till system, cover crops add little-if-any costs beyond those for establishing the cover crop. Some farmers may need to adjust herbicides in the burndown spray or occasionally have additional or spot sprays in unusual situations. To recognize these possibilities, an additional $5 per acre change is added to cover additional herbicides. This additional cost represents 1.25% of the $40 pesticide costs budgeted for soybeans (2016 Illinois Crop Budgets). The $5.00 additional herbicide cost plus the $20.60 per acre establishment costs results in total cover crop costs of $25.60 per acre.

Minimum Tillage: In many minimum tillage situations, two tillage passes occur: a deeper tillage operation in the fall and a secondary tillage in the spring. Switching to a cover crop would eliminate these tillage passes, but add a burndown spray to terminate the cover crop. This example, therefore, assumes eliminating the costs of the forgone tillage passes and adding those of a burndown spray. The fall pass is valued assuming a chisel plow pass in the fall having a $15.40 per acre cost and a field cultivator pass in the spring having a $10.10 cost. Both tillage pass costs are taken from the *2015 Machinery Cost Estimates*. Tillage costs foregone total $25.50 per acre. A burndown spray likely has a $15 per acre cost. Hence, a switch from a minimum tillage system to cover crops would be expected to reduce the $25.60 establishment costs by $10.50 per acre ($25.50 tillage cost reduction - $15 additional burndown spray), giving the practice a net cost of $15.10 per acre.

The above two situations illustrate ranges in cover crop costs. A no-till system would be expected to have higher costs of $25.60 per acre compared to $15.10 per acre for minimum tillage. This difference in cost is largely due to the reduced costs moving from minimum tillage to no-till and cutting out two passes in the field. Somewhat ironically, adopting cover crops in a no-till situation likely is easier to implement because fewer production practices need to be changed than in a minimum tillage scenario.

Water Quality Benefits of Cover Crops

Concerns that nutrients from farming are negatively impacting water quality have increased interest in cover crops in Illinois. For example, the Illinois Nitrogen Loss Reduction Strategy developed by a working group formed by the Illinois Water Resource Center-Illinois Indiana Sea Grant, the Illinois Environmental Protection Agency, and the Illinois Department of Agriculture, has established a goal of reducing nitrate loading in waters by 15% by 2025. Cover crops can scavenge non-organic nitrogen from soils, tying nitrogen up in the cover crop, thereby reducing the chances that those nitrates enter water bodies.

Farmer Benefits from Cover Crops

Reducing nitrates in water-bodies has public benefits which do not directly accrue to farmers. Stated alternatively, a reduction of nitrates in streams and lakes does not directly aid farmers in paying cover crop costs. For farmers to benefit, a combination of yield increases or cost reductions must occur. Many evaluations of cover crops to date do not include farmer-based benefits. For example, the Illinois Loss Reduction Strategy identifies a $3.26 per pound of nitrogen removed on corn and soybeans grown on tile-drained soils using cover crops (Table 3-11 of report). This $3.26 is based on revised costs for the no-tillage scenario given above, but it does not assume that farmers benefit from cover crops. If that pound of nitrogen removed from cover crops becomes available to crops in the future, the $3.26 cost would be reduced. Commercial nitrogen has a cost of about $.37 per pound of nitrogen ($600 price per ton of anhydrous ammonia / 1,640 pounds of nitrogen). Replacing one pound of commercial nitrogen then results in a cost of $2.89 per pound of nitrogen removed. Of course, benefits would occur in the future if the nitrogen becomes available to the crop.

Cover crop practitioners suggest that benefits may occur over time as continual use of cover crops improve soil physical properties and may increase soil carbon and organic matter levels (Eileen Kaldivko, Cover Crops for Modern Cropping Systems, and Proceedings from Cover Crop Symposium). Unfortunately, much more research is needed on cover crops to know the full extent of their long-run benefits. Benefits could be large if the continual use of cover crops result in increases in organic matter. A Microsoft Excel spreadsheet that estimates these long-run benefits from increases in organic matter is available from the Natural Resource Conservation Service (click here for download).

While benefits are uncertain, another way to look at the issue is through break-even analysis of the levels of change needed to cover the additional costs. Break-even yield levels and nitrogen application reduction levels are calculated for the cereal rye cover crop example given above. Here, we assume that there is a corn-soybean rotation, cereal rye is planted following corn, and no cover crop is used between soybeans and corn. In the no-till situation, the cover crop costs are $25.60 per acre. The $25.60 per acre cost is offset if:

- Soybean yields increase by 2.5 bushels per acre. This break-even is based on a long-run soybean price of $10.40 per bushel.

- Corn yields increase by 5.8 bushels per acre. This break-even is based on a long-run corn price of $4.40 per acre. This yield increase would happen in the year after soybeans have been planted into the cover crop.

- Nitrogen application rates would have to be decreased by $70 per acre. This break-even is based on a $.37 per pound of actual nitrogen ($600 per ton anhydrous ammonia price). These nitrogen applications would have to be reduced in the year following the cover crop.

The above break-even levels are calculated holding the other factors constant. For farmers, these items will have important interactions that need further analysis. For example, an increase in soybean yield of less than the 2.5 bushel break-even level will reduce the corn yield needed have additional revenues exceed cover crop costs. Different yield impacts will also impact nitrogen application rates and vice versa.

Concluding Comments

The costs to the farmer of implementing cover crops are relatively straightforward to determine, but the benefits for the farmer are less apparent, especially in the short run. Much of the benefits rests on improvements to the soil over time. Documentation and quantification of those benefits will become more apparent as cover crop research and experience increases.

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