Chapter 12

Cover Crops in No-till Systems

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Introduction

In areas of western Oklahoma where precipitation (< 35 inches per year) is the main limiting factor in dryland cropping systems, the use of cover crops has generally been viewed as unacceptable due to limited precipitation. During the last quarter of a century, cropping systems have switched from a relatively diversified cropping system to a continuous winter wheat system. Wheat is often grazed, since many producers rely heavily on production of beef as their main source of income. The current general consensus of many producers in the western part of Oklahoma is that no suitable summer crops exist for their climate and no suitable alternative exists to replace wheat forage for cattle, so they are reluctant to grow anything except winter wheat. The quality of winter wheat has continued to decline in this area due to increased weed and insect populations as a result of minimal crop rotation. Another aspect of limited rotation is that no-till systems have not become popular in this region because of yield reduction under no-till with continuous winter wheat. In order for Oklahoma producers to successfully implement no-till in their cropping systems, they must be willing to rotate crops. One potential is through the use of cover crops, especially during the summer months when temperatures are high and rainfall is highly variable. Cover crops may be cheap, and if legumes are used, they may reduce nitrogen fertilizer costs for the following crop.

Cover crops contribute a variety of conservation benefits. For water conservation, they offer a triple bonus. A living cover crop traps surface water. When killed and left on the surface, cover crop residue increases water infiltration, lessens erosion, and reduces evaporation. Green manure cover crops involve incorporation for the purpose of soil improvement. Water storage efficiencies in traditional clean-till fallow systems usually are around 20 percent, while water storage efficiency in no-till systems is near 40 percent, but seldom exceeds this amount (Greb, 1983; Unger, 1984). This means 60 percent of the precipitation received during fallow is lost to evaporation.

In a no-till system, incorporation of residues is not possible, which makes it difficult to determine nutrient contribution from these crops. A cover crop is any crop grown to provide soil cover, regardless of whether it is incorporated later. Cover crops are grown primarily to prevent soil erosion by wind and water. Cover crops and green manures can be annual, biennial, or perennial herbaceous plants.

“Cash crops grown are wheat, cotton, corn, milo, cowpeas, canola, and hay, along with cover crops...use cover crops to start a no-till rotation.”

A. Mindemann
Apache, OK

Cover crops in a No-till cropping system can:

- Provide soil cover
- Prevent soil erosion by wind and water
- Be annual, perennial, or biennial plants
- Can be grown during all or part of the year
- Fix nitrogen in the soil
- Suppress weed, insect pests, and diseases
Cover Crops in Rotation

Cover crops can fit well into many different cropping systems during periods of the year when no cash crop is being grown. In some areas even the simplest corn/soybean rotation can accommodate a rye cover crop following corn, which will scavenge residual nitrogen and provide ground cover and forage in the fall and winter. When spring-killed as a no-till mulch, rye provides a water-conserving mulch and suppresses early-season weeds for the following soybean crop. In Kansas, Claussen (2004) found late-maturing soybeans reached an average height of 24 inches, showed limited pod development, and produced 2.11 ton per acre of above-ground dry matter with an N content of 2.11 percent or 90 lb per acre. Sunn hemp averaged 72 inches in height and produced 3.19 ton per acre with 1.95 percent N or 125 lb per acre of N. Soybean and sunn hemp suppressed volunteer wheat to some extent, but failed to give the desired level of control ahead of the wheat. Also, when averaged over N rate, soybean and sunn hemp significantly increased grain sorghum yields, by 9.7 and 13.4 bu per acre, respectively.

Perhaps the greatest challenges for dryland producers in the southwestern part of the United States is storing and using the precipitation they receive throughout the year. Figure 1 illustrates the average monthly precipitation and mean monthly temperatures for western Oklahoma.

Production of continuous winter wheat is the common practice in the area so producers are not fully taking advantage of moisture they receive during the summer months. If we assume 40 percent water storage efficiency for a no-till system, then 5.5 inches of water is lost during a given year or >15 percent of the precipitation they receive. Summer moisture has the potential to produce cover crops or leguminous cover crops to reduce their fertilizer costs and use the soil moisture that may otherwise be lost during the fallow period.

Nitrogen Contribution

One of the biggest obstacles with nitrogen contribution from cover crops is estimating or measuring the amount of nitrogen that a given cover crop will contribute to the following crops, especially in a no-till system. A review of the literature provides wide ranges of nitrogen contribution from various nitrogen fixing cover crops (McLeod, 1982; Claassen, 2004; Heer and Janke, 2004).

Nitrogen production from legumes is a key benefit of growing cover crops, especially with the recent increase in nitrogen prices. Nitrogen accumulations by leguminous cover crops typically range from 35 to 18 pounds of nitrogen per acre. The amount of nitrogen available from legumes depends on the species of legume grown, the total biomass produced, and the percentage of nitrogen in the plant tissue. Cultural and environmental conditions that limit le-
gume growth, such as a delayed planting date, poor stand establishment, and drought will reduce the amount of nitrogen produced. Conditions that encourage good nitrogen production include getting a good stand, optimum soil nutrient levels, soil pH, good nodulation, and adequate soil moisture. Heer and Janke (2004) reported nitrogen contributions from 27 to 54 pounds per acre. Nitrogen contributions in a no-till system will no doubt be affected by lack of tillage operations. Table 1 shows percent nitrogen in above and below-ground root mass.

The portion of green-manure nitrogen available to a following crop is usually about 40 percent to 60 percent of the total amount contained in the legume. For example, a hairy vetch crop that accumulated 160 pounds N per acre prior to plowing down will contribute approximately 80 pounds N per acre to the succeeding grain or vegetable crop. Floyd (1987) estimated that 40 percent of plant tissue nitrogen becomes available the first year following a cover crop that is chemically killed and used as a no-till mulch. He estimates that 60 percent of the tissue N is released when the cover crop is incorporated as a green manure rather than left on the surface as a mulch. Lesser amounts are available for the second or third crop following a legume, but increased yields are apparent for two to three growing seasons.

In addition to providing ground cover, and in the case of a legume, fixing nitrogen, they also help suppress weeds and reduce insect pests and diseases. Weeds flourish on bare soil. Cover crops take up space and light, thereby shading the soil and reducing the opportunity for weeds to establish themselves. Providing weed suppression through the use of allelopathic cover crops and living mulches has become an important method of weed control in sustainable agriculture. Allelopathic plants are those that inhibit or slow the growth of other nearby plants by releasing natural toxins, or “allelochemicals.” Cover crop plants that exhibit allelopathy include the small grains like rye and summer annual forages related to sorghum and sudangrass. The mulch that results from mowing or chemically killing allelopathic cover crops can provide significant weed control in no-till cropping systems. Claassen (2004) observed soybean and sunn hemp effectively suppressed volunteer wheat and, in the fall, reduced the density of henbit compared to areas having no cover crop.

**Limitations of Cover Crops**

The recognized benefits of green manuring and cover cropping—soil cover, improved soil structure, nitrogen from legumes—need to be evaluated in terms of cash returns to the farm as well as the long-term value of sustained soil health. For the immediate growing season, seed and establishment costs need to be weighed against reduced nitrogen fertilizer requirements and the effect on cash crop yields. Water consumption by green manure crops is a concern and is pronounced in areas with less than 30 inches of precipitation per year. Still, even in the fallow regions of the Great Plains and Pacific Northwest, several native and adapted legumes (such as black medic) seem to have potential for replacing cultivation or herbicides in summer fallow. Additional management is required when cover crops of any sort are added to a rotation. Turning green manures under or suppressing cover crops requires additional time and expense, compared to having no cover crop at all. Insect communities associated with cover crops work to the farmer’s advantage in some crops and create a disadvantage in others. For example, certain living mulches may enhance the biological control of insect pests but may serve as a host to non-beneficial pests.

**Summary**

The use of leguminous cover crops has gained attention due to increased nitrogen fertilizer prices. In western Oklahoma, the lack of precipitation has precluded producers from including cover crops in their rotations. It is believed that the use of cover crops can be effective in using soil moisture that would otherwise be lost during the fallow period.

**References**

Claassen, M.M. 2004. Effects of late-maturing soybean and sunn hemp summer cover crops and nitrogen rate on no-till grain sorghum after wheat. Kansas State University, SRP928.


