COVER CROP OPTIONS AFTER CORN SILAGE

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Introduction

Harvest of crops, including corn for silage, which removes the majority of aboveground plant material leaves the soil exposed and vulnerable to erosion over winter. Use of cover crops following harvest could provide residue to prevent or reduce soil erosion. The problem with this approach is finding a suitable cover crop and/or planting method which can produce effective soil cover in the short period from harvest to freeze up and not interfere with preparations for establishment of the following crop.

Cover Crop Choices

Several plant species have been successfully used as cover crops in Wisconsin. They are best categorized by lifecycle, because the type of lifecycle dictates the nature of their vegetative growth and hence value as a cover crop for a given situation.

Annuals

Annuals complete their vegetative growth in one growing season, so residue production is limited by the period available for growth from planting to freeze-up (or initiation of reproductive growth, which ever occurs first), and environmental conditions during that time. This lifecycle offers the advantage of not having to kill the cover the following spring, but can be a problem if not enough residue is produced in fall. Annuals can produce ground cover very rapidly with favorable growing conditions. Examples of annuals successfully used as cover crops include oat, annual ryegrass, several brassicas (rape, forage turnip), buckwheat, berseem clover and annual medic.

Winter Annuals

Winter annuals such as rye are planted in fall of one year and complete their vegetative growth the following season. This offers the advantage of residue production in the fall, as well as spring after the soil thaws. Often winter annuals produce insufficient growth in fall, depending on when planted, to be effective cover. However, spring growth and the resulting soil cover coincides with a usual period of rainfall which normally creates a high erosion potential for thawed soil. An obvious disadvantage of growth resuming in spring is the need to kill the cover. Delay in killing the cover may result in excess soil moisture use to the detriment of the following crop.

Biennial and Perennials

This group, comprised of the traditional forage legumes, have lifespans of 2 or more years. They are of low value as cover crops planted for conservation purposes in late summer, because a combination of slow germination and early growth limits residue production. However, they do offer tremendous potential as nitrogen supplying green manures when seeded with small grains in the year before corn, where they have sufficient time to grow and fix atmospheric nitrogen (N).

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Currently winter rye appears to be the cover crop of choice after corn silage. Rye is a very good cover because of its winterhardiness, biomass production and low establishment cost. However, growth in spring can create several problems for the succeeding crop including excess soil moisture usage and residue interfering with tillage and/or planting. Also, its alleliopathic effect may prohibit planting of some crops or limit use of minimum or no-till planting options.

Will Annuals Work After Corn Silage?

A rapid growing annual may be a better choice than rye after silage harvest because they winterkill, eliminating the problems associated with rye in spring. Choosing which annual to use becomes an issue. Rapid growing non-legume species may be better suited as cover crops than legumes for seeding after short-season crops. Slow initial growth by legumes often limits seeding year dry matter (DM) yield. Warm-season species may be more productive than cool-season species when seeded in mid-summer, while the reverse may be true as seeding dates become progressively later. Also, as yield potential decreases with a shortening growing season, it may be possible to maintain DM yield potential by increasing seeding rate. More information is need on species selection, possible seeding dates, seeding rates, and the interactions of these variables.

A field study was conducted in 1993 and 1994 near East Troy, WI on a Fox silt loam soil to determine the effects of species, seeding date, seeding rate, and their interactions on cover crop productivity as measured by DM yield. Dry matter yield was selected as the indicator because measuring ground cover in standing plant material is difficult and selecting when to measure can be a contentious issue. It follows that the greater the dry matter yield is, the higher the percent soil cover will be.

Methods

Five species (Table 1) were seeded on five dates: Aug. 1, 15 ,Sept. 1, 15, and October 1. They were chosen because they are successfully used as cover crops elsewhere, seed is widely available, and they represent monocots and dicots of warm-season (sorghum-sudan and buckwheat) and cool-season (oat, forage brassica and annual ryegrass) species. There were drilled into bare, tilled soil at the recommended seeding rate and 1.33 times the recommended rate. N fertilizer was not applied, while P and K were applied to the site before initiation of the study, based on soil tests. Aboveground dry matter yield was measured at the end of the growing season.

Table 1. Cover crop species and seeding rate (lb/a).

Species	*Classification*	*Seeding Rate*
Buckwheat (*Fagopyrum esculentum* L.)	Warm-season	45
Sorghum-sudan (*Sorghum sudanese* (Piper) Stapf.)	Warm-season	30
Oat (*Avena sativa* L.)	Cool-season	96
Forage brassica (*Brassica rapa* ssp. Olifera)	Cool-season	4
Annual ryegrass (*Lolium multiflorum* L.)	Cool-season	25

The experimental design was a randomized complete block with a split-split plot arrangement and four replicates. Main plots consisted of seeding date, sub-plots consisted of species, and sub-subplots consisted of seeding rate. Data were subject to analysis of variance procedures to detect significant main effects and interactions. Main effect means were separated using a least significant difference test at the 5% level of probability where appropriate.

Results

Both seeding date and species had a significant effect on DM yield while year and seeding rate did not. For this reason data are presented as mean of two seeding rates average over two years.

Seeding Date

Dry matter yield at the different seeding dates is shown below, presented as both individual cover crops (Figure 1) and as the mean of warm and cool-season species (Figure 2). In general, DM yield remains constant for all species until mid-august seeding dates at which point it begins to decline, reaching near zero for cover crops planted in mid-September. This suggests that planting date is not critical until sometime between mid-August and September 1 with this group of cover crops. Yield potential declines beyond that point, making it necessary to plant as soon as possible to maximize yield potential.

Species

Cover crop species had an effect on DM yield within each seeding date through mid-September. In aggregate, the cool-season species produced significantly more DM across all seeding dates until September 15. The difference is nearly constant until the yield decline begins after mid-August. At this point the difference widened, suggesting that the yield decline is slower for cool-season species, making them a better choice for later planting.

Forage brassica produced significantly more DM than the other species when planted in August. Within either the warm or cool-season groupings, there was no significant difference between species when planted after Sept 1.

Discussion

What does this mean for using an annual as a cover crop after corn silage? Planting date is critical for producing sufficient DM to be an effective soil cover. The decline in yield potential coincides with the beginning of silage harvest. In years with early corn maturity and harvest, using an annual is possible. In a more typical year, use of annuals is probably risky. In either case, a cool-season annual is a better choice than warm-season species, and if planted after September 1, cover selection should be based on lowest cost. Beyond this point, all cool-season species performed similarly based on DM yield. Finally, these species should be planted at a rate within the normal range. This data suggests that DM yield could not be maintained with increased seeding rate as yield potential declined with later seeding dates.

Figure 1. Dry matter yield of individual species as affected by seeding date.

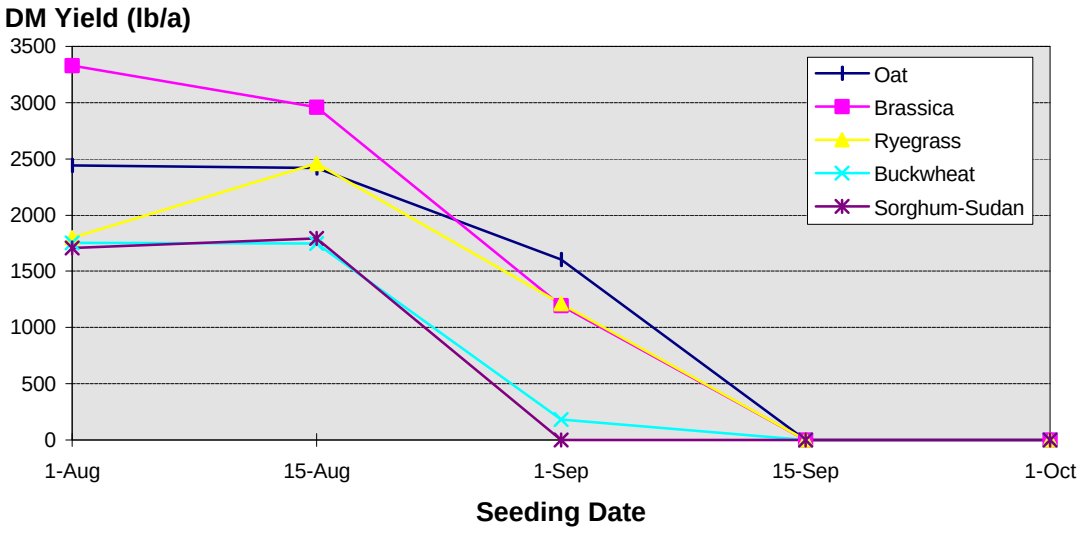
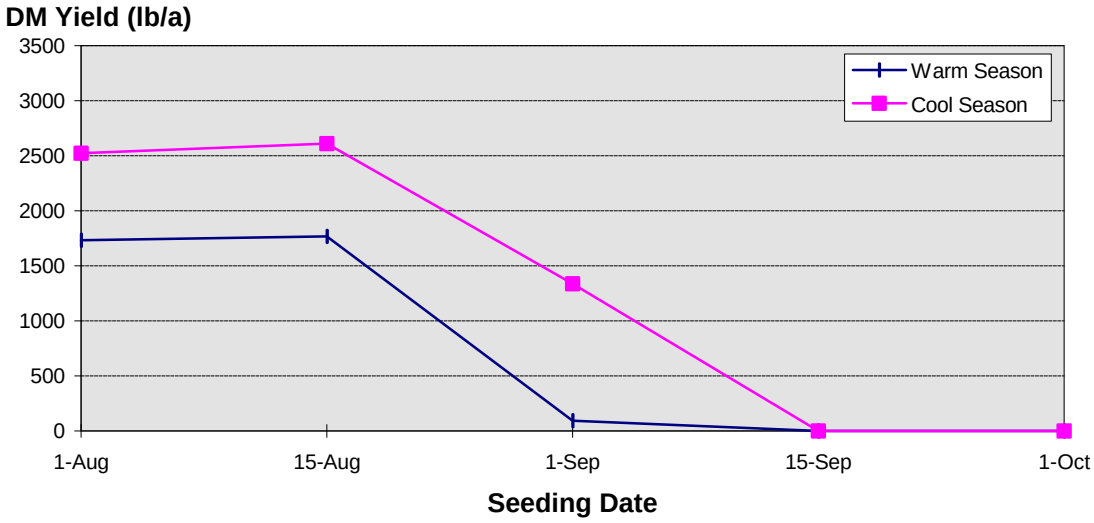


Figure 2. Mean DM yield of warm and cool-season species as affected by seeding date.



Latest Practical Seeding Date

What is latest a cover crop can be planted and be expected to produce sufficient residue to be an effective cover crop under normal conditions? Experience from several Wisconsin trials indicates the following dates represent a practical cutoff for planting the various groups (Mallory, 1994; Stute and Posner, 1993). A cover crop could be planted later and perform satisfactorily but the success rates diminishes rapidly after these dates. Winter rye is not included in this list because it can be planted much later, still produce biomass and be expected to over-winter. While the biennial and perennial legumes will also regrow in spring protecting soil before establishment of the next crop, they should be seeded before August 15 if they are to be expected to survive.

Table 2. Suggested latest seeding dates for various cover crops.

Biennial and Perennial Legumes	August 1
Red clover, sweetclover, alfalfa	
Annual and Winter Annual Legumes	August 15
Berseem clover, hairy vetch, medic	
Warm Season Annuals	August 15
Buckwheat, sorghum-sudan	
Cool Season Annuals	September 1
Oat, ryegrass, brassicas	

What About Interseeding in Standing Corn?

If seeding a cover after harvest presents so many challenges, what about interseeding into standing corn? This approach offers the advantage of having the cover in place at silage harvest. Possible disadvantages include incompatibility with weed control programs (i.e. interaction with certain herbicides) and timing of establishment. If planted too early, the cover will act as a weed, competing for nutrients and moisture. If planted too late, competition from corn may limit growth and hence effectiveness as a cover.

Recent experience with interseeding in Wisconsin (Stute and Posner, 1993) found successful interseeding with forage legumes at last cultivation to be difficult, which makes the practice not recommended in commercial corn production, at least with forage legumes. Competition from corn severely limited growth of all species tested, including red clover, the most shade tolerant forage legume. This trial evaluated the practice in corn grown for grain, at a population of 27,000 plants/acre, much lower than one would expect in corn grown for silage, where even greater shading would be expected.

Summary

Use of cover crops after corn silage harvest could provide residue to prevent or reduce soil erosion. Some growers are using rye in this situation, but experiencing problems in spring, including excess soil moisture use, green crop residue to contend with, and possible allelopathy. Rapid growing annuals may be a better choice than rye after silage harvest because they winterkill, eliminating the problems associated with rye in spring.

For annuals, planting date is critical for producing sufficient DM to be an effective soil cover. The decline in yield potential for annuals coincides with the beginning of silage harvest. In years with early corn maturity and harvest, using an annual is possible. In a more typical year, use of annuals is probably too risky. In either case, cool-season annuals are a better choice than warm-season species. Using winter rye is probably the least risky cover crop option. When using rye, problems with spring regrowth should be anticipated and planned for. Possible options for dealing with regrowth could include killing it early with herbicide or harvest of the herbage for forage.

References

Mallory, E.B. 1994. Performance, profitability and adoption of cover crops in Wisconsin cash grain rotations:on-farm trials. MS Thesis, Department of Agronomy, University of Wisconsin-Madison.

Stute, J. K. and J. L. Posner. 1993. Cover crop options for grain rotations in Wisconsin. Agron J 85:1128-1132.