TECHNICAL NOTE

USDA-Natural Resources Conservation Service
Americus, Georgia

GA PLANT MATERIALS NO. 24 **July 2019**

Considerations for Building Cover Crop Mixtures

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Fig. 1. Multi-species cover crop in bloom

This Technical Note provides guidance for selecting species and seeding rates for cover crop seed mixtures.

Introduction

Cover crops are non-market crops grown on the farm to provide benefits or solve identified resource concerns. Cover crops can provide many benefits or agro-ecosystem services to both farmers and society at large. On the farm, cover crops can improve soil health, reduce erosion, alleviate compaction, provide nitrogen, cycle nutrients, improve water quality, and suppress weeds. For society at large, cover crops can reduce sediments and nutrients moving off site and into road ditches or public water supplies. Cover crops can also support pollinators and other beneficial insects.

Individual cover crop species each provide unique benefits. Individual species may provide benefits to improve issues or resource concerns identified for a farm or field, while another farm or field may have a variety of issues or resource concerns that a single species can't fully address. Mixes or multiple-species can be combined to provide a more diverse range of benefits than a single species alone can provide. Planting cover crop mixtures provide farmers an opportunity to increase plant species diversity on their farm, add to the number plant species grown across the cropping system, potentially improve soil health, and increase crop yield.

Finding the appropriate seeding rate for mixes is critical to gain the full range of benefits. Selecting complementary species and seeding at the right proportions provides the best opportunity for full benefits. Research on this has been limited to specific examples and indicates many variables can affect mixture composition. Planting date, seasonal weather, and soil fertility can all affect species composition in the mixture and this may change over time across the growing season. While it is not possible to know with certainty seasonal weather or how much nitrogen is available in the soil, following these guidelines can improve success of cover crop mixes.

Considerations

Identify the Benefits

This answers the question of why grow a cover crop. Each farm, and even field can be unique. Identify the concerns or problems in a field to identify the benefits desired from the cover crop. Past production records, field observation notes, and in-field assessments can all help identifying issues or concerns that need improving. For example, if a field has high weed pressure; then a benefit of the cover crop would be weed suppression. If the crop rotation is going to a crop that requires nitrogen; then a desired benefit of the cover crop would be the ability to produce nitrogen.

Mix or Individual

Once the decision to grow a cover crop is made, a choice is made on what species or mix of species will best address the identified concerns and problems. Compare the benefits or strengths of the selected cover crop species or cover crop mix to their ability to address the noted concerns. It is also important to understand weaknesses of individual species. No single species will provide an entire range of benefits. When varying benefits are desired, a mixture of species may better address the concerns.

When considering plants to combine into a mix, select species that complement one another. Cover crops can be grouped into 6 major categories or functional groups. A functional group is a collection of plants with similar characteristics. The 6 functional groups of cover crops are: cool season grasses, cool season legumes, cool season broadleaves, warm season grasses, warm season legumes, and warm season broadleaves. The benefits gained from plants in a functional group will generally be more similar than plants from different functional groups. Grouping by warm season or cool season will fit a given time niche and provide choices of species to include in a mix. Including more functional groups

will enhance the range of benefits. Adding plants from different functional groups provides a wider range of benefits and is more complementary than adding plants from the same functional group. Additional benefits across a wider range enhances the complementary nature of cover crop mixes.

Including multiple species in a mix that are very good at suppressing weeds may not make the mix any better at suppressing weeds. A better strategy is to add plants that are complementary. Such as selecting a legume to complement a grass. The grass scavenges nutrients which can be limiting to the following crop but adding a legume in a mix can offset this limitation.

Consider how many species to include in the mixture. Research in natural grasslands indicates that increasing the number of species enhances ecosystem functions. In cropland, selecting a small number of complementary species can provide a full range of benefits. The addition of species to a mix will not necessarily yield additive benefits. Cover crop variations caused by weather or management decisions, may be addressed through redundancy. Adding additional species from the same functional group that provide the same general benefits, but differ in traits such as cold tolerance, growth timing, etc. adds redundancy to a mix.

Time Available for Cover Crop

Identifying and understanding the window of time available includes establishing expected planting and termination dates for the cover crop. Individual species have differing optimum or recommended planting dates and to allow successful establishment this should be matched into the cropping system. An early planting window will generally allow more choices but may not fit into the cropping system. When establishing cover crop mixes, the recommended planting dates of all the species must be observed. When a species included in the mix is planted too late that plant may be reduced or eliminated from the stand resulting in loss of its benefits. Use the optimum planting date to focus in selecting the best options for the cover crop. The cover crop must be able to provide its benefits and be terminated before causing delays in planting the cash crop. Termination timing involves balancing method of termination, managing seed production, soil moisture recharge, and allowing the cover crop the maximum opportunity to provide benefits.

Growth Form of the Plant

Consider the growth form of plants to include in a mixture. Competitive species may take up light, nutrients, and water reducing the benefits of the cover crop. Species with similar growth forms often compete for resources, while species with different growth forms are more likely to be complementary. A plant with a tall, open canopy is complementary to a plant with a shorter, or vining growth habit.

Nutrients in the Soil

The nutrients in the soil, especially nitrogen, and what the following cash crop needs determines plants in a mixture. Grasses are good scavengers of nutrients, especially nitrogen, while legumes produce nitrogen. Nitrogen available in the soil after a cash crop favors the growth of non-legumes such as grasses. Limited nitrogen availability can favor growth of legumes. Maturity stage also affects the carbon nitrogen (C: N) ratio of the cover crop. As plants move toward maturity, the C: N ratio increases. Grasses that grow close to maturity, have higher C: N ratios that can become problematic by limiting nitrogen available to the following crop.

Well Adapted Varieties

Once species for the mix are decided, variety selection is important to ensure success of the cover crop. Choosing a well-adapted variety should be the primary consideration. Local performance of a variety

can vary significantly by location. A part of this consideration is maturity group. Strive to choose species that will mature at the same time to reduce risk of producing seed that could become a weed problem. Keeping maturity closely grouped allows uniform termination and eases transition to the cash crop. Plan to ensure the species and cultivars best suited to your farm and cropping system are available.

Seeding Rate

Determining the seeding rate for a cover crop mixture begins by determining the seeding rate of each species. Seeding rates for broadcast cover crops are higher than for drilled cover crops, so use the planting method that will be used for determining seeding rates. Some species are aggressive and crowd out less aggressive species. Environmental variables also affect the growth individual species differently. Since mixtures involve multiple species, a reduction from the full monoculture seeding rate will be needed to prevent overcrowding and competition between species.

As a starting point divide the full monoculture seeding rate for each species by the number of species included. A starting point for a 2-species mix would be to divide the monoculture seeding rate for each component by 2. Likewise, a starting point for a 6-species mix would be to divide the monoculture seeding rate by 6. From that point adjustments can be made. Adjustments should be based on the functional groups included, growth habits of the individual species as well as the overall goals for the mixed species cover crop. A fast growing or aggressive species seeding rate would be further reduced relative to slow growing or less aggressive species to maintain balance in the species composition of the mix. When a positive nitrogen balance is desired, a legume seeding rate would be increased above the baseline.

If more than one species from a single functional group is included, further reduce the rate of those species to prevent that functional group from dominating the mixture. In this scenario, the combined seeding rate of the multiple species from one functional group would be set equivalent to using one species from a functional group.

Examples of recommended starting point for mixed cover crop seeding rates are shown below:

Sample 2-Species Mixture Baseline		
Species	Monoculture seeding rate	Mixture seeding rate
Rye	90	45
Crimson Clover	20	10

Sample 3-Species Mixture with Redundancy Baseline		
Species	Monoculture seeding rate	Mixture seeding rate
Rye	90	22
Oats	64	16
Crimson Clover	20	10

Sample 6-Species Mixture Baseline		
Species	Monoculture seeding rate	Mixture seeding rate
Rye	90	15
Oats	60	10
Crimson Clover	20	3.3
Hairy Vetch	25	4.2
Daikon Radish	9	1.5
Rapeseed	5	1.3

Conclusion

Cover crops can provide many benefits at the farm level and beyond. Mixed species cover crops can provide additional benefits for soil health, address resource concerns, and enhance diversity and resiliency in cropping systems. While several variables can affect the development of the cover crop mixture, general principles have been developed to guide the selection process for building cover crop mixes. Following these will allow development of unique cover crop mixtures with success.

Citation: USDA Natural Resources Conservation Service, Jimmy Carter Plant Materials Center Americus, Georgia 31719. July 2019.

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