Planting Cover Crop Mixtures and Monocultures: Literature Review and Considerations

Cover Crop Mixes and Considerations:

Cover crops have many beneficial features in cropping systems. Cover crops can influence many factors such as weed pressure, nutrient availability, soil erosion and water use. Cover crop mixes are a complicated subject to evaluate. Before planting a cover crop mixture the purpose of the mix must be identified. Common purposes protection of soil, improve soil conditions, conserve soil moisture, add biomass to the soil, improve infiltration and tilth, reduce compaction, manage pests and nutrients, and/or provide supplemental forage (Natural Resources Conservation Service, Practice Standard 340A). A cover crop may also be used to alter the nitrogen in the system by either fixing it from the atmosphere or taking up excess out of the soil after crop production and storing it as vegetative material. The purpose of a cover crop planting will determine species, rate, planting time, management and termination. Due to the number of factors and species involved, these factors can be quickly confounded with one another. There has been research done in some areas to evaluate the contribution of each specie and how it affects the soil and ultimately vegetative production. Work is continuing in this study area by many researchers providing more insight to cover crop mixes and their contributions through time.

Mix Selection and Population:

Cover crop mix species selection can be a difficult task. Single species cover crop plantings are popular with producers because of the ease of seeding, cost, as well as a single termination method that is likely to be successful. Single species seedings may also be cheaper and meet the identified resource concern. Cover crop mixes have gained popularity due to grazing, adaptability in adverse conditions and effectiveness to address multiple resource concerns with one seeding. In a Nebraska study, (Wortman et al., 2012(a)) was able to grow more biomass with a cover crop mix than any single monoculture planting of those same species. Other researchers have found no difference in biomass production of a monoculture cover crop compared to cover crop mixes but were able to address more than one resource concern (Finney et al., 2016). Murrell et al. (2017) found that grasses generally over perform and brassicas (*Brassica spp*.) underperform when grown in mixtures. They also found that Austrian winter pea (*Pisum sativum*) may overwinter in a mixture vs a monoculture. Seeding rates must be considered when using aggressive species. It is important to remember that individual species perform specialized functions to address resource concerns and that it is more important to address the functions in the species mix as it is possible number of species that can be planted. Finney and Kaye (2016) suggest that when planning a cover crop mix to include species from a variety of functional groups as opposed to selecting a number of species that all may perform the same function.

Forage:

Cover crop mixtures have long been grown for forage use. Planting multiple species for forage production not only allows the grazing animal free selection of the most palatable specie at any given time but it also may allow for erosion control, nitrogen fixation as well as building soil organic matter.

Considerations must be taken when developing a forage cover crop mix to avoid toxic plants or grazing plants at a toxic plant growth stage.

Weed Management:

An area where cover crop mixes are gaining more attention is for the purpose of weed management. In a study done by Mirsky et al. (2011), little difference existed in weed density under a monoculture of cereal rye (*Secale cereal*) mulch compared to a cereal rye and hairy vetch (*Vicia villosa*) mulch. Having a mulch layer of cover crop decreases the amount of sunlight, intensity of sunlight and adds as a barrier for emerging weeds. Teasdale et al. (2000) found that quantity of residue had a greater impact on weed suppression than material that composed the mulch. This research suggests that as long as a mulch is grown it can be used to suppress weeds. A situation to understand however, Teasdale and Mohler (1993) found that greater soil moisture conditions in cover crop mulch can increase weed emergence. Another component that can reduce weed growth is allelopathic chemicals, one of those chemicals has been identified as 2,4-dihydroxy-1,4-(2H)benzoxazine-3-one or DIBOA. DIBOA is a chemical produced in abundance by rye and has been shown to be toxic to other species (Barnes and Putnam, 1983). Reberg-Horton et al (2005) evaluated DIBOA concentrations in different rye varieties at different growth stages and found that DIBOA concentrations were different in rye varieties and this may help explain the variability in weed suppression in monocultures vs cover crop mixes. It was found that DIBOA concentration decreases at later growth stages and that a later maturing cereal rye may produce more DIBOA longer into the growing season than an early maturing cereal rye. This indicates timing of cover crop termination may drastically effect weed suppression.

Cover Crop Mixture Water Use:

It is understood that green leaf area index has a direct correlation with water use. Cover crops in monocultures and in mixes do use water because they are after all a growing or metabolically active plant. The benefit of a cover crop to soil moisture may come after a cover crop has been terminated and the residue is helping reduce evaporation. This comes into play in areas of limited rainfall. A major concern of producers is will the cover crop reduce the soil moisture enough to limit yield on the following cash crop. Nielsen et al. (2015) conducted a study in Colorado and Nebraska found that cover crop mixtures do not use water differently than a monoculture. They also found that cover crop water use can be 1.78 times greater than evaporative water loss from the no-till fallow treatment with proso millet residue. In a Western Kansas study, researchers found that cover crop effects on soil water decreased the yield of the following cash crop in dry years; however, in wet year the soil profile water was replenished to minimize yield losses after a cover crop (Holman et al., 2018). Though the cover crop has used water to grow, the mulch which reduces evaporation has been found to have increased soil water vs no cover crop 21 days after termination of the cover crop (Wortman et al., 2012(b)). Penetration of compacted soils by rye and radish roots have been shown to provide low-resistance paths of rooting for the subsequent cash crop as well as the cover crop vegetative residue reducing evaporation allowing for more soil moisture later in to the season (Williams and Weil, 2004). This phenomena may help explain yield increases in cash crops following a no-till cover crop.

Ultimately, successful use of cover crop mixes must come from sound guidance and experience of the producer and the climate they are planted in. Mixes have shown to have redeeming qualities and allow producers flexibility and the chance to address multiple resource concerns with the right combination of cover crop species adapted to your area.

For more information on cover crops and planting specifications for Kansas, Nebraska, Colorado, and Oklahoma, refer to the NRCS Cover Crop practice standard (340) in the Field Office Technical Guide. (https://efotg.sc.egov.usda.gov/)

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